The Worth of Water

By Augustus Jove

Contents

INTRODUCTION

"The well was dry beside the door,
And so we went with pail and can
Across the fields behind the house
To seek the brook if still it ran…"
Robert Frost

Many living in the United States and other developed nations of the world aren't aware of the potentially devastating crisis of water scarcity—I know I was virtually oblivious to it until not all that long ago. But after a thorough investigation of this situation, I have learned how truly severe it is. There are parts of the world that are literally being crippled by the result of not having water—or having polluted water and unsanitary water facilities. As of now, the majority of the people being affected by water scarcity reside in third world or other emerging or undeveloped nations. Many don't have the funds to make an impact and correct this issue, and in more severe, but not uncommon cases, people are on the verge of death because they don't have access to clean water—or simply any water at all. If this problem is not addressed, it could potentially impact everyone on Earth in a significant way.

This research paper will point out many areas and nuances surrounding the water scarcity conversation. By beginning to understand and relate to it better, only then will people have a profound reaction that will potentially lead to some form of action being taken to undertake this problem before it is too late. All that is necessary is an open-mind about the information being presented. For clarification about some key pieces of information, the term water scarcity crisis will be used often, and it refers to a situation where the quality of water is so poor, or the supply of water is so limited, that it cannot be used by humans—resulting in very dire consequences. Furthermore, a water scarcity crisis pertains to freshwater—although there are connections to salt water (as you will see), freshwater it the central focal point. An additional noteworthy clarification is in regards to the quotes that you will see throughout this paper; they derive from literary sources or philosophers. Each quote indicates a new focus, where they will provide claims of value, and highlight, capture, or abstractly speak to the crux of that particular section.

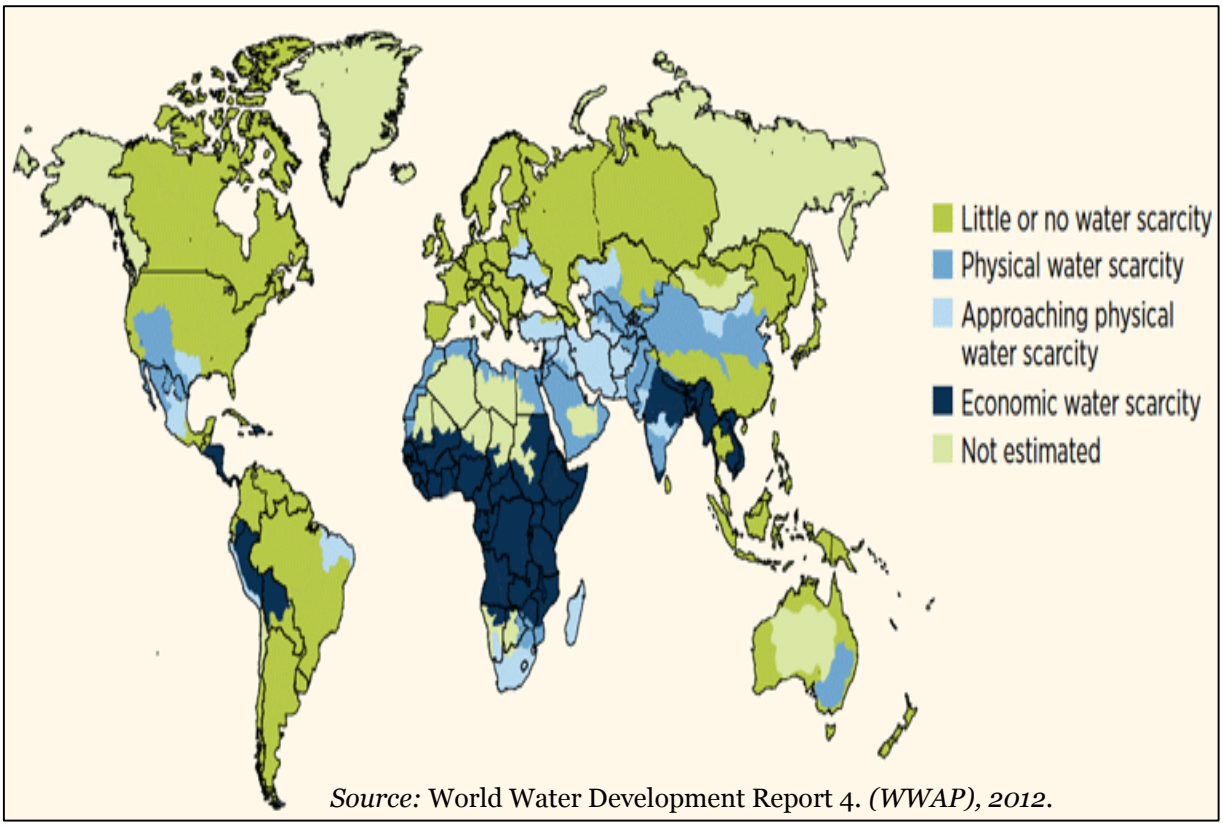
A key aspect of this paper will revolve around the following two part question: Is water going to be the next major commodity (akin to oil), and if so, what kind of societal and economic impact will this have on the world? If every stone is turned over, as far as examining exactly what the problem is, as well as who will be affected, and where this crisis is most likely to occur—concluding with viable solutions—then hopefully enough people can grasp how important this topic is. If awareness and education levels are raised about this very important topic, then action can be taken to help those already devastated by water scarcity, and perhaps more importantly, action can be taken so that a water scarcity crisis does not impact everyone on Earth in a calamitous manner. Whereas we once took water for granted, we—as a species—may soon learn how lucky we were, and how good we had it.

PART I

"The only thing that can save the world
is the reclaiming of the awareness of the world."
Allen Ginsberg

Every twenty-one seconds a child somewhere on the globe dies from water a related disease, and every hour, 171 children die from similar water related diseases. Areas being affected the hardest, like undeveloped regions, typically have the highest concentration of water scarcity related fatality. These figures are shocking and sickening, but perhaps even more disturbing is the exponential rate at which these statistics could grow in the not too distant future. The United Nations cites that around 1.2 billion people—almost one-fifth of the world's population—live in areas of physical water scarcity, and 500 million people are approaching this unpleasant reality. The UN goes on to assert that by 2025, 1.8 billion people will be living in areas with absolute water scarcity, and two-thirds of the world's population could be living in water stressed environments. With daunting figures like this I find myself wondering how such a phenomenon could exist today—I have a feeling there are several paradoxical explanations.

Global Physical & Economic Water Scarcity



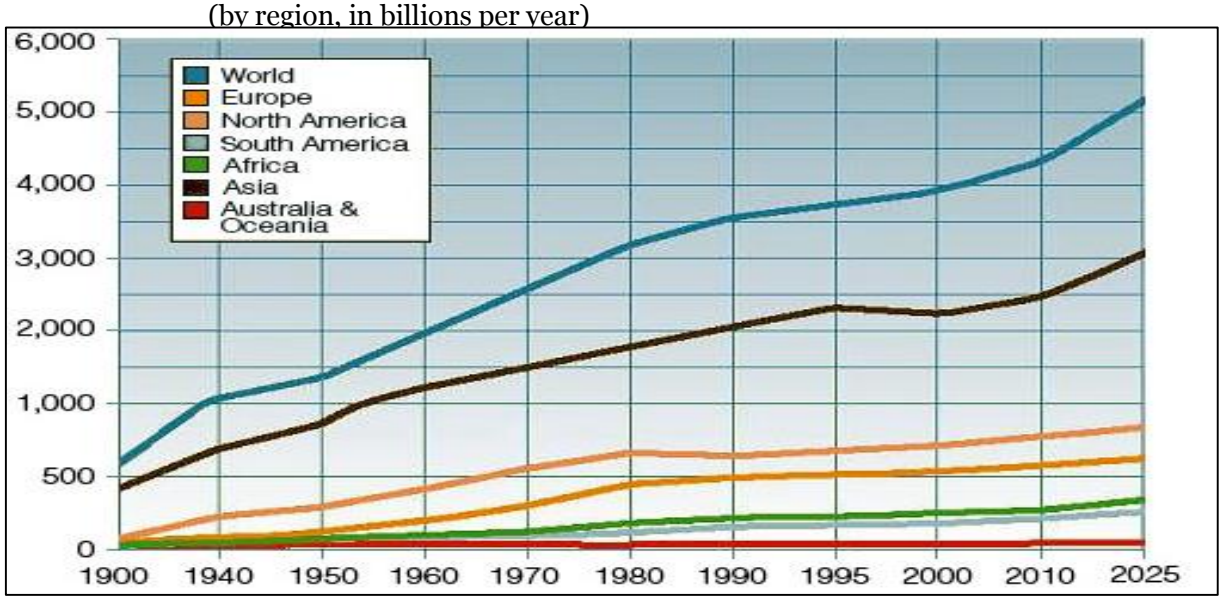
Source: World Water Development Report 4. *(WWAP), 2012.*

At first glance for Westerners like myself, and others living in developed countries, water scarcity as a looming crisis seems unlikely and dubious at best—I mean, nearly 70 percent of the earth's surface is covered in water, how could there possibly be a paucity of water? While it is true that roughly 70 percent of the earth's surface is covered in water, only three percent of that is freshwater—97 percent is saltwater. Of the roughly three percent of freshwater that is on the earth, approximately two percent of it is unavailable because it is trapped in glaciers and snowfields. This leaves us—all 7.2 billion people on Earth—with just one percent of the readily available freshwater that is on the planet. To put things in better perspective, from a wider lens, only 0.007 percent of the earth's freshwater is available, and it must be used by roughly seven billion people. From a sheer supply and demand perspective, it is beginning to become more evident of how serious a potential water scarcity problem may be. Especially when you factor the plethora of uses water has, from drinking, cooking, and hygienic related activities, to farming or more industrial uses. Simply put, water is something people *need* to survive, and the supply of readily available water for human use is not an infinite supply—haplessly for some on this planet, they are already realizing this.

The global rate of water consumption on Earth has been growing at more than twice the rate of the global population increase over the last century, and despite the fact that water scarcity is not felt by all those on Earth, there is an increasing number of regions of the world that are facing it firsthand. Developing and undeveloped nations are the areas in the world being hit the hardest by water scarcity. To put this in better perspective, around 700 million people in 43 countries (most are undeveloped or developing) are currently suffering from water scarcity; the Sub-Saharan region of Africa is the area that is impacted the most. In regions like this clean water is often hard to come by, or is already a commodity that requires laborious work or substantial funds to obtain. *The Water Project* highlights how demanding it can be just to get water, as pointed out in the following lines from their website: "Women and girls especially bear the burden of walking miles at a time to gather water from streams and ponds—full of water-borne disease that is making them and their families sick." Despite that roughly one percent of freshwater is readily available for human use, and that this amount is actually enough to be distributed to everyone living, this does not actually happen, and far too much of it is squandered, polluted, and unsustainably managed—this speaks to another pernicious part of the conversation surrounding water scarcity.

Global Water Consumption 1900 – 2025

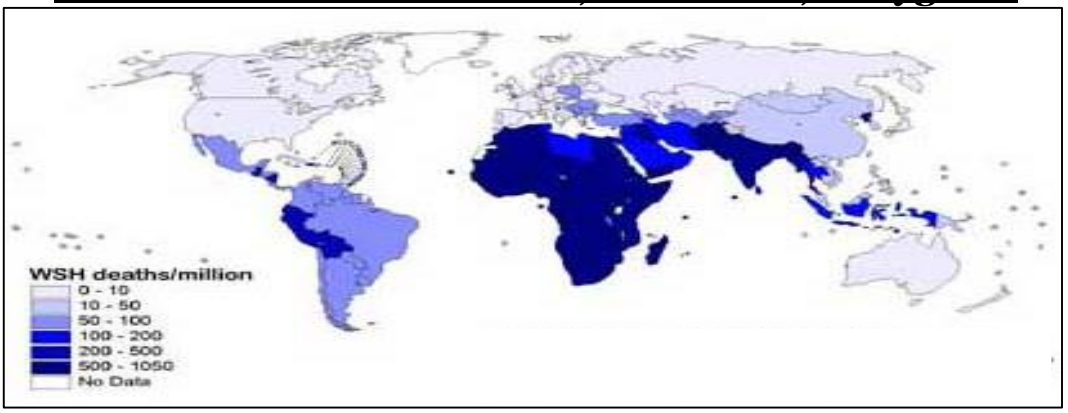
(by region, in billions per year)



An important point to note in the conversation of water scarcity is that it can occur even in areas where freshwater is abound—but the key is how water is conserved, used, and distributed, as well as the quality of the water available. When there is not enough water to meet the demands of individuals, various industries, and so on, problems arise. As of now, water scarcity affects one in three people on every continent of the globe. The situation is being exacerbated as the demand for water rises in correlation to the rise of population growth, urbanization, and increases in household and industrial uses. In some instances, people live in regions where the water is physically scarce, and many—about one quarter of the global population—live in regions that incur water shortages due to a lack of infrastructure to get water to the people; these are typically the poorest areas of the world. With the lack of water, it forces people to depend on unsafe sources of drinking water, as well as unsafe water for hygienic activities. Poor water quality can increase the risk of diarrheal diseases like cholera, typhoid fever, dysentery, and other water-borne ailments. These diseases are incubated by a wide variety of microorganisms, and children are the most likely to become ill because their immune system is not as strong as adults. Subsequently, 1.4 million children die each year from preventable diarrheal disease, and 90 percent of the deaths are children under 5 years old—again, typically in the poorest regions of the world. To shed even more light on the havoc that water scarcity causes, the World Health Organization cites that 99 percent of the 3.4 million water, sanitation, and hygiene-related deaths occur in the developing world. Additionally, water scarcity encourages people to store water in their homes, often in improper storing conditions. As a result, there is an increased risk of household water contamination, which provides a breeding ground for mosquitos—common carries of numerous diseases.

Another facet to this part of the conversation is that water paucity has increased the use of wastewater in various circumstances around world—from farming to consumption—and the World Health Organization cites that 10 percent of people around the globe eat or drink food that may be contaminated by wastewater, and it can often contain chemicals or disease-causing organisms. Now, a vicious cycle is beginning to become much more evident. In that, people living in the poorest regions of the world, affected most by water scarcity, have no choice but to drink and use the very water that is making them ill. Therefore, people have no other choice but to rehydrate with water that caused their illness to begin with. This is exacerbated by the fact that 2.5 billion people do not have an adequate, clean toilet, and even if there is a hospital nearby to help someone that is ill, nearly half of the hospital beds in developing countries are fraught with people suffering from diseases caused by dirty water. A healthy community cannot exist and survive without clean water, and until the water dilemma is solved, or at least improved from the current status, then ordinary diseases like diarrhea will continue to kill more and more people throughout the world.

Deaths From Unsafe Water, Sanitation, & Hygiene



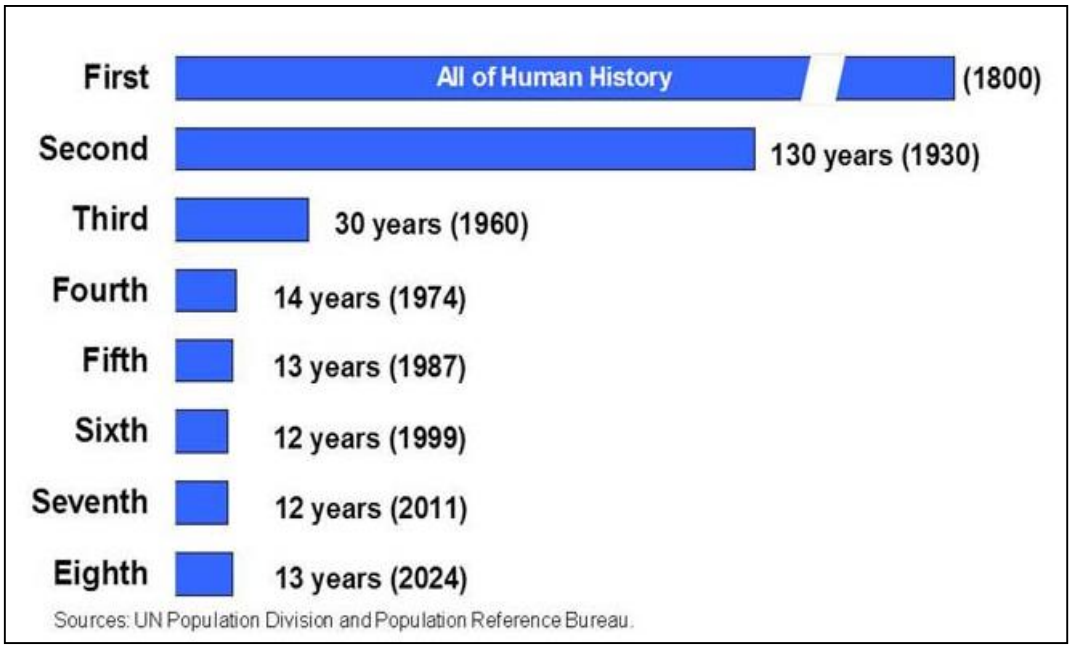
PART II

"Before the effect one believes in different causes than one does after the effect."
Friedrich Nietzsche

There are a plethora of causes that result in the effect of a potentially looming water scarcity crisis; as Nietzsche once alluded to, after the effect, and once calamity is in front of us, the causes may then become as clear as night and day. One such cause that is unequivocally culpable is the human element; specifically the rapid rate at which the human population on Earth has increased over the past several centuries. Another cause that is closely related and highly correlated to the exponential expansion of human population on Earth is the pernicious ways in which humans are taking for granted and squandering freshwater. And perhaps paradoxically, Mother Nature herself has a hand in the water scarcity crisis story. Despite the fact that some causes of a potential water scarcity crisis may be more difficult to discern than others, as well as the extremely disparate nature of each cause, one thing that is certain, is that each specific cause on its own can be quite detrimental, and when all of the aforementioned causes are combined, the aggregate result can be devastating.

One of the most frequently highlighted causes of water scarcity is human population growth. To put things in better perspective, around 8000 B.C.—when an agrarian world was just beginning—the world population was roughly five million people, and it took until around 1800 for the world population to reach the one billion mark . An even more staggering statistic is that during the 20th century alone, the global human population has expanded from 1.65 billion to 6 billion.

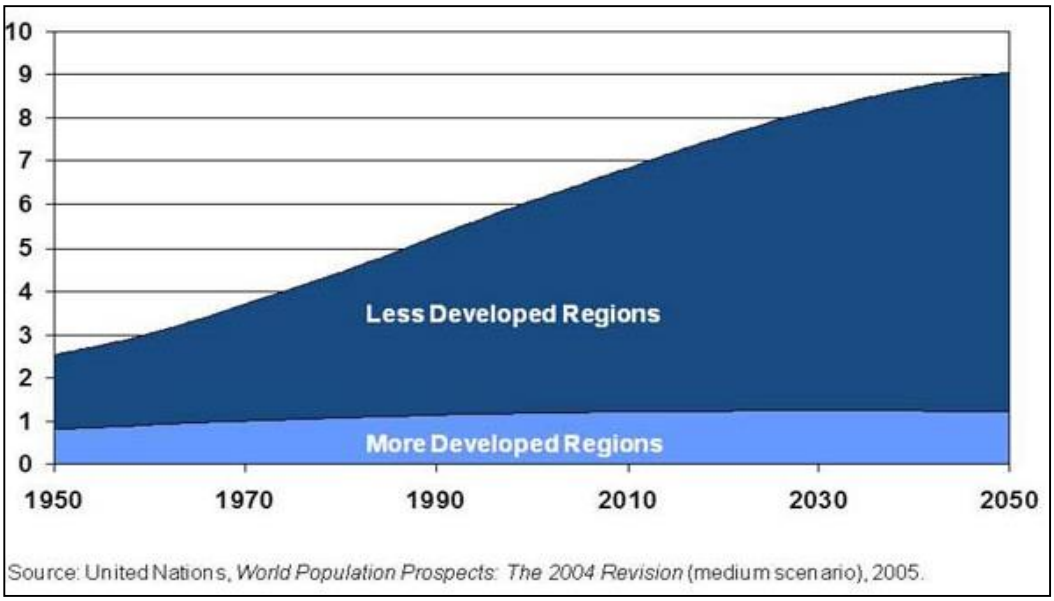
Amount of Years Taken to Add Each Billion to World Population



The World Bank cites that the global population is growing by around 200,000 people each day, and we are near the point where approximately every decade increases the total global population by 1 billion; projections point to roughly 10 billion people on Earth in 2050, with most of this population growth occurring in the poorest regions of the world.

Human Growth in More & Less Developed Regions

(in billions)

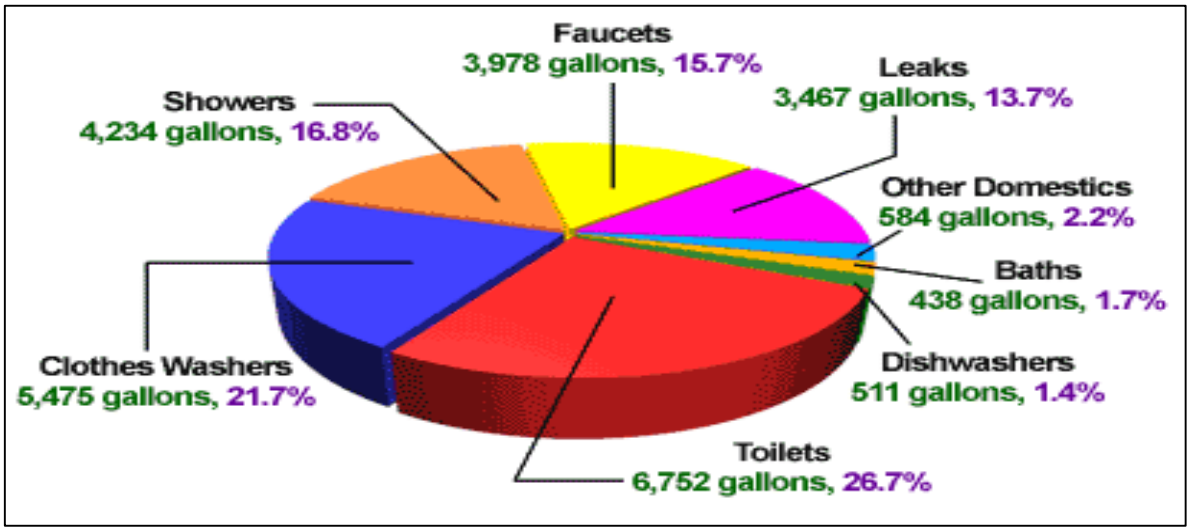


As more and more people are living on Earth there is a subsequent increase in the demand of water. One factor that is applicable to this increase is everyday demands, like drinking, cooking, and cleaning. Similarly, the cultivation and production of food that is needed to feed the enormous human population relies heavily on the use of water. Another factor is from the infrastructure development perspective, in that, new homes and buildings will need to have running water, just as renovated or previously existing ones will. Since the amount of humans living on Earth appears to be increasing at a rapid rate as time goes on, this massive amount of demand will only become more intense, and will continue to be an enormous drain on the supply of readily available freshwater.

As human population growth continues to increase there is another dynamic that plays a role in the water scarcity situation, and that is that people are abusing water. In this case, abuse is the excessive ways in which people overuse or simply waste water. In areas of the world like America, where a water scarcity crisis is the last thing on many peoples' minds, people are using water, well, like water. Some of the ways in which water is being used is not only inefficient, but it also exacerbates the bigger picture of water scarcity. *Scientific American* magazine provides some examples as to how we—as a society—are wasting water. One common example is washing dishes, in that leaving the water on during the entire time that one washes dishes can use twice the amount versus if one were to turn the water on and off (which uses about 20 gallons)—even

more ideal is dishwashers, which need less than 10 gallons per average load. Another common example is washing the car, driveway, or watering one's lawn; a home car wash can go through 80 to 140 gallons of water, whereas a professional service will only use about 30 to 45 gallons (often times using recycled water). On an individual level these types of figures may not seem like a huge deal, but when multiplied by millions of people around the world they begin to become much more serious.

Average Single Family Home Water Use



Looking at things from an even bigger perspective, some more common wastes of water are due to farming. For instance, about 90 percent of the Colorado River's water is drawn for agricultural irrigation in some of the driest areas of the Southwestern U.S. But even more damaging is that roughly half of this water does not even reach the intended crops because of evaporation and seepage during the pumping and transport process, as per a 1997 Cornell University study. And this type of pernicious activity isn't isolated, it is happening all over the world; an example that highlights this can be found in central Asia, where the Aral Sea was once the fourth largest body of freshwater on the planet. Due to local farmers siphoning water from the massive lake, for irrigation and other farming related purposes, the Aral Sea has been drained to 10 percent of its former size. Although causes like this seem to be natural and necessary, there are some causes that are even more natural and necessary—as far as Mother Nature is concerned.

A potential water scarcity crisis is in large part due to human impact, but there are also natural environmental factors that should be included in the conversation, because even if they aren't making the biggest impact, they are certainly causes nonetheless. One of the most prevalent and predominantly discussed natural causes is global warming—or climate change, depending on how you refer to it. Climate change is a highly controversial topic that elicits many different views and reactions, but the majority of views—on an academic and scientific level—are in the camp that believes in the notion that the global temperature has been, and will continue to increase. So let's go with the majority consensus and realize that even a small rise in the global temperature can cause changes in the seasons, which can subsequently result in the

decrease of rain that falls on Earth; this can also cause decreased water in the ground or other readily available sources. Whereas once April showers brought May flowers, this may no longer be the case. A 2013 report by the Columbia University Water Center highlights this notion by citing that droughts magnify the effects of water scarcity, and it shows that water-scarce regions of America, where drought is expected to have the greatest impact, will include metropolitan areas of Washington, D.C., New York City, Los Angeles, and San Diego. These regions alone could impact nearly 40 million Americans, and the effects of (climate change induced) droughts on a water scarcity crisis can touch countries all around the globe. Similarly, the consensus is that the effect of global warming will accentuate the extremes of weather patterns—and pertaining to a water scarcity crisis, this could mean more pronounced droughts, and areas of land that are already dry transforming into new desserts.

Many around the world are already witnessing and experiencing life-changing drought conditions; one example is the current drought happening in California. People across California are having their lives drastically impacted by draught conditions, perhaps most notably are farmers. I recently had the opportunity to speak with a friend of mine, John, who helps out at his family's farm in California; he provided me with a unique and firsthand perspective as to how farmers in the area—and as a whole, really—are being affected by the drought. As follows are the highlights of our conversation (I'm asking the questions, John is answering):

Q: Tell me a bit about the farm—how big is it, who works there, where is it located, what kind of crops are grown, how long has it been operating, the process, and anything else that you can add?

A: Our farm mainly produces Cal Rose rice, Brown Basmati rice, Chinese rice, and Long rice, as well as almonds, walnuts, and pistachios. The farm is near the Sacramento River in Willows, California, and sits on 185 acres of California golden land. My uncle Paul, his wife, and my father oversee and work on the farm, along with about 5 to 10 helpers (that number fluctuates each season). I come from a generation of rice farmers and it goes all the way back to the 1880s. Rice grows so well in northern California because of the texture of the soil and how it holds on to the water, as well as the climate. Many other crops would likely drown but this area is perfect for growing rice. That is why there are tons of rice farmers in this area. Water plays such a huge role in the process of rice production. There has to be a consistency with the depth of the water that the rice grows in; five to six inches deep of water is needed for the rice to turn out perfect. Once the fields are ready to go, the rice seed is soaked and loaded into the aircraft that will distribute them by air. Once this is done, the next step is a five month journey of plant growth. During this whole cycle it's the farmers' job to control and maintain the depth of the water; always making sure it's around five to six inches deep. By August/September the grain appears long and on the very top portion of the plant, that is the prime part of the crop, the grains head are ready to be harvested. On average, each acre (so 185 total is my farm) will yield over 8,500 pounds of rice. Our farm can produce up to 1.5 million pounds of rice—that all depends on several factors, including insects, weather, climate, drought, etc., but that is on average what is possible.

Q: How much of a dependence on water does the farm have, and in what ways is water used?

A: Rice cannot grow without an abundant supply of water, so our farm is very dependent on water. Northern California is a prime location for farming because of the Sacramento River and the San Joaquin Delta. This is located where the Sacramento River and San Joaquin River meet and flow into the San Francisco Bay. The combination of fresh water from the rivers, mixes with the salt water in the Pacific near San Francisco, and creates a very large source of water. This source of water is so large that it pumps water for over 25 million people, throughout all of southern California and central California, as well as up north (keep in mind, the Colorado River also supplies a lot of water for southern California). We depend so much on rain and snow to fall into our rivers, lakes, and streams, and this year that just hasn't happened. Rice farmers are getting hit the worst. Many rice farmers in this area are experiencing scarce water supply on over 75 percent of their crops. That basically means that farmers producing 8,500 pounds of rice/per acre will only produce a quarter of what they usually do.

Q: Explain ways the current drought in California is affecting the farm?

A: I kind of discussed this previously, but we can't grow rice without water. It gets complicated, but basically without snow and rain, our lakes, streams, rivers, dams are empty. The Sacramento River is so low, and that is where we get most of our water. We pump the water from the Sacramento River directly to the farm, and this shortage is preventing us from doing that. Unfortunately the production of rice needs an extremely high amount of water. We need it way more than almond or walnut farming. Right now with it being March, we are just beginning the process of rice production. We are getting the fields ready and leveling. We cannot predict the future, but right now the shortage of water is so severe we can only assume we are going to experience problems during this growing season.

Q: Are droughts this severe common in that area, or is the worst one experienced in the area?

A: The 2013/2014 drought is the worst in history, according to statistics. I hear that in 1977 there was a similar drought but this one seems to be worse. However, I do feel like it is kind of being overhyped, because we could get hit hard in March and April with rain or snow and be fine, so you just never know. But according to statistics, this year's rainfall is the lowest in almost three decades.

Q: Do droughts like this pose a serious threat to farms, how so?

A: Yes, without our usual supply of water, nothing will grow correctly. Farmers lose a lot of money and the government is forced to help us with subsidies and other methods. I don't know the specific break-down of what it costs to maintain a farm (in general) but a drought like this is something we will be paying for, for a long time; I've heard that it could take 200 years to recover from this. Even worse, a drought this severe, occurring again next year could be very devastating.

Q: Has there been any help or aid from the government or any other agency or activist?

A: I don't know the exact numbers but farmers get a ton of government aid; I think there is a limit on subsidies, like $40,000 per farmer, or $80,000 per couple. There are different laws for the amount of subsidies one farmer gets but there are ways to get around it. An area of land can be divided amongst family members. For example, on my farm, we could technically divide the land into four different parts, and one could be mine, one could be my brother's, one could be my dad's, and one to my uncle. We all would receive individual subsidies from the government, and that is why government subsidies in the farming industry are considered unethical and in need of more restrictions (we don't do this but I do know many farmers who divide their land amongst their kids to receive more government aid). The regulations are ambiguous and that's a huge debate on its own.

Q: Do you think the issues of water scarcity and droughts have enough national or global attention—or do you think it really only affects those in the areas hit the hardest?

A: I don't think the rest of America understands how much this affects the whole country. The production of rice and other crops in this area essentially feeds the entire country. When the state of California is in a drought, the whole country loses. So in that regard, no, I don't think there is enough coverage on this problem.

Q: How has this drought affected life as a whole for those in your area?

A: This drought has affected life a great deal in my area because 90% of the economy here is agriculture based, so virtually everyone in this area is impacted because food prices go up, jobs are affected, and taxes go up. Not only will it affect the people, but this type of drought affects wildlife. Keep in mind, the bees, for example, aren't able to pollinate like they usually do because flowers will not be growing like they usually do. The rivers and streams are extremely low, so there is a shortage of fish in our waters. Droughts this severe affect everything from a tiny bee to humans.

Q: Finally, if this type of water scarcity doesn't change or isn't addressed more broadly, do you see it having the potential to close farms and drastically alter peoples' lives—in what ways?

A: There are several factors that need to be considered, because down the road, we will likely experience serious droughts more often, and we need to do what we can to help the problem. With answer to your question, my farm is owned by my family, so even though a drought like this will hurt our business this year, it is not likely we will lose the land or have to sell it. Many farmers learn to save because the weather and droughts are so unpredictable. My family is prepared for this and is able to handle the situation, but that doesn't mean they will be okay if droughts like this happen every year, and that also doesn't mean that all farmers will have this forward looking mindset. If these types of droughts are a consistent pattern in the future, then yes, virtually all farmers will be forced to close up shop.

Here we see another example of just how useful water is; essentially being the blood of the farming operation. We can also see the drastic affects that the 2013-2014 California drought is having, not only on the farmers and those in the surrounding areas, but for people throughout America. Droughts of this severity seem to have a high probability of occurring again and again—based on the studies that assert climate change can aggregate to an enhanced state of storms or conditions, like droughts. Similarly, many argue that climate change as a whole is spurred by humans, so as follows are other "pure play" natural environment causes. Earthquakes can completely incapacitate a regions' piping and water systems. As a result, a myriad of people can lose all access to water and or be forced to use sordid water—often water shortages are one of the biggest contributors to death in the aftermath of an earthquake. Another natural phenomenon is the eruption of volcanoes. Volcanic ash can result in physical and chemical changes in water quality, and like earthquakes, volcanoes can disrupt the water-delivery and treatment facilities that get safe water to people. However, it is worth noting that volcanic eruptions generally have caused few water quality problems, which typically just result in short term unsuitable water, with the most common impact being found in open water-supply systems—like uncovered reservoirs, lakes, streams, and water-catchment systems. All in all, Mother Nature is responsible for some causes that enhance and or exacerbate a water scarcity crisis, but it is uncontestable that the human element plays a much larger and much more detrimental role in a calamitous water scarcity situation.

"The excessive increase of anything causes a reaction in the opposite direction."
Plato

The increase of human population on Earth is inevitable—as is the subsequent increase in demand humans will account for (like more and more water usage)—and with this increase in population there will be an increase in the amount of business development. Since more humans are living, more will need jobs. And so there will be this continual correlation—to some degree—for companies to be created or expand so that they can fulfill a specific role in the marketplace and provide opportunities for people to work. Going forward, the hope is that companies will be prudent and environmentally responsible. Currently, there are a myriad of companies that contribute and add to a potential water scarcity crisis—although many are working to curb this. Often, companies pollute or abuse natural resources and the environment, and they are doing so legally—simply because governments don't have specific restrictions or harsh fines prohibiting them from doing so. With this, we began to make more sense of this situation, and to a large extent it is all about money. In that, corporations do their part to make as much money as possible, and in many cases, governments facilitate a business environment where more money can be made—often

throwing principles like environmental responsibility by the wayside. Relating to Plato's earlier mentioned quote, the excessive increase in human expansion and business development—fostered by government incubation—definitely causes a reaction in the opposite direction, and in many cases, it can be a pernicious reaction that is intensifying the water scarcity picture.

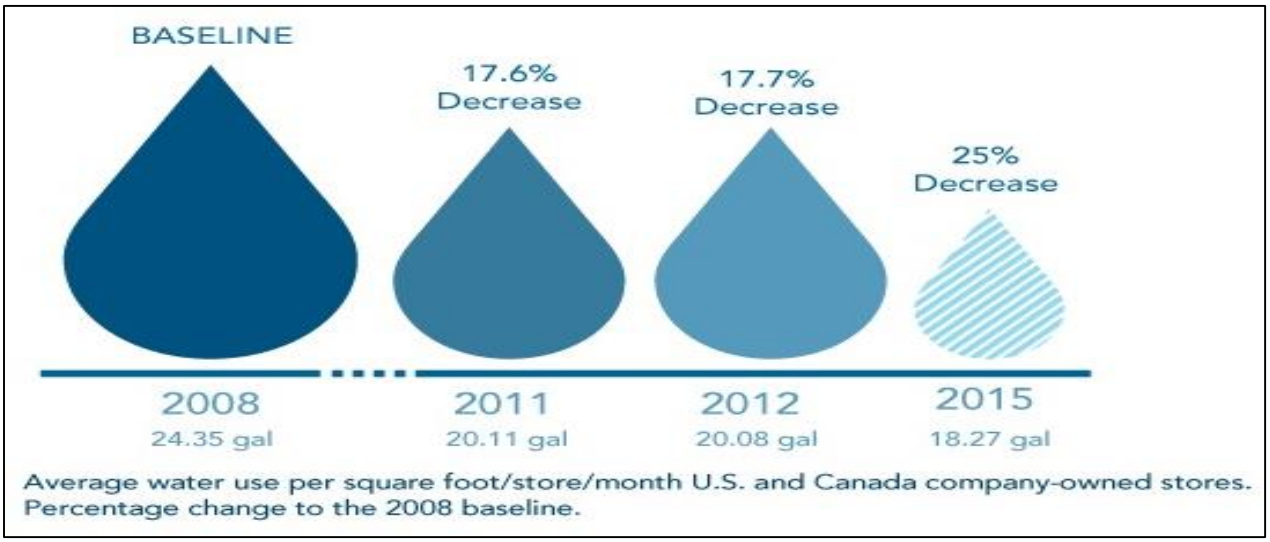
Sometimes in life humans can be blinded by the light, especially when that light is money; often times this blurs corporations' visions of carrying out an environmentally friendly operation. As a result, some companies are more concerned with their bottom line than the ways in which they pollute and abuse the earth. One example of a company where this could be plausible is Williams Energy—a fracked natural gas processor—that had a leak of close to 250 barrels of natural gas liquids, which inevitably made its way into the waterway in western Colorado at the end of 2012. Another possible example is General Electric, which has been facing outcry by the EPA for three decades for the company's extensive pollution of the Hudson River, in New York. Another company that may be reprehensible of putting profits before environmental safety is Dow Chemical—infamous for their polluting activities—which has recently been cited for spewing dioxins in various water ways, among many other pollution related offenses. A singular example that has recently made national headlines occurred on January, 9, 2014, when Freedom Industries had a fiasco that resulted with 10,000 gallons of chemicals spilling into West Virginia's Elk River; the contamination of freshwater left 300,000 West Virginia residents without usable water.

Water in West Virginia After Freedom Industries Chemical Spill

Accidents happen all the time, but when it comes to companies that deal with toxic chemicals on a daily basis—like Freedom Industries—I would hope there would be an enhanced level of vigilance in regards to potential disasters. Apparently this was not the case. One could imagine that that adding extra checks and maintenance procedures to the tank that leaked, among other similar safety precautions, were disregarded because of cost reduction strategies. An even more disconcerting piece of this story is that Gary Southern—president of Freedom Industries—said the company did not know how the leak occurred, and that workers first noticed the leak around 10:30 that morning, at which point they began a cleanup attempt. However, the State Department of Environmental Protection contradicted this account, citing that the leak was discovered at 11:10 in the morning, via complaints of odor by nearby residents, and that when inspectors arrived at the facility they saw chemicals leaking out of a containment dike and no cleanup at all happening. So not only does it appear the company responsible for this massive chemical spill did not know how it happened, but they did not even begin a cleanup attempt until thousands of gallons were already clearly leaking. As a result hundreds of thousands of people were unable to get access to clean water for weeks. These types of situations can be extremely damning to the environment and the water scarcity picture, because if stories like this happen more frequently, then that alone could be one of the main culprits to a water scarcity crisis. To be fair to Freedom Industries, the dust has yet to settle on their case and an ongoing investigation is still pending, but this is just one case that exemplifies what *could* happen when a company may be more concerned with profits than they are with the environment.

Certain companies around the world rely heavily upon water—without it they could not function. On such company is Starbucks, which had environmental campaigners attack them back in 2008 over allegations that the company wasted millions of gallons of water every day. An investigation by the British newspaper *The Sun* cited that over 23.4 million liters of water were poured down the drains of 10,000 stores worldwide. This was due to a company policy that banned staff from turning the water of sink taps off, because, as they put it, "a constant flow of water prevents germs from breeding." To put things in perspective, the amount of water that Starbucks wasted each day was enough for the entire 2 million population of Namibia, Africa, and a single Starbucks tap left running for just over three minutes wastes the exact amount of water that one person needs to survive for a day in drought conditions. To the credit of Starbucks, they realized this was a major issue and they have since been working to remedy the problem; water conservation efforts have yielded the company a nearly 20% annual decrease—since 2008—in the amount of water that they use (see graphic on next page).

Starbucks Water Conservation Progress



This is just one example of a major global corporation that uses a great deal of water, and in their past, they had a notorious history of squandering massive amounts of water for no apparently valid reason. Instances like this are far and wide. Many companies use far more water than Starbucks, and many haven't been as responsible and proactive. One thing that is certain, is that water is extremely valuable for a myriad of corporations, and nearly all need it—in at least some capacity—to function with their day-to-day operations.

A prime example of a company that depends heavily on water is Anheuser Busch (post 2008 merger with InBev it is known as AB InBev), which is the largest brewer of beer in the world, and the perennial number one as far as market share. I recently had the chance to sit down with a former executive, Charles, who until recently oversaw the day-to-day operations of the Newark, N.J. brewery—one of the largest breweries in the world and often the largest annual user of water in the greater NY area. He shared some interesting facts about how much water is used, why so much water is being used, and ways in which the company looks to curb the amount of water usage, as well other related insights. As follows is a question and answer breakdown of our conversation (I'm asking the questions, Charles is answering):

Q: During your time overseeing the operations at the Newark brewery, how much water was being used?

A: Potentially a million gallons of water per day. In large part this was dependent upon on utilization and how much we were running from a product production standpoint. At peak utilization levels, we would approach 400 million gallons of water per year.

Q: Why is so much water used?

A: Well for starters, water is a fundamental ingredient in beer. I would estimate about 50 percent of our water usage was for making the product. Plus a substantial amount of water is used in the brewing process for cooling and steam production, as well as pasteurization, sterilization, and sanitation related efforts—I would estimate this accounts for about 45 percent of the water usage. The additional 5 percent was miscellaneous and regular daily usage.

Q: Were there any other means that represented viable alternatives?

A: No, not really. Water was a must, because there was a risk of having anything with chemicals contaminating a piece of machinery involved in the brewing or packaging process. Things had to be extremely clean at all times, this was key, and water was the cleanest and only substance to use in many of the operations.

Q: Similarly, was recycled water a component of the strategy?

A: Yes, very much so. We tried to optimize efficiency by redistributing water to various facets of the process that didn't come into direct contact with the product. Like certain types of lubrication for machinery, pasteurization, and equipment sanitation. But again, we had to be very careful that recycled water wasn't used in areas that had direct contact to any of the products.

Q: Was the company vigilant of the amount of water they used?

A: Oh yes, we were constantly having meetings and think-tanks about ways in which we could employ water-saving tactics. We also would hire outside consulting services to help find ways that we could reduce the amount of water we were using and ways we could use it more efficiently. Being aware of our water usage and ways to reduce our usage was a top priority, since it is such an important part of the business.

Q: What were some specific approaches to reduce the amount of water that was being used?

A: Well, some of the internal and external research that we would do provided us with statistics that cited where we could be more efficient. As a result, we would reduce frequencies of certain water uses and optimize efficiency. Also, we would often take preventative measures and conduct maintenance audits to identify any early stage leaks or repairs that needed to take place. We were very proactive in that sense, constantly repairing piping or anything else that needed repair, and devising automatic shutoffs that would reduce the amount of less needed areas. But above all, there was a top down approach to raise awareness

via internal campaigns that alerted people of the issue of reducing our water use—with specific goals and targets to hit, specifically pertaining to various divisions of the brewery, each doing their part to help reduce amount of water usage.

Q: Last question, from your vantage point, did you notice a hindrance of any sort, or a sense that the local, state, or federal government was breathing down your neck—specifically as it relates to water usage?

A: No, not really, the only real issue in this regard was the draining systems, and the ways in which water we used was disposed of. From my view, overall, I noticed the city of Newark and the state of New Jersey to be very supportive and encouraging for increasing volume. There were all sorts of tax breaks, incentives, or credits that were offered, both locally and federally. I suppose a big reason there wasn't such a big involvement of government regulation, or EPA, or similar agencies, is because Anheuser Busch has historically been a very environmentally friendly company—at least as goes for global conglomerates. Realistically though the environment wasn't our top concern in the process, more so that we didn't want to have a PR headache or potential for any negative news headlines—that's the reality of it, in my opinion.

Here we can see how pivotal water is in the corporate arena. If a company like AB Inbev had to deal with substantial cost increases due to a water scarcity crisis, then the entire operation of the business would be drastically altered. For a company of this scope it may be damaging to their bottom-line and shareholders, at least initially, but what is even more disconcerting is when you consider that some companies do not have the fortress-like balance sheet that AB Inbev does. So the probability that smaller companies could withstand such a drastic blow to their business would likely be far lower. Subsequently, for many smaller businesses around the world, that are heavily reliant on water, the results could be catastrophic. Additionally, it is quite clear that AB Inbev runs a responsible, ecofriendly operation, but for companies that aren't leaders in their particular market, or that don't get as much media attention and scrutiny, there is a concern that they will cut corners and put their business before the environment. Not only could the smaller, private companies of the world present a major risk from an environmental basis, there are many global conglomerates that are more concerned with their cash flow, than with running an ecofriendly business operation. And when the scale of these corporate behemoths are far larger, the consequences could be detrimental.

PART III

"If liberty and equality, as is thought by some, are chiefly to be found in democracy, they will be best attained when all persons alike share in government to the utmost."
Aristotle

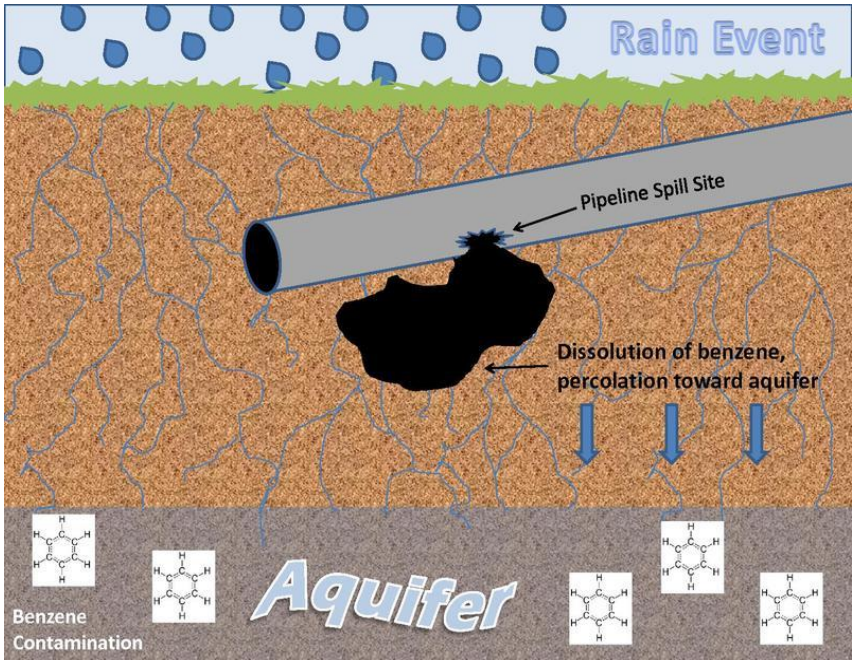
John Pierpont, "J.P.," Morgan once said, "A man always has two reasons for doing anything: a good reason and the real reason." Often times, especially in the scope of politics, the real reason originates from selfish roots that revolve around self or group affiliated interests—much to the hapless chagrin of those who get the short end of the stick. Political agendas can often be hijacked by money and power, each making the politician that is tempted by such Sirens to do unscrupulous, and sometimes, even sinister acts. In the realm of environmental responsibility, we see this intertwined connection every day. Sometimes it is the collaborative force of a government that doesn't enact or enforce laws, which ultimately prevents the natural environment from staying pristine. Other times it is a governmental system that enables a corporation to make as much money as possible, and if any laws are broken in the process, minor castigations will be served—if any at all. So often we see corporations, countries, and individuals around the globe involved in some form of environmental wrongdoing—and many times, they do so with impunity. In large part, it is the governments of the world that often enable corporations to put profits before environmentally friendly business practices, and ultimately, it is the governments of the world that can actually do something about all of this, but so often, they don't.

In a democratic society—which most developed (wealthy) countries of the world are—the people elect politicians to carry out plans that will better everyone in society, at least in theory. But in reality, politicians, and governments as a whole, often work in mysterious ways that make one question just whose interest they are working for. One such example is the spill of 241 barrels of mixed natural gas liquid in Parachute, Colorado, that contaminated groundwater and other freshwater sources. The eye-brow raising aspect to this story is that the state of Colorado did not issue a single fine. An even more disconcerting aspect to this is that local lawmakers in Colorado were shocked to learn that state penalties for accidents just like this one had been capped at a mere $10,000; that is until new legislation was passed that increased possible states fines for such incidents—albeit to $15,000. But the real kicker is that even with the Governor of the state signing and getting this bill passed, the state of Colorado has yet to fine Williams Energy (the company responsible for the spill) a cent. Fines were not issued because of a loophole that the Colorado Department of Public Health and Environment contested: "the release was not due to negligence but to accidental equipment failure." So now things begin to make a bit more sense.

If Williams Energy had to invest more money for proper maintenance and preventive measures to avoid such accidents, then they would potentially reduce the amount of their earnings and revenue generation. Subsequently, they would also pay less to the state of Colorado and Federal government in taxes—perhaps this explains the

reluctance to issue fines. Companies that are liable for accidents that can potentially ruin the natural environment should not be able to go with impunity just because they generate a massive amount of tax revenue, as well as the increase in consumer spending and investment by those who invest in or work for such highly profitable companies. To put this in better perspective, Williams Energy generates approximately seven billion dollars in annual revenue. Paradoxically, I guess it makes more sense for them to worry about making more money, rather than focusing on environmentally responsible business practices that ultimately revolve around integrity. Perhaps though, it is not a company like Williams Energy that is at fault. Ultimately they are just playing by the rules that are formed and dictated by the government. And the rules enable this type of behavior to happen more than most can even imagine. Sadly, this was just one spill—and certainly not the largest—of the 179 oil and gas related spills in Colorado in 2013. An overview of Colorado Oil and Gas Conservation Commission data shows that nearly 15 percent of the 179 had a similar effect in regards to contaminating ground-water; close to 400,000 gallons of contaminated groundwater were siphoned from the Parachute Creek, containing benzene (a chemical that causes cancers among other ailments) levels that exceeded the federal drinking water standard.

Benzene Contamination to Groundwater via Oil Spill



To look at things from a wider lens, a 2004 EPA Jurisdiction Oil Spill Database cites that there have been 42,860 massive oil spills in the US over the past 20 years, which doesn't even cite spills of less than 50 gallons, but if it did, there would be about 4.3 million oil spills since 1980. Even more staggering is when you look at things from an even wider lens and realize that the amount of oil spills around the globe that are contaminating the earth's water supplies aggregate to astronomically higher figures. In the end, companies like Williams Energy know that even in a worst case scenario where an accident—due to negligence or otherwise—that results in the destruction of the environment will not be a major problem for them, because even in the rare case that a

company does get fined or face penalties, the trivial amount of those fines are a drop in the bucket compared to the amount of money they generate.

I recently had the chance to speak with someone (Steve) who works in the oil and gas industry. He provided me with information in regards to the use of water in the operation, as well as numerous other relevant points. As follows are the highlights from our conversation (I'm asking the questions, Steve is answering):

Q: Tell me about the specific area of the oil & gas industry that you work in, and what your specific role is?

A: I'm a rigging engineer in the shale oil segment of the oil and gas industry. The focus of my role is to oversee the extraction process. The key points of the process that I deal with is when a lubricant called slippery water goes through the shale, and gets pumped to the refinery, where the usable shale supply is separated—that is a basic overview of the process. More specifically, I oversee the engineering as it pertains to the drilling operation and the flow of slippery water into the well, as well as managing the thermodynamics.

Q: How much of a reliance on water is there—and in what ways is water being used?

A: A tremendous amount. Water is lubricated with various chemicals, creating the slippery water lubricant base, which is pivotal in the pumping process, an absolute must.

Q: What is the biggest source of pollution in your line of work, & on average, how often does this happen?

A: When slippery water from the wells leak into the aquifer. So when the slippery water gets past the concrete columns and walls of the aquifer it damages the water supply. It has happened, but it is not that frequent of an occurrence.

Q: How important is safety and taking preventative measure to avoid leaks or other pernicious accidents?

A: Very important. We try to run a very careful and strategic operation so that the shale oil or any of the other chemicals involved in the process don't leak into the aquifer. We also take various safety precautions in the rigging and piping process to ensure that the environment isn't negatively impacted.

Q: Does your company put profits ahead of running an environmentally friendly business; do you think companies as a whole, in the oil and gas sector, put profits before environmentally responsible business practices?

A: That's a tough one, I'd like to say that I think they don't, but at my level it is tough to give you a good answer to that question. What I can say, from examples set by senior management, is that they definitely emphasis how important running an environmentally safe operation is—not just for our company, but for

the entire shale industry, because if it is going to be a realistic energy solution going forward we need to reduce the damage it does to the environment as much as possible. I would guess that is the case for most companies in the shale oil segment of the business.

Q: What sort of involvement does the government play in terms of regulation, penalties, or tax incentives?

A: Again, this is a bit beyond my expertise, but I do know that various aspects of the exploration process receive tax credits and tax breaks. I like to stay informed of news in the industry, so obviously I read about new forms of regulation being proposed, and stories of companies being penalized for wrongdoing of some sort, but my company has yet to have any issues in those areas.

Q: What do you think motivates the government to be so lax when it comes to fines and so forth?

A: Well, I don't know that they are, for starters, but if they were, I would have to think the enormous potential for economic stimulation this industry could provide is a pretty likely reason.

Q: Do you think governments are more at fault for oil spills and things of this nature, since oil companies are just playing by the rules dictated by lawmakers? Explain.

A: I think they are both accountable. I would say the government is accountable for not having as stringent regulations as there could be, so maybe the government should dedicate more funds to creating a bigger department that oversees and regulates the oil and gas industry if they really want to make an impact. Don't get me wrong, oil companies are accountable as well, but we are professionals, and in most cases highly trained and skilled, and to your point, we are pretty much just following the parameters the government sets up.

Q: What do you think are some good steps to take, from those in your area of business, to prevent spills and other environmental destruction, as well as way to reduce the amount of water in the operation?

A: Better well designs, more accurate pipe fittings and designs, and as a whole, just better engineering. Look, this segment of the industry is going to take off, and I think it will happen sooner than later. It's a new industry and we're getting the kinks out—when people first starting drilling for oil there were oil fires and other sorts of serious problems happening all the time, we look now, and sure there are accidents here and there, but as a whole, it is a pretty safe process. There's no denying that this stage of the shale industry lifecycle is not dangerous, but it's just going to take time—I have no doubts it will one day be as safe as the crude oil industry currently is.

Q: Last question, if there is a time where water is an extremely scarce commodity, traded at a price similar to the way oil does, how do you think that will affect your business and the oil and gas industry as a whole?

A: It would be detrimental, definitely a game-changer. But I honestly don't think it will ever get to that point—at least I try not to think about scenarios like that.

Here we see the perspective from someone in the trenches, at the ground level of the "shale oil revolution." And yet again, we see an incredible demand and necessity for water in the shale oil explorative process. We also see the potential that money can have in regards to a lax government, which may be more apt to sit back and reap the benefits, rather than crack down on an industry the poses a serious threat to the environment. Additionally, there is an undeniable connotation of danger because of accidents—that even Steve admitted to—and the hope is that these are just the initial problems that will eventually be ironed out. I think that they could be, and I really do hope that is the case. But I also think that these types of problems could occur even decades into the shale oil story, so it may be a fools dream to think of shale oil as a clean and viable energy source. It all comes down to corporate responsibility and assiduous government oversight; those two factors are the only ways to drastically prevent any environmental damage by companies involved in a potentially dangerous industry. But it is becoming clearer that politicians aren't too concerned, and are willing keep their hands clean, while others aren't as fortunate.

There are a plethora of companies, covering virtually all sectors of the global economy, that are powerhouses in their respective businesses, generating mammoth amounts of revenue—in no small part thanks to relief from fines and regulation provided by friendly politicians. One such example is how the Supreme Court of Michigan granted Dow Chemical—a company notoriously known for its pernicious environmental impact—a license that virtually allows them to pollute, despite heavy objection from activists and environmental defense organizations, as well as pollution victims. In large part this is due to corporations' formidable legal teams that quell any individual or class action suits instantly, or drag them out until the plaintiffs run out of money or die. In the Michigan case, hundreds of landowners filed a class action suit against Dow Chemical for the leak of dioxin—a highly toxic and cancer-causing byproduct of their chemical manufacturing process—and ultimately lost because they could not compete with the defense of Dow Chemical.

Dow Chemical Report Card via GMI Ratings

Component Ratings	Global	Home Market
ESG OVERALL	D	D
GOVERNANCE	D	D
Board	C	D
Pay	D	C
Ownership & Control	B	A
ENVIRONMENTAL	F	F
SOCIAL	A	A
Country: United States		Home Market:USA

Massive institutional and political support for companies that pollute the environment make it hard for people to fight them, let alone hold them accountable, which speaks to another key facet of the equation: lobbying. Koch Industries is a company that is infamously known for their environmentally irresponsible business practices, as well as their skills when it comes to lobbying against regulation or pollution related fines. Koch Industries, the nation's second largest private company, focuses on oil and gas, among other core businesses that are directly related to the environment; they have annual revenue around $115 billion and they are not afraid to use their enormous supply of capital and political weight to have fines reduced or rescinded. The Koch brothers, Charles and David—the two principals of the company and two of the wealthiest people on Earth—push their polluting agenda by way of hundreds of millions of dollars in political campaign contributions, lobbying, and funding various groups and think-tanks that align with their views. Simply put, their views revolve around denying climate change and other clean energy policies, as well as reducing regulation when it comes to business practices that relate to the natural environment. A 2010 Greenpeace USA report documented the millions of dollars that Koch Industries spends on lobbying against various clean energy policies, as well as campaign contributions to polluter-friendly politicians—citing that $61 million has been donated for political campaigns since 1990, and over $67 million to lobbyists and other similar organizations that align with their views. And this is just the money that can be tracked via taxes and other legal forms; in total, the amount of money they dole out is likely to be far higher. These types of figures give insight to the amount of weight that corporations and some individuals have when it comes to the politicians and lobby groups that impact many of the laws that enable companies to conduct irresponsible environmental practices without serious punishment.

The Evolution of U.S. Lobbying From 1998 - 2013

Source: Center for Responsive Politics

Looking at the bigger picture, politicians may get more votes, especially by wealthy and powerful influencers, if they are against corporate and environmental regulation that would stymie pollution. One such example of this was exhibited by Texas Governor Rick Perry, who ran in a 2012 Republican primary election on a platform that would completely abolish the EPA (The Environmental Protection Agency). This is also why proponents and those who are involved with potentially environmentally unfriendly business practices raise massive sums of money for the candidates that will provide a business environment that is more conducive to profit increases versus environmentally responsible operations. So it only makes sense for politicians to go after votes and improve their own chances of victory by any means necessary, right—this is the name of game, isn't it? This points to a key reason as to why politicians, and the governments they form, are so lax on sanctions and penalties to companies that abuse the natural environment: If it isn't about the economic perks associated with putting profits first, it is about the power that is attainable via aligning yourself with the *right* people and organizations.

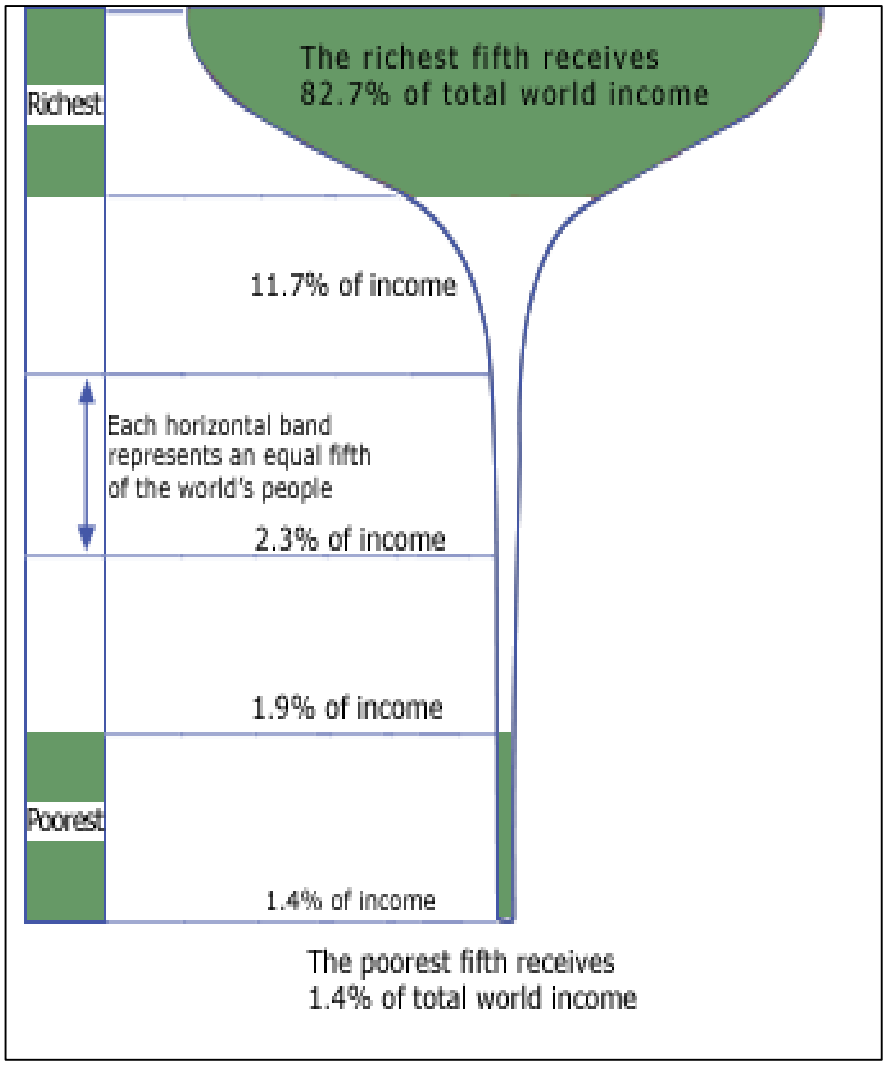
All too often companies all over the world—like Williams Energy, Dow Chemical, or Koch Industries, for example—are being incubated by the weak or completely lacking jurisdictions of the government, that *could* seriously alter their irresponsible environmental practices and clouted corporate mindsets—but that is a big *could*, and more times than not, it is a *don't*. Aristotle's earlier mentioned quote recommends greater participation by everyone in a government; I firmly agree that this is a necessity. If this were the case, it could very well remedy the inherent political corruption that is rampantly intertwined with corporations across the globe; subsequently reducing the amount of pollution and waste of the earth's pristine water supply. But more important than everyone participating and working together—which, not to be undercut, is of pinnacle importance to actually getting things done—I believe a government should do what is equitable for the people; and not just *some* of the people, *all* of the people.

"The civility which money will purchase, is rarely extended to those who have none."
Charles Dickens

Perhaps the most profound effect that misdirected political agendas and corporate irresponsibility—from participants on all corners of the globe—has had is the enormous wealth and income inequality gap that persists in today's society. The Oxfam Committee's 2014 report on global inequality sheds light on just how drastic this inequality is, and asserts that the 85 wealthiest people on Earth own more than the bottom 3.5 billion people (roughly half the planet's population). It is often those with the least, residing in undeveloped countries, that don't have the means to acquire adequate amounts of water for their survival—yet it is these areas where water costs are already reaching astronomical levels. Paradoxically, those living in the wealthiest, most developed countries in the world typically have the means to obtain substantial amounts

of water for whatever reason they want, yet it is these areas where the cost of water is relatively cheap. Additionally, the lack of means also reduces the amount of educational opportunities, specifically pertaining to socioeconomic development and environmental responsibility, to the people that are in dire need of learning the exact steps that must be taken to break the pernicious cycle that exacerbates water scarcity. The fact that certain parts of the world have more wealth and control than others can even imagine—let alone hope for—make a potential water scarcity crisis even more calamitous.

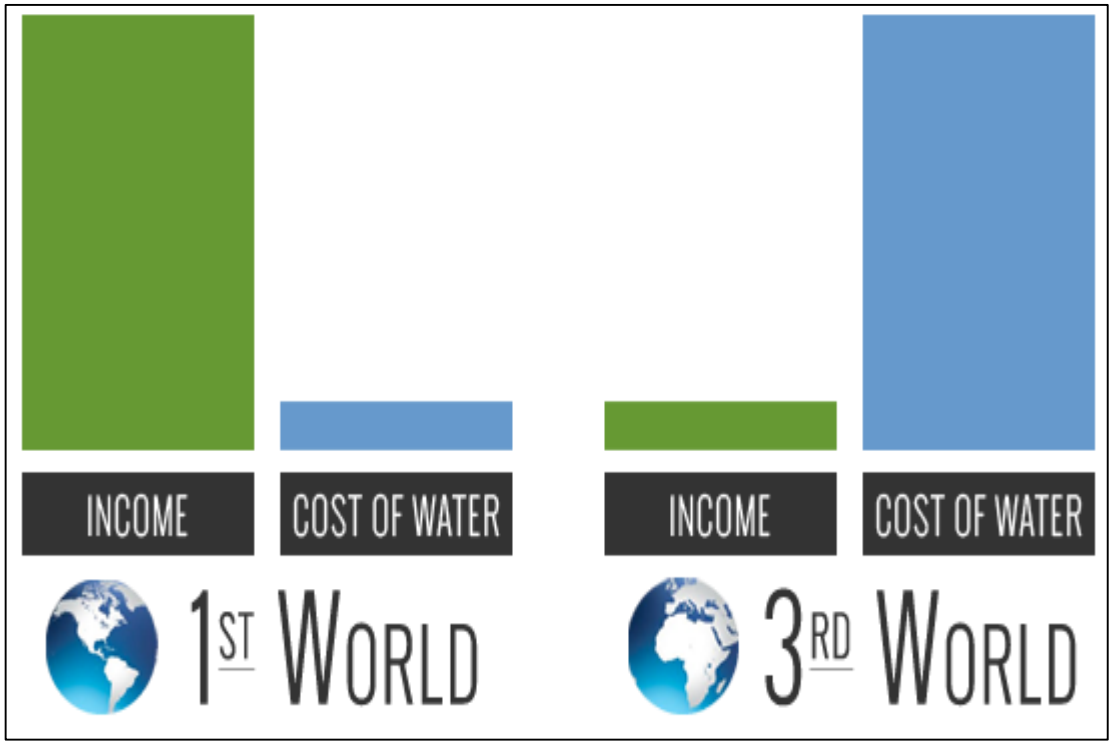
Distribution of Income for World Population



Those in the world who are the most indigent often don't have access to clean water, and if they do, they have to pay a very steep price to obtain it. The United Nations Development Programme's 2006 Human Development Report, *Beyond Scarcity: Power, poverty and the global water crisis* corroborates just how dire this situation is, and cites that nearly 66 percent of people who lack safe drinking water live on less than two dollars per day, and 33 percent live on less than one dollar per day. The

UNDP reports goes on to say that people living in slums and poverty-ridden conditions often pay five to ten times more per liter of water than wealthy people living in the same area. Clearly, this is not an equitable scenario, and when the most helpless people in the world don't have access to one of the simplest forms of survival you would think that more would be done to help remedy this situation—especially since extreme disparity of peoples' wealth in past civilizations has proved to be disastrous for everyone in society when the gap becomes too wide. Perhaps even more disconcerting is the fact that those with the least, have to pay a substantially higher amount for water—the foundational element of survival—than those who have far more financial security.

Global Income to Cost of Water Discrepancy



In November 2013, the World Economic Forum released its *Outlook on the Global Agenda 2014,* which revolved around many topics to improve the state of the world, but the most predominant topic of conversation focused on the drastic widening of income and wealth disparity—specifically citing that increasing inequality is seen by North Americans as the biggest challenge facing the region. Many of the top ranking business people, academics, economists, politically related people, and even celebrities of the world attended this event, and the overwhelming consensus was that the widening economic disparity is a major issue that needs to be addressed. This consensus view, by the global influencers that attended, is corroborated by people throughout the world. The WEF report cites that the overwhelming majority of people, from every country throughout the world say the economic system in their country favors the wealthy—on a percentage basis, the 61 percent to 80 percent group of people

that feel this way account for the average global view, but a very close second is the 81 percent to 100 percent bracket of people that feel that the economic system in their country favors the wealthy.

Global Economic Inequality Averages

		Rich-poor gap...	
	System favors wealthy*	Has increased past 5 years	Is very big problem
Medians for...	%	%	%
Advanced	74	80	53
Emerging	70	59	67
Developing	70	70	74

* Data not available for China.

Source: Pew Research Center, 2013

The global income and wealth inequality can certainly be connected to a water scarcity crisis, because there is virtually an equivalent type of discrepancy between income and the cost of water—which is a serious exacerbating factor to the water problem. More specifically, if Americans were to pay a proportional amount of money for their clean water (based on the income to cost of water ratios of developed versus undeveloped countries), just one bottle of water would cost 62 dollars. Sadly, this unfairness will likely continue, if not get worse, if action isn't taken now. A major hindrance to actually fixing—or taking steps to fix—the problem is the fact that there is a lack of money by those affected the hardest.

Without financial flexibility it is difficult to invest in the much needed education that could potentially thwart the water problem that is exacerbated by economic inequality. Education, specifically socioeconomic and environmental related education, is pivotal for breaking the cycle of poverty that incubates the perils of water scarcity. But without adequate funding, schools and educational programs cannot exist. Additionally, with over half of the world's schools lacking access to safe water and sanitation facilities, this brings another problem to the conversation. In that, the lack of safe water has enormous effects on students' academic performance, as well as their attendance rates—even the brightest students can be derailed by the stomach pain, diarrhea, disease, and hunger that are associated with water scarcity. Also, many times students miss the opportunity to attend classes because they are spending a tremendous amount of time fetching water, or looking after sick family members that are affected by water related problems—and the same goes for the teachers, because if they are sick or dealing with sick family members, or fetching water, then classes get cancelled.

An additional wrinkle to this equation is that the women and children of poor regions are most affected here, as it is their primary responsibility—in 76 percent of households in developing countries—to collect water. Women and children travel six to nine miles per day collecting water, and carry north of forty pounds per trip. So when the majority of their time is dedicated to trying to get clean water, it leaves very little time to explore developmental and educational opportunities—that in most cases don't even exist because of a lack of funding. And even if educational systems are in place, they cannot operate a school or program that cannot provide clean water or bathroom facilities to students and faculty, thus completely exacerbating an already dire situation.

Without an emphasis on education, there is a disastrous cycle of poverty and inequality that is directly entangled with a water scarcity crisis—and so often it is a lack of funds that is at the root of stymieing a remedy. When indigent people have to spend the majority of their time just attempting to obtain clean water, they are forgoing the time needed for an education that could potentially alter the long-run socioeconomic and environmental conditions that make their lives challenging. Yet in more developed and affluent regions of the world, it is so often the case that students with a plethora of educational opportunities take them for granted, which is akin to the ways in which many people living in developed nations have an abundance of per capita wealth and take for granted the availability and drastically cheaper costs of water—as compared to those in less developed regions. Another facet to this conversation is that economic inequality and political capture are too often interlinked, and when wealth persuades government policymaking, the rules tend to favor those with more money, much to the detriment of those less fortunate. This is the very reason that James Madison, the man who helped ink the US Constitution, said that the government should prevent an immoderate accumulation of riches, and similarly, why the other Founding Fathers, like, George Washington, Thomas Jefferson, and Alexander Hamilton, all agreed that too much money in the hands of too few would destroy democracy. In the end, Dickens had it right, because the act of showing regard for others can be acquired by money, but it is seldom extended to those who have none. If we want to live in a world that quells the economic inequality that incubates a water scarcity crisis, action must be taken now to correct these issues, and more importantly, civility must be extended to those who have the least.

PART IV

"When I was young I thought that money was the most important thing in life; now that I am old I know that it is."
Oscar Wilde

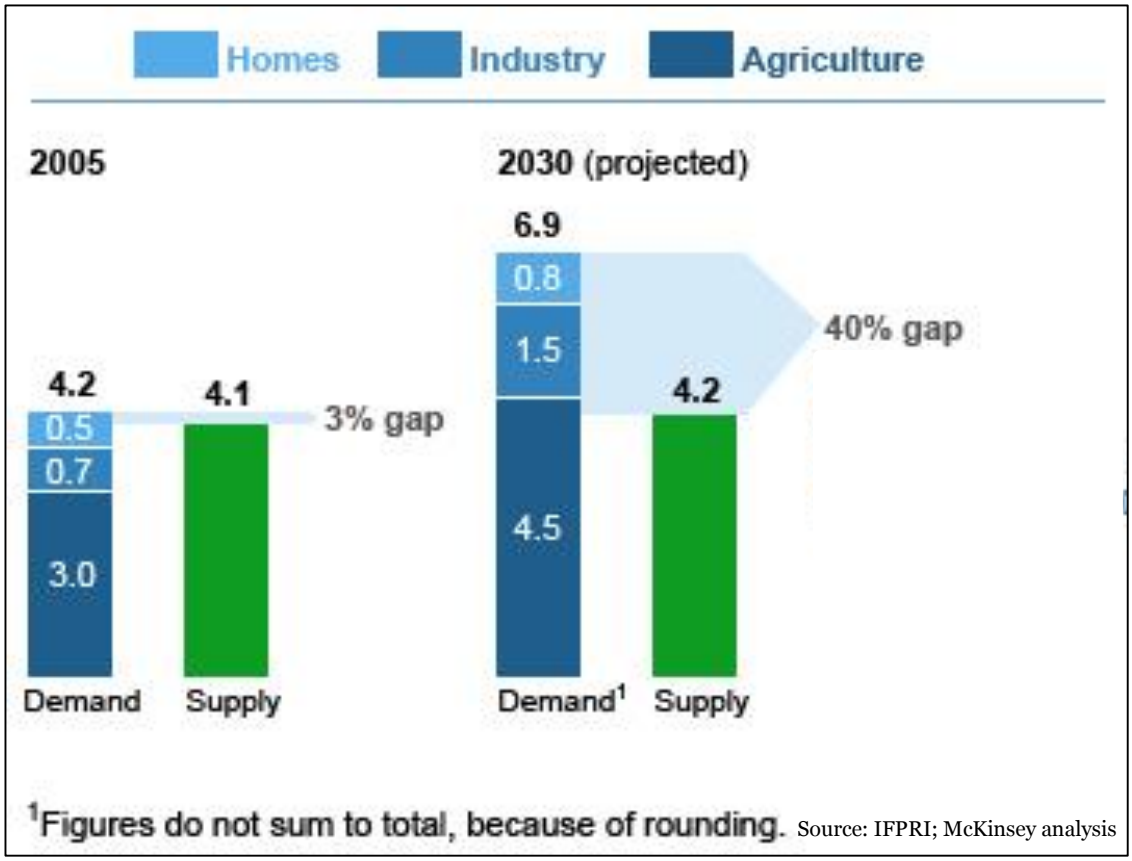
Money makes the world go round. Many subscribe to this cliché notion—famed writer Oscar Wilde certainly seemed to—and I agree, to a certain extent…do you? We've already encountered many ways that money is connected to water scarcity, but I'm going to provide a much different perspective going forward — more specifically, an economic perspective. Most simply, economics can refer to financial considerations, or the part of something that relates to money. To clarify with further detail, economics is a social science that studies how individuals, governments, firms, and nations make choices on allocating scarce resources (i.e., money) to satisfy their wants and needs; it also aims to explain how economies work via the interactions and relationships of the production, consumption, and distribution of goods and services, including the pivotal concept of supply and demand. Moreover, there are two main branches of economics, and they are macroeconomics and microeconomics. Macroeconomics covers the broad-strokes and wider lens view of a nation's—or group of nations'—economic issues, while micro-economics focuses more on the individual level. Another way to look at it is that macroeconomics is symbolic of an entire, vast forest; whereas microeconomics is symbolic of the individual trees within that forest. In economic terms, water scarcity affects the forest and the trees within the forest—both figuratively, and literally. Not only does water scarcity have societal, environmental, and cultural ramifications in various circumstances—on a global scale—but there are a plethora of economic repercussions as well.

From an economic vantage point, the looming water crisis is going to affect people of all financial backgrounds, all across the world, much sooner than many may think. A *Harvard Business Review* study (via McKinsey Quarterly) cites that by 2030 water supplies will satisfy just 60% of global demand (see graphic on next page), and less than 50% in numerous undeveloped regions that are already being affected. This means that the global household, industrial, and agricultural demand will cumulatively outweigh the supply by roughly 40%. Similarly, based off the HBR study, if global demand increases by nearly 40% over the next couple of decades, while the supply stays relatively the same—all else being equal—one of the four basic laws of supply & demand states that when demand increases and supply remains unchanged, a shortage occurs, leading to a higher equilibrium price (which is the point where the demand meets the supply, represented by the intersection of the demand and supply curves). This means that as the global demand for water increases, and the supply of available water is virtually unchanged, the price of water will increase. From a real world economic context, this will mean that governments will have to manage demand by raising the price of water or restricting the amount of water that can be used. So a company that relies heavily on water—which as we've touched on earlier, there are a myriad of them—

will now face the burden of higher water prices and or restrictions. As a result, the company will potentially counteract this economic burden by raising the price of their products, and thus individual consumers that purchase that company's products will face higher prices at the register. This higher price could be an economic hindrance to those with more resources, and a crippler to individuals and corporations that aren't as financially robust—especially in times of economic distress or uncertainty.

Global Water Supply & Demand Projection

(global water supply, in trillion cubic meters)



If individuals' allocation of money for a particular product or service doesn't yield them the same marginal utility (an economic term, that essentially means the level of happiness a product or service can provide) then they may reduce the amount of money they allocate to a particular product or service, or they may even cease expending on that product or service altogether. As a result, firms may incur losses which could stymie economic growth and result in the reduction of production and distribution of their products or services. Or worse, firms could be forced to downsize via widespread layoffs—or even liquidation. This, in a cumulative effect, could end up affecting individuals in a particular nation because the unemployment rate would increase as the amount of jobs decreases and they would lose their job or be forced to face reduced earnings potential. Subsequently, peoples' quality of life—and the quality of life of an

entire nation—could be drastically diminished. As we've addressed, there is a very close relationship between corporations and individuals, as well as governments—but this sheds light on a different facet to this dynamic. With less money in the pockets of individuals—or on the balance sheet of corporations—taking steps to get out of the hole becomes much harder because there is a paucity of funds to invest in developmental growth.

This is a continuous cycle that is rather vicious and can not only have pernicious effects on individuals and corporations alike, but it can detrimentally impact a nation or governmental system as whole. The latter point is enhanced when you consider how interconnected the world is today. In that, if one country has an economic illness, they sneeze, and before you know it, there are numerous countries that have caught the same illness—all trying to recover and get back to full health at the same time. In essence, there is a plausibility that the entire world could be sick from the same illness that started at one company, in one city—stemming from an increase in prices and or a reduction in employment. Subsequently, individuals, firms, nations, and governments could dramatically alter their choices and decision making process in regards to the allocation of resources that satisfy their wants and needs. So if wants and needs are no longer satisfied, there is the possibility for protests, riots, or uprisings that could completely alter the foundation and composition of a nation—potentially resulting in a demonstrably different world. And to think, this all started because of a substantial variance in one of the foremost economic concepts: The demand of water far exceeded the supply that was available.

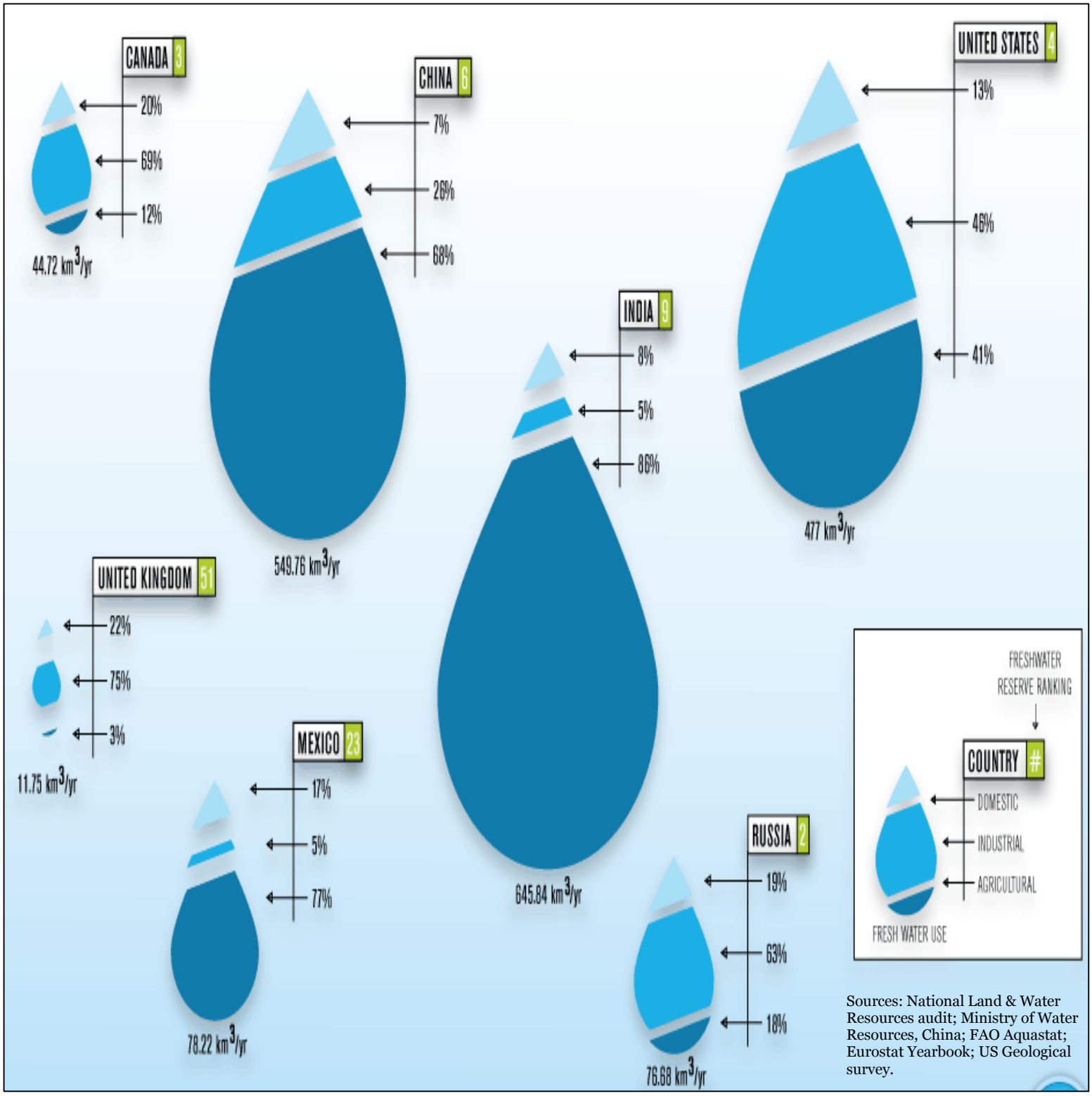
"The price of anything is the amount of life you exchange for it."
Henry David Thoreau

Water is the engine of the global economy, so it's only fitting that the economics of a looming water scarcity crisis could be felt by everyone on Earth, in very drastic ways. As we've already touched on, there would be serious impacts for many sectors of the economy that depend on water—resulting in a plethora of hardships for individuals, firms, governments, and nations alike—and we will go a bit further in-depth with the corporate facet of this equation, as well as some of the more broad-scope economic implications associated with water scarcity. Additionally, and perhaps most notably, the agricultural sector could be hit the hardest—resulting in hardships not just for farmers. One thing that seems rather probable is that the price of water around the world will be increasing in the decades to come, and if we connect this to Thoreau's earlier mentioned quote, we can begin to discern an environment where the price of water has been exchanged for a great deal of life.

Without water, neither small businesses nor major global conglomerates—of any kind—can function. Energy, power, and industrial companies use substantial amounts of water in the production process, as well as for coolants and lubricators; accounting

for 16 percent of the global demand today, with estimates pointing to 22 percent by 2030. Even other sectors of business, that do not account for such a substantial amount of water demand, use a tremendous amount of water; for example, to make just one pair of jeans requires more than 2,900 gallons of water.

Freshwater Reserves & Use, by Sector, by Country

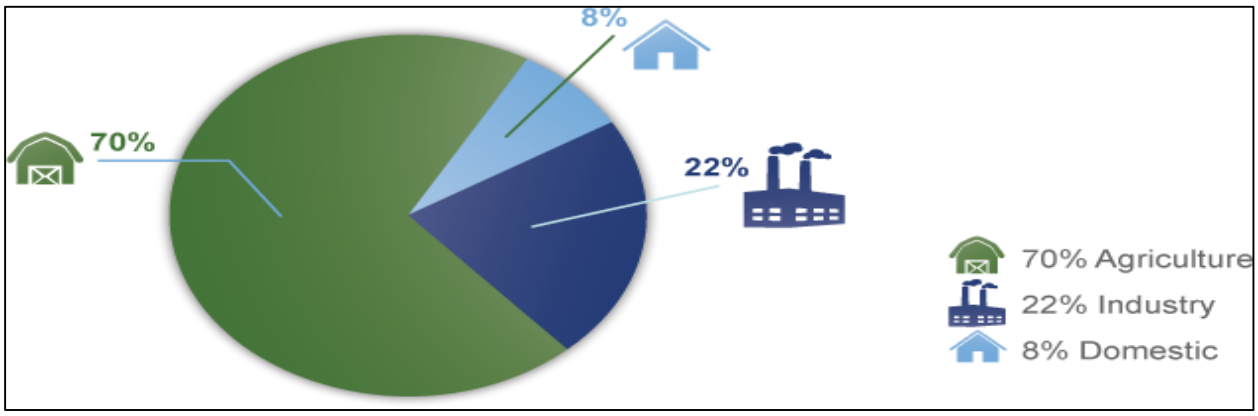


Sources: National Land & Water Resources audit; Ministry of Water Resources, China; FAO Aquastat; Eurostat Yearbook; US Geological survey.

Similarly, reduced amounts of water, or poor water quality, act as a hindrance to a firm's long-term viability and competitiveness—especially because water is such an integral element for virtually all businesses. The effects of water scarcity in the corporate realm can be felt intensely and very quickly. For instance, when the supply of water becomes scarce, unsafe, or unreliable, businesses cannot grow or sustain the same level of high operation. Subsequently, local—and potentially national—commerce deteriorates, incomes drop, and tax revenues fall. As a result, governments feel the pain and may be forced to raise taxes to make up for this loss of tax revenue—the individuals and firms of a nation feel this pain even more. From a national US perspective, this is particularly disconcerting when you figure that current estimates cite that 22 percent of GDP (gross domestic product; one of the most widely used metrics for a nation's growth) is produced in water-scarce areas, and even more unsettling is that our current trajectory points that by 2050 that number will be 45%. From a global perspective, especially in the developing regions of the world, the paucity of healthy and sufficient amounts of water and faulty water infrastructure circumscribe economic growth where it is needed the most. The severity of all of the aforementioned situations and impacts speak to a salient quote in a 2010 *Newsweek* article, where oil tycoon T. Boone Pickens said the following: "Water is the new oil. We are in the midst of a global freshwater crisis, and unless we manage our water better now, we will run out." If Mr. Pickens is correct, then all of these negative effects of water scarcity – as they relate to the economic ramifications – will become a large and painful pill that everyone has to swallow, and perhaps one of the oldest businesses in human civilization will face this daunting possibility hardest.

The farming sector is the largest consumer of water in the world; more specifically, farming accounts for roughly 70 percent of global water withdrawals. A water scarcity crisis would not only be detrimental to the cultivation of crops, but the economic ramifications to individuals, firms, governments, and nations would be just as dire. In many highly populated countries of the world, like China and India, agriculture will account for about half of all global water use in the next couple of decades. By 2030, these two countries, among numerous others, are estimated to experience a shortage of water that will not be able to keep up with this level of demand. One such source of demand is needed for the cultivation of cotton crops, which are one of the thirstiest plants on Earth. Even more disconcerting is that more than half of the global cotton crop is grown in regions with high water risk; China is the largest producer, followed by India (as per WWF International). Just think about what you are wearing right now, chances are rather high that it is made of cotton—so what do you think is going to happen when the cost to cultivate and process cotton increases? Certainly this outcome won't be welcomed warmly by anyone.

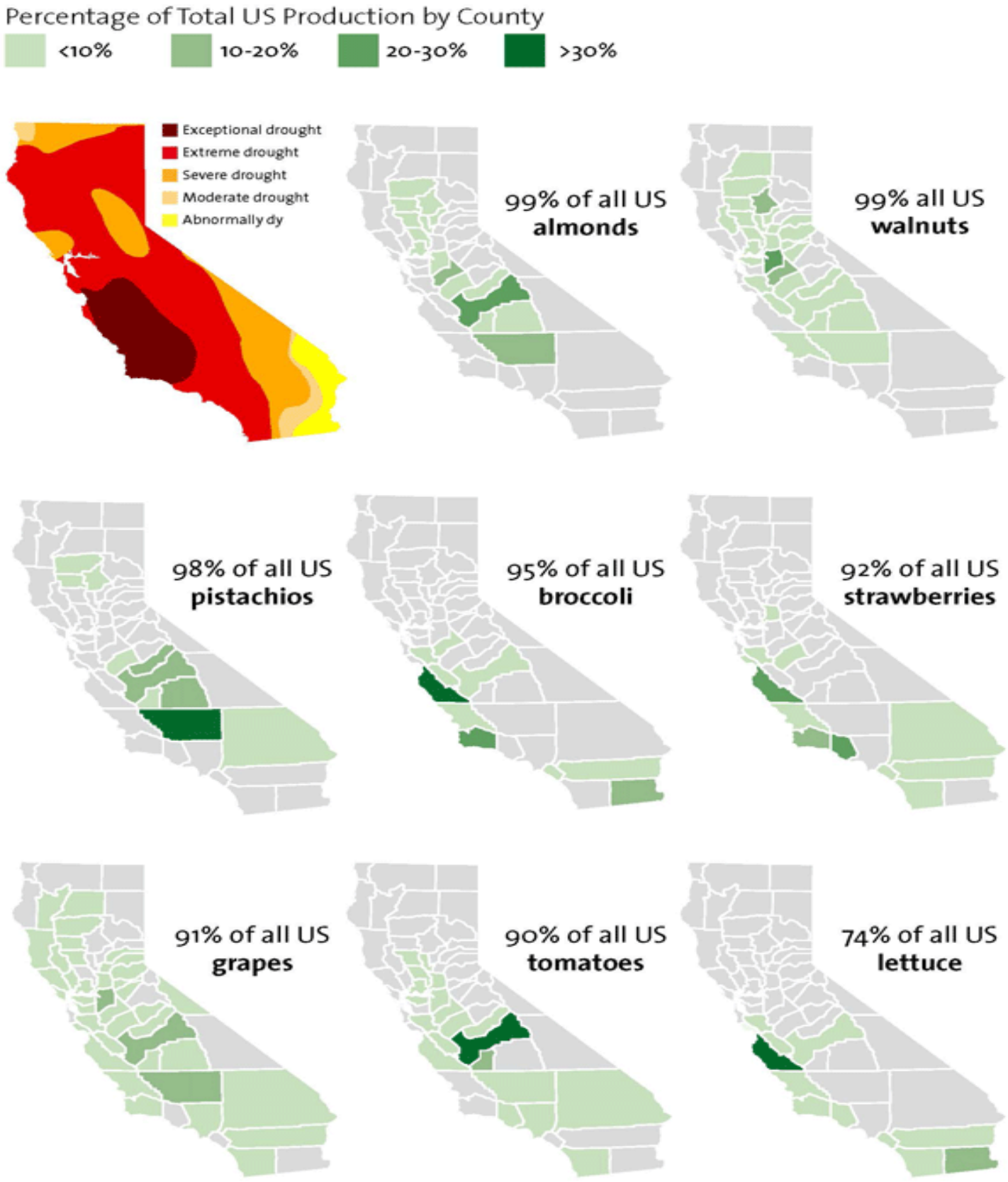
Main Sources for Global Water Demand



The agricultural sector has already begun facing water scarcity issues, especially as it relates to food; this is highlighted by the March 2014, US Department of Agriculture, *World Agricultural Supply and Demand Estimates* report, which cut its annual farm income predictions by 27 percent for this year. The major concern is the ripple effect that is plausible. For example, even though agriculture is only accounted for by roughly one percent of the US population, the entire food sector is responsible for about 16 million jobs, which is about one out of every eleven US jobs. So if crop incomes go down, land prices can stagnate, and if land prices stay the same, a farmer isn't as likely to take on as much credit. Subsequently, when there isn't as much credit being used, there aren't as many loans for tractors, seeds, and other equipment—the farm reduces the operational capacity and the amount of production. This affects the rural economy, manufacturing, and jobs—rippling all the way through. For consumers, this could lead to stable food inflation—to make up for the decrease in farmer income and or decrease in supply—where you may not see exponential increases in the prices of food tomorrow, but you may notice a more gradual increase in food prices. For farmers—and the business that service them—it means there is likely to be a reduction in income and or scale of operation, which plays a big role to the broader economy, as well as the government's tax revenue. As for global crop prices, the US is a very big driver, so if the US is a bellwether for the worlds' crop prices, then everyone around the world may feel a similar ripple effect. Water scarcity could greatly exacerbate this situation, and drastically increase the price of foods.

Take the 2013-2014 drought in California for instance; if droughts like this occur more often, because of climate change or otherwise, it seems highly likely that the decrease in production will lead to a decrease in supply, and since demand is going to, at worst stay the same, or more realistically increase a good amount, then the price of food could rise at a much higher velocity. For the US, as well abroad, this is very unsettling, especially since fertile areas like California (and many other areas around the world) have a higher propensity for water scarcity—and they are projected to be even more risky in this regard in the future. When you think about the sheer volume of production of fruits, vegetables, and nuts that California alone accounts for, the broader picture gets much, much more disturbing. For example, California is responsible for the production of: 99 percent of all US almonds and walnuts, 98 percent of all US pistachios, 95 percent of all US broccoli, 92 percent of all US strawberries, 91 percent of all US grapes, 90 percent of all US tomatoes, and 74 percent of all US lettuce (see graphic on next page). With so many different foods and crops potentially being negatively affected by a water scarcity crisis, not only could farmers, the businesses that work with them and the governments that tax them be hurt, but the people, who need them to survive, could pay the highest price of all—with their life.

California Production of Fruits, Vegetables, and Nuts



Source: California Dept. of Food & Agriculture, USDA

"The day, water, sun, moon, night – I do not have to purchase these things with money."
Plautus

Times have drastically changed since Plautus said these words pre-75 BC, and it is becoming clearer that everyone pays a price for water. For some, this price is their life, or the lives of their loved ones. For others, it is a monetary price that could be life-altering. The price—in any capacity—is connected to a slew of economic ripple effects that are associated with water scarcity; these effects could result in the hindrance of economic growth on a small and large scale. Another grave impediment in the water scarcity conversation is the infrastructural element, which can be responsible for its own host of ripple effects that drastically alter the quality, accessibility, and price of water for all. Furthermore, water scarcity related problems could arise and be exacerbated because of a critical flaw in the economic foundation of many areas of the world. Some in the world would rejoice for the chance just to purchase water—even though they may not have the adequate funds to acquire it—and others may not be cognizant of the potential burden of increased water prices that is going to impact their day-to-day lives, as well as the dwarfed economic growth and development of the nations they live in or the firms they do business with—but one thing that seems clear is that all will feel the pernicious impacts of water scarcity sooner rather than later if nothing is changed.

A looming water scarcity crisis will have rife economic ripple effects; as the global demand outstrips the supply, individuals will likely struggle to find the water they need to meet their household necessities, and firms will likely struggle to acquire the water they need to run their businesses—or, both parties will pay a substantially higher price. Even more disconcerting than the inevitable contagion effects that can impact every facet of a society, is the fact that seven of the ten most populated regions in the world are projected to face such dire water paucity over the next thirty years that they threaten to derail the economic growth of hundreds of millions of people around the globe. The value of goods and services produced in these regions—most of which are undeveloped or developing—is projected to increase more than sevenfold, to almost $16 trillion by 2050. From a growth perspective, this would increase the share of these seven countries—of the global economy—from three percent to twelve percent; helping lift hundreds of millions of people out of poverty in the process. But extremely high levels of water consumption, coupled with a scarce supply, threaten to make this feat a fantasy.

Another contributing detriment is the inefficiencies in regards to the ways in which water is collected and distributed via unsound piping and other flawed infrastructural systems. A report by Frontier Economics sheds light on this, and asserts that better access via improved infrastructural systems to safe water and sanitation, in Brazil, China, and India alone, would aggregate to an economic boon of $113 billion per year—and if such a policy was employed on a global basis, that figure would increase to $220 billion per year. It would be a very costly endeavor though; the Frontier Economics report cites that upfront capital investment costs would be astronomically high, at more than $725 billion. But it would be a prudent investment, because the infrastructure would last for approximately 35 years, yielding a return of five dollars for every one dollar initially invested. So not only could this investment help solve this facet

of a water scarcity problem, but it could also provide a return of roughly 80 percent—a win-win scenario by all accounts.

The infrastructural aspect of water scarcity is also a major economic issue in developed nations. A 2013 report by the U.S. Environmental Protection Agency (EPA) sheds light on this, and cites that $384 billion in infrastructure improvements are needed in order to continue providing safe drinking water in America. Additionally, the EPA report asserts that America's wastewater and stormwater systems are estimated to reach almost $300 billion in capital investment needs over the next two decades. So as people in developed countries, like the U.S., continue to use approximately one hundred gallons of water per person per day, this infrastructural element becomes even more unsettling. In that, current infrastructural systems in developed countries enable water to be very clean & accessible, and putting the substantial amount of investment that will be needed to maintain this level of clean accessibility to the side, water is still a resource that has negative economic issues in countries like America. A 2012 study by Circle of Blue speaks to this; over a two year period, it recorded water prices in thirty of the largest U.S. cities, and the average cost of water for a family of four for one month—that was using 50 gallons per person per day—was $26.23. If the consumption rate was changed to a more realistic variable, like 150 gallons per person per day, the cost hit an average of $83.55 per month. When these figures were compared to the same cities in 2011, the on average price increase was 7.2%—an extraordinary example came from Chicago, where the price increased 24.9%. What we can extrapolate from the two aforementioned studies, is that not only will costs be likely to increase if the infrastructural water systems do not receive a substantial capital investment for maintenance, but it appears that the most seemingly stable resource in America—and most other developed nations—is actually quite susceptible to price instability.

Aging Water Infrastructure



Economic water scarcity is a devastating element of the conversation; it occurs when a population does not have the financial wherewithal to utilize an adequate source of water or underwrite a potential remedy—like improved water distribution infrastructure or water irrigation systems. A key enabler is the fact that incomes in many areas of the world—that are affected the hardest by water scarcity—are so low that even the most rudimentary clean water remedies are not viable. In many of these indigent nations, there is no banking system in place, which results in people not saving—what little money they do have—because this is not even a thought or consideration for those in that society. With this, there is a lack of liquidity in the entire financial system of a region that has no reason, or way to save money; without savings there is no chance of investing in development. Subsequently, there is continued economic loss due to the lack of development and detrimental impact of water scarcity. The solid foundation of an economic system opens the door to investment. And an investment in research, development, and solutions are pivotal, because they can yield the results that stymie an economic water scarcity scenario. For instance, every dollar invested in water and sanitation provides an economic return of eight dollars. Similarly, investment in safe drinking water and sanitation contributes to economic growth; the World Health Organization cites that for every $1 invested, there are staggering returns of $3-$34, depending on the region and technology. But without a solid foundation to begin with, there are no funds, plans, or ideas—all of which are an absolute must for breaking this vicious cycle, which seriously threatens to keep undeveloped nations in a regressive or stagnating economic state.

When a region has cracks in their economic foundation, there is very little hope for growth and development. And since water is an essential resource and asset, we—as a global society—need to efficiently manage the supply of water that we do have. Similarly, we need to be prudent stewards over our infrastructural water systems and make investments when possible. More specifically, global leaders, especially from developed nations, need to do a better job of managing this scarce commodity and the economics that revolve around it. Make no mistake, if things continue without change, we will continue to see large disparities and instabilities of water price and accessibility. Ultimately, without hope and a solid foundation to stand on, solutions—that can alter a water scarcity crisis—are faced with consternation. Ideas, innovation, awareness, and research towards correcting a water scarcity crisis are the only ways to break the vicious cycle that exacerbates it. But the silver lining is that there are meaningful and impactful solutions that currently exist and they have the potential to put us—as a species—on the right course for growth, development, and healthy lives all across the globe.

PART V

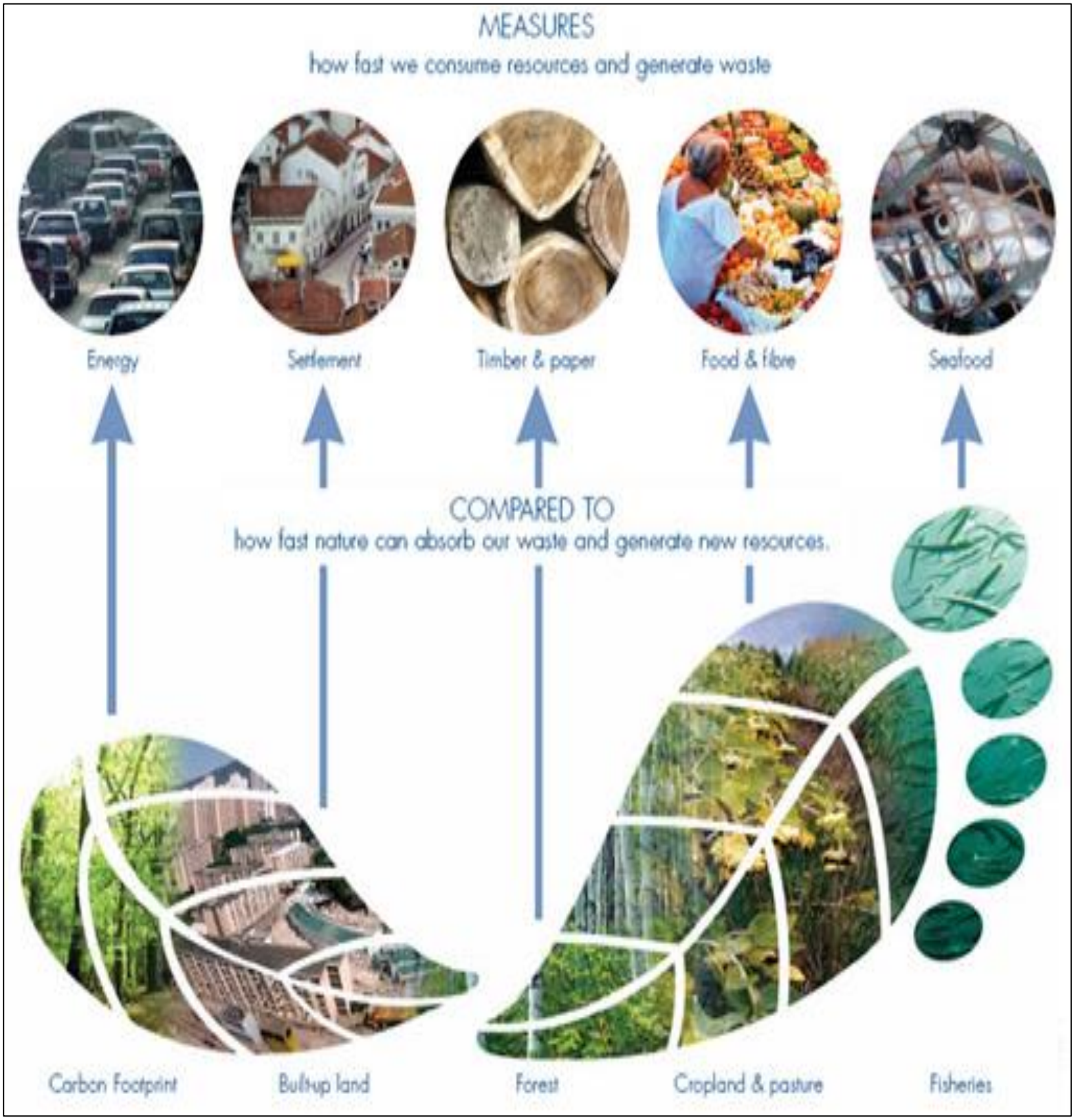
"From a small seed a mighty trunk may grow."
Aeschylus

In order for humans to run, first they must crawl, and then they must walk. When it comes to devising solutions for a water scarcity crisis, this methodology is similar. In that, corrective measures to thwart—or at the very least, slow—all of the pernicious elements that relate to water scarcity must first be employed on a small-scale basis. Only once a foundation of small-scale solutions exists, can greater strides be taken to demonstrably quell a water scarcity crisis and all of the detrimental ramifications associated with it. Perhaps most uplifting, in regards to small-scale solutions, is that they may very well aggregate to yield tremendous results; as Ancient Greek poet and playwright Aeschylus put it, "From a small seed a mighty trunk may grow." If a water scarcity crisis has any chance of being stymied, there must be a plethora of small seeds planted, that will grow many monumental trunks—metaphorically speaking.

The Tragedy of the Commons is a theory by Garret Hardin that essentially states that there will be a mass degradation to a resource because of the collaborative psyches' of many individuals. More specifically, the tragedy of the commons represents when individuals have the mentality that reflects these thought processes: "Well, if I don't pollute or waste this natural resource someone else will, so why should I bother making an effort not to abuse it," or, "the little bit of pollution or waste that I personally account for won't really make a difference." When just one person thinks this way it can potentially be true, but the problem arises when a collective group of people think this way—which is much more probable and closer to reality. When a vast array of people—or, "commons"—think their actions won't be pernicious or make a difference to the big picture, there is an aggregate result that has detrimental impacts—often resulting in tragedy. So when one person thinks that wasting or polluting water comes without negative consequence to the world, he or she may be right, but when millions of people around the globe have this same mindset we have a deadly problem. This is the first issue that must be addressed in terms of creating small-scale solutions to a potential water scarcity crisis.

The best way to remedy a tragedy of the commons scenario is to raise awareness, which will lead to the reduction of both ecological and water footprints. For further clarification, an ecological footprint gauges the amount of the environment—in terms of land, energy, water, food, etc.—that is necessary to produce the goods and services needed to support a community's, corporation's, or person's particular lifestyle (see graphic on the next page); a water footprint gauges a person, company, or community, and measures the total volume of freshwater that is used to produce the goods and services that such parties use, consume, or produce. Essentially, ecological and water footprints measure how much of the earth or water a party uses.

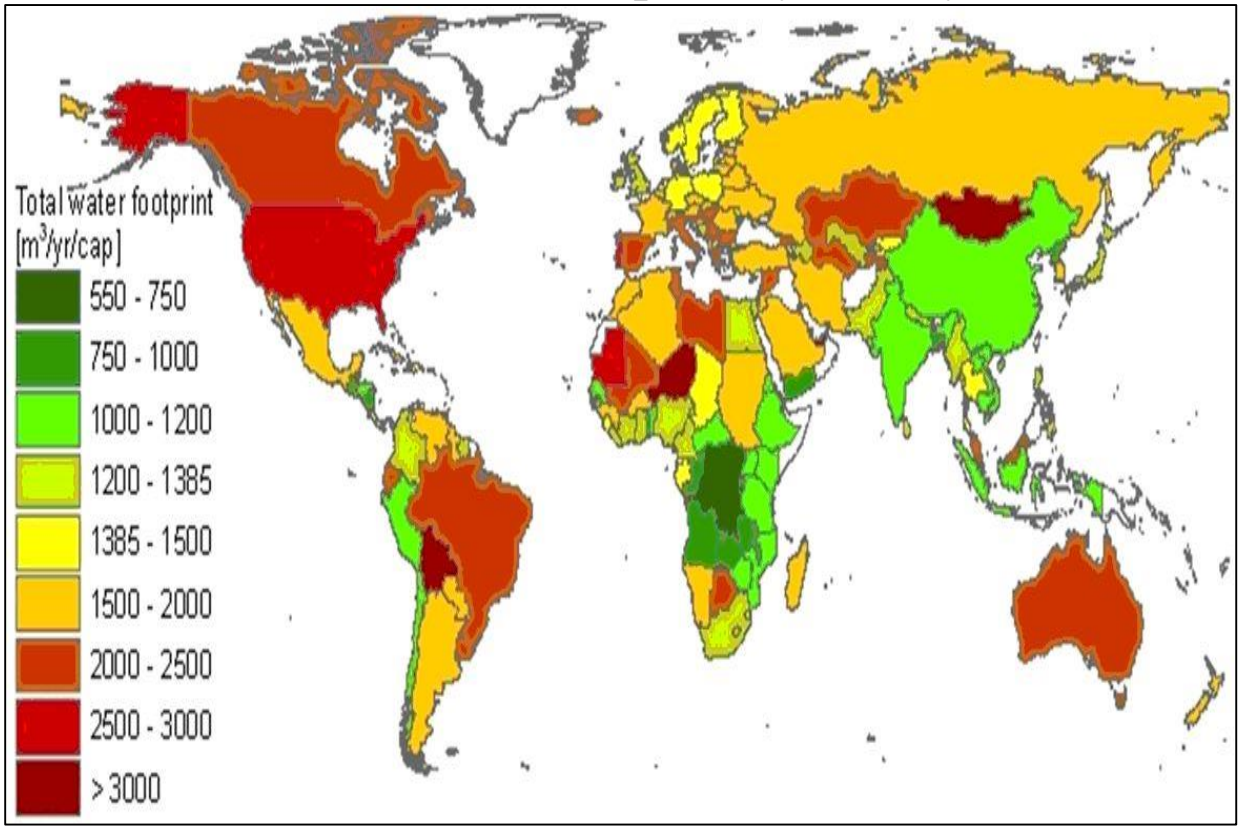
The Ecological Footprint



In order to actually reduce an ecological or water footprint, one must be informed of their starting part and how much demand (and damage) that they are personally

accounting for. Fortunately, all one needs is access to the internet and they can figure out their individual footprint based upon various footprint calculators. Once people realize exactly where their missteps are deriving from, in terms of degrading or squandering the earth's natural resources, then they can target individual plans of action that will reduce the amount of earth and water abuse that they account for, as well as a checklist of ways that they can conserve water and use it more efficiently.

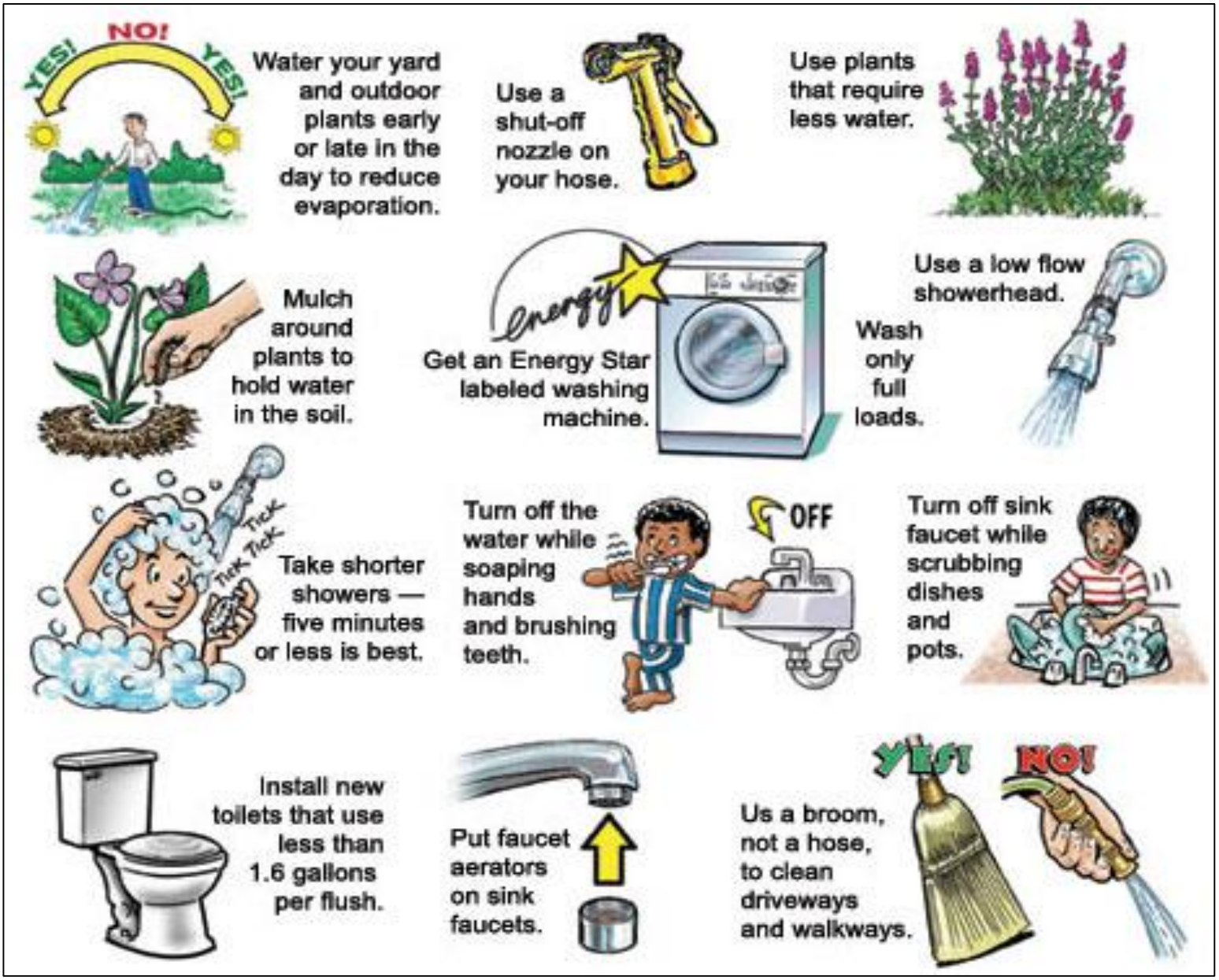
Global Water Footprint, by Country



Keep it simple stupid; this is a cliché saying, but it can be extremely effective if implemented to a myriad of scenarios—such is the case with using water more responsibly. By keeping practices simple, it enables ecofriendly habits to form easier and last longer. And what may even be construed as non-impactful water conservation habits can actually have a profound impact for people all around the world. For starters, people don't need to leave the water running while they brush their teeth—and really, people don't need to use water at all to brush their teeth. Similarly, people don't need to take showers that last for extended periods of time, or start the water minutes before they get in. Instead, a five to ten minute shower is more than a sufficient amount of time to clean oneself. Additionally, people don't need to leave the water running while they are washing dishes or doing other related kitchen activities. Furthermore, people don't need to water their gardens or lawns every day, wash their cars every weekend, or use water for other quasi-recreational home activities. All of these little steps towards water conservation (and many others just like them) might seem a bit inane, or even pointless—see the parallelism to the tragedy of commons mindset?—but in all actuality

these small-scale solutions, via individual water responsibility, aggregate to global water savings that would be astounding. Jacob Tompkins, managing director of Waterwise—an organization focused on decreasing water consumption—provides some perspective as to how much positive impact these little steps could have; he asserts, "A [typical] tap runs at six liters (1.6 gallons) a minute – if people brush their teeth for two minutes, twice a day, that's 24 liters (6.3 gallons) that goes down the sink. If everyone cut two minutes off their shower time, in one day they would save enough water to fill 373 Olympic swimming pools." That's approximately 234,990,000 gallons of water saved in one day, if people just reduce the amount of their shower time by two minutes. Additionally, brushing one's teeth with the tap on uses six liters of water per minute, whereas brushing one's teeth with the tap off uses roughly one liter. Such small, seemingly silly steps don't seem as insignificant now, do they?

Small **Steps Towards Water Conservation**

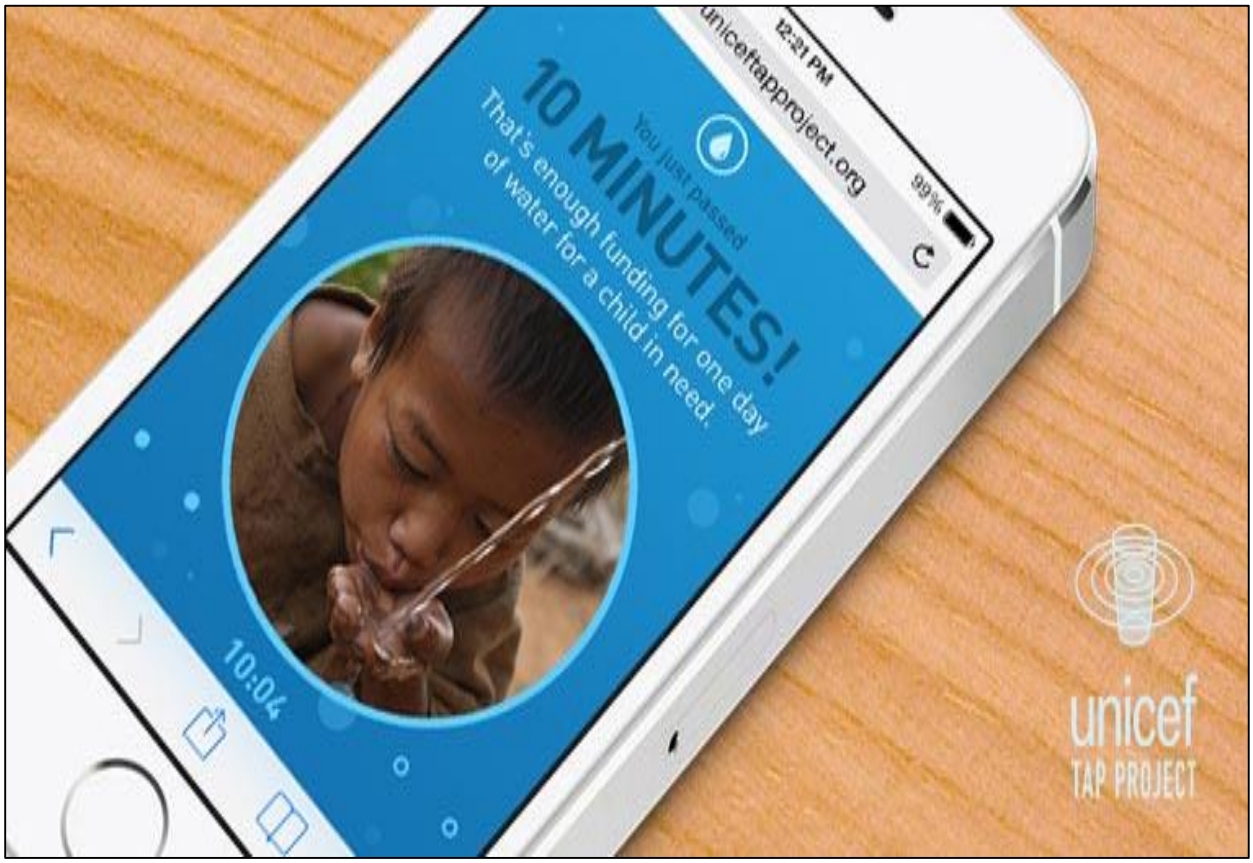


plastic to name a few. If everyone disposed of their trash in a responsible, environmentally friendly ways, there would be a drastic reduction to the amount of contamination that the ecosystems around the world face—contamination that has a very high probability of ending up in a freshwater supply. Additionally, water pollution is connected to sources of travel. Take driving an automobile for instance, the carbon dioxide a car emits goes into the atmosphere and could potentially end up coming back to the groundwater by way of acid rain (a form of rain that contains many pernicious elements, caused by greenhouse gasses and the like entering the earth's atmosphere). So instead of taking a car for quick trips, it would be more prudent to ride a bicycle or walk, and for longer trips, there are now a plethora of completely electric or hybrid automobiles that are far more ecofriendly than the historical, gas burning combustion engines cars have. Also, if individuals curb the amount of products that they use that have toxic chemicals or other potentially dangerous substances in their composition—or require a lot of toxic chemicals for their production—there could be a massive reduction of pollution to water systems. If more people took just some simple steps like the previously mentioned ones, and took responsibility for their individual pollution contribution, the greater good of the world would reap great benefits.

When people come together and work for the greater good of humanity, epic results can follow. The first step in this regard comes via education and raising awareness. To alter pollution, consumption, and behavioral habits, there has to be a motivating factor, and one of the purest and most successful ways of motivating people is by educating them. By facing an issue head-on and raising people's awareness of it, you can hopefully catch their attention. Then, influence the way they think about. And by getting people to think about a problem, there is a good likelihood that some will begin to develop ideas or solutions that will correct the problem and change the face of a potentially devastating situation—like a water scarcity crisis. Congruously, a culmination of forward thinking ideas and solutions can lead towards community projects. When people that are educated on a situation establish common goals, inspired by a burning desire to achieve results, there is nothing that can impede their progress. So if more people around the world were educated about the potential calamity that exists because of a water scarcity crisis, as well as some of the more nuanced aspects surrounding the water scarcity conversation, then more people could ban together and work with one another to devise actionable steps towards reaching globally ubiquitous goals. If this were to happen, quite simply, it would be a game-changer that could completely alter the varying roots of a water scarcity crisis. Similarly, if awareness is raised about a water scarcity crisis, then people can come together with volunteer or donation campaigns.

The remarkable aspect in regards to volunteering and donations is that a little goes along way. For instance, a twenty dollar donation could give a child clean, safe drinking water for twenty years. Imagine how many children would be able to have clean drinking water if everyone you knew donated just twenty dollars, just once—the results could be awe-inspiring. Just as meaningful is when people volunteer and donate their time towards a cause that helps people and helps to raise awareness, so that others can do their part to help. This speaks to an uplifting solution called the UNICEF Tap Project, which is a national campaign that provides clean water and adequate sanitation to children around the world. In addition to the traditional monetary donations that

many community projects and special interests groups offer, UNICEF has taken a unique and technologically innovative approach to raising awareness. More specifically, UNICEF has created a mobile Web app that raises money for water scarcity by challenging people to put their phone down; for every ten minutes you leave your phone alone, the project's sponsors will fund a day of clean water for indigent children worldwide. It's a brilliant campaign that raises awareness to the fact that millions of people don't have the luxury of having access clean water or sanitation, and UNICEF helps put things in perspective by asking: "How long can you go without something far less vital…like your phone?" Subsequently, awareness is raised and a foundation of education exists—targeted towards a younger demographic—that can truly alter the trajectory of a water scarcity crisis once and for all.



Ultimately, environmentally responsible, small-scale steps being taken in the right direction aggregate to far more hope developing. Hope for solutions that could terminate a water scarcity crisis. And in the process of progressive growth—on a crawl first then walk basis—we are steps closer to the more profound, large-scale solutions that are equally as important. But these large strides can only be achieved once the small seeds are planted and begin to grow.

"Challenges are what make life interesting; overcoming them is what makes life meaningful."

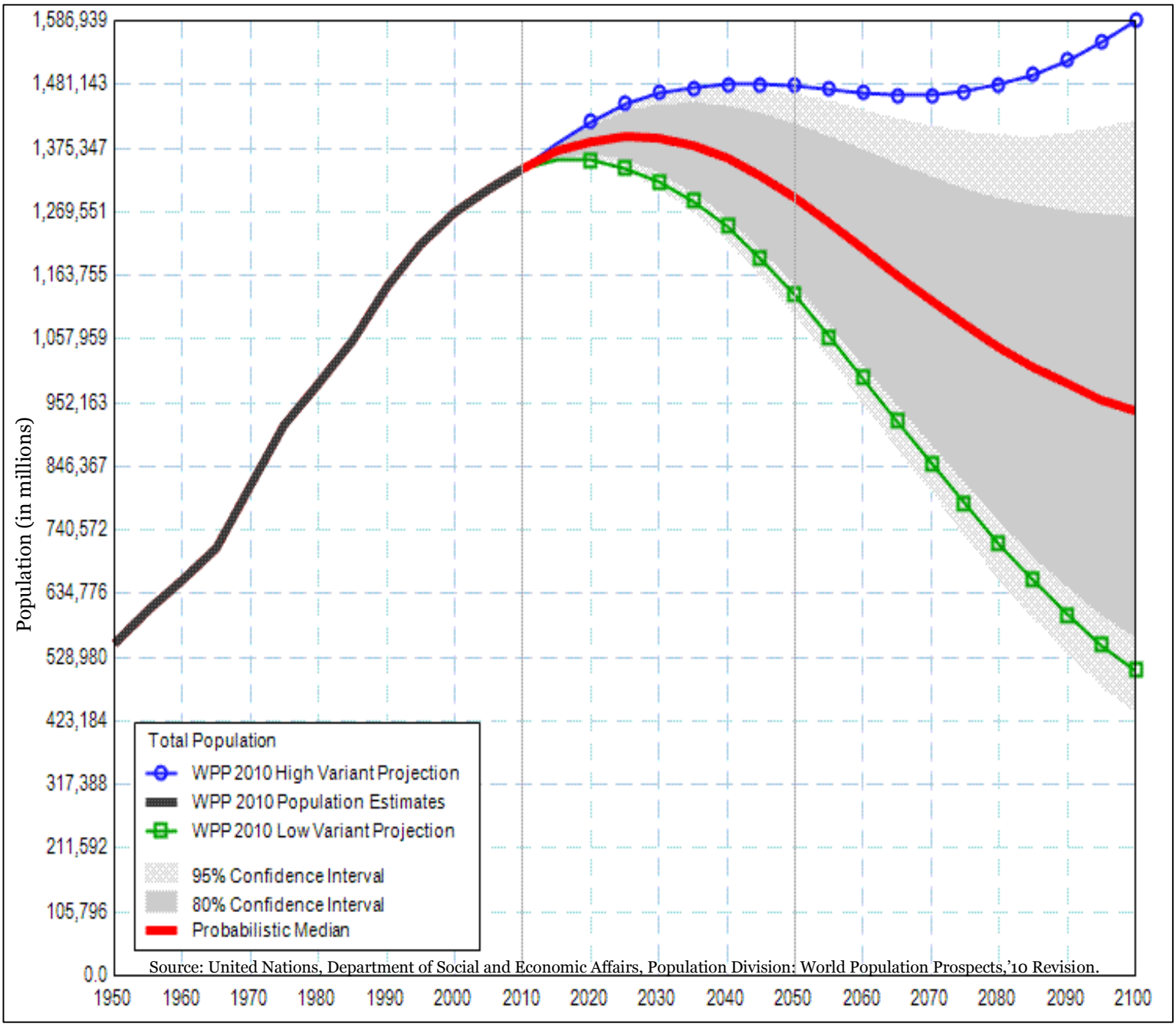
Ralph Waldo Emerson

I wholeheartedly agree with Ralph Waldo Emerson's previously mentioned quote. And if challenges are, not only what make life interesting, but more importantly, what make life meaningful, then we—as a global society—have a tremendous challenge that will make life equally as interesting as it does meaningful. Even more encouraging is the fact that there are a vast array of large-scale solutions that could completely correct a potential water scarcity crisis. Some solutions require more effort and will than others, but make no mistake, the ideas to halt a water scarcity crisis exist. In some instances, the ideas and solutions are a bit more unconventional, but with the potentially devastating effects—both socially and economically—that a water scarcity crisis could have, any solution is a welcomed one. Ultimately, a potential water scarcity crisis could be an extraordinarily detrimental scenario, and this is why it is even more crucial to develop intensive and original ideas and solutions—as Albert Einstein once said, "We cannot solve problems by using the same kind of thinking we used when we created them."

A major problem surrounding a water scarcity crisis is the ever-growing human population; fortunately, this is an issue that can be corrected. It is my view that nations of the world can learn a great deal from China's one child policy. China is currently the most populated nation in the world—with around 1.3 billion people—and their one child policy has greatly benefited the exponential human growth occurring there. In that, they will have a peak population in 2025, and by 2050 they will already be experiencing a decline in their population. This is encouraging news, especially since it is the most indigent nations of the world that will be expanding their human population the most over the next several decades. To this point, the United Nations, World Population Prospects report, cites that almost all of the human population growth—roughly 7 billion to 10 billion people worldwide—over the next 40 years and beyond will be in the poorest countries of the world. This is why it is even more imperative to address this population issue, since it is the poorest countries of the world that are affected the hardest by water scarcity. A one child policy, implemented by governments throughout the world, would give incentives to those who adhere to the stipulation, as well as penalties for those who break the law. In addition to a one child governmental policy, the human population issue can be addressed by better socioeconomic development and family planning programs. If men and women had better education about family planning, as well as better healthcare systems and access to contraception, then there would be a significant reduction in the amount of births. Subsequently, this would be a solution at the very genesis of the problem—reducing the amount of the global human population, therefore reducing the amount of freshwater demand. Ultimately, one child government policies and enhanced education, in regards to socioeconomic development and family planning

programs, will aggregate to great strides forward towards solving one of the key areas of a water scarcity crisis.

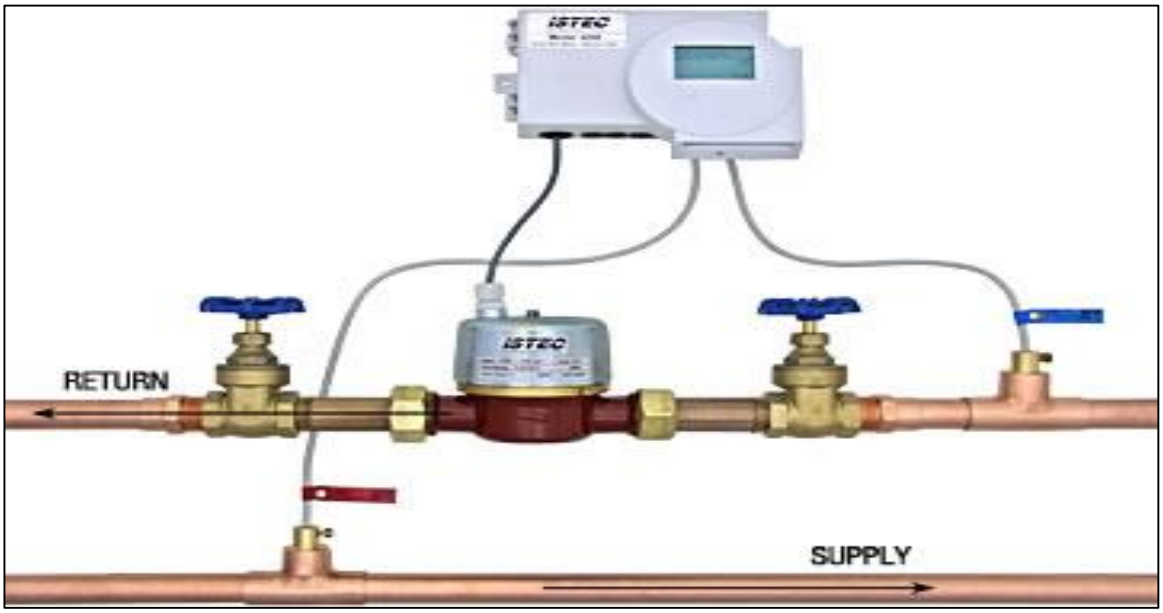
Projected Population Effects of China's One-Child Policy



Another large-scale solution, by way of government leadership and intervention, is to employ the metering of water systems—with increased prices and penalties

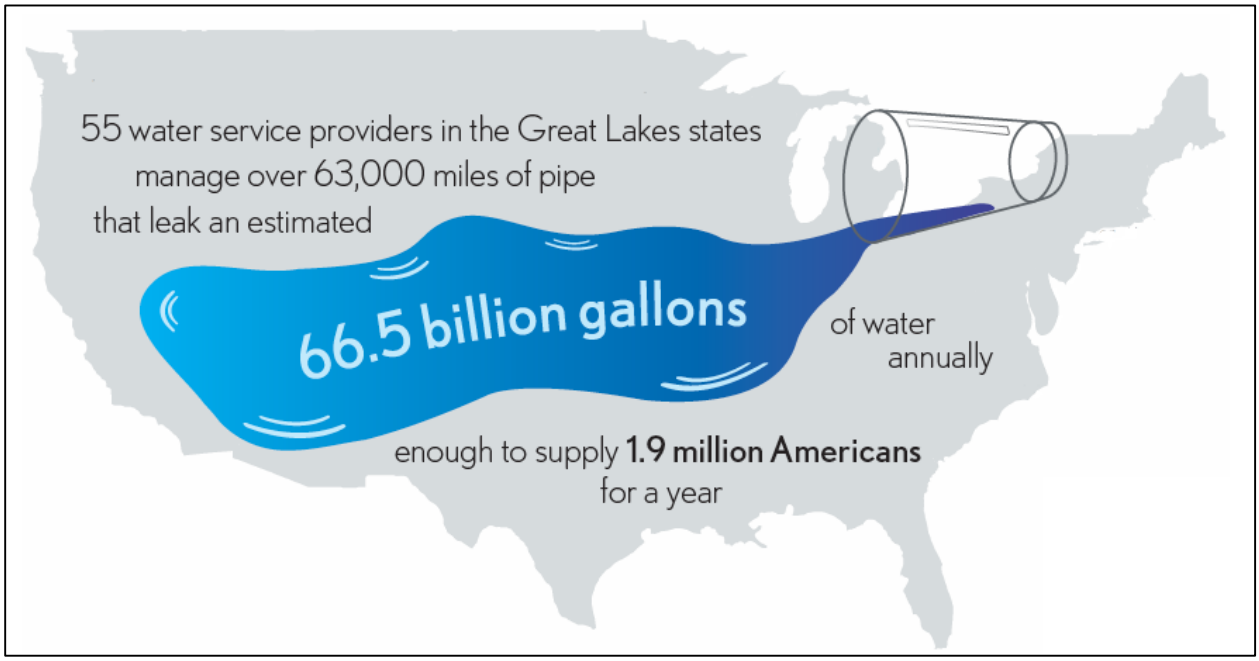
involved for higher than stipulated water usage. According to many experts, using meters to monitor exactly how much water people or companies are using promises to reduce the rate of use. Advocates say that metering is the most equitable way to charge for water—on the basis of how much one uses—and assert that people need to be held accountable for the amount that they use. I could not agree more. A UK study has shown that homes with water meters use 10-15 percent less, on average, than those without them. I think it is a great idea to raise the level of vigilance, as well as accountability, in terms of water usage. And I think it is an even better idea to charge people higher prices based upon the amount of water they use. However, not everyone feels this way; Christopher Spray, chair of water science and policy at the UNESCO Center, says that charging people by usage doesn't always have the intended effect. In that, you may encounter some people who say, "well, I'm paying for this, and I've got a lot of money so I'm going to use exactly as much as I want." A report by Deloitte, titled Water Tight 2012, asserts that increasing water prices is going to be a difficult political decision, since water usage is virtually always considered a basic human right. And I agree that it will not be an easy implementation of policy, especially initially, but the long-run benefits that can come via this water metering and pricing system will be far too tremendous to eschew.

Prototypical Water Metering System



Similarly, it is essential that governments develop and enact better policies and regulations in regards to water scarcity. This is especially important in the corporate world, where rampant pollution and abuse of water is rife. If governments actually had laws in place, that would heavily fine or castigate companies—or even people—for abusing water, I would have to think the amount of destruction to water would decrease

substantially. So creating these types of laws, that are void of any loopholes, could be a tremendous solution to solving the corporate malfeasance surrounding water scarcity. To this point, even making sure that companies fix and maintain potential leaky pipes or chemical systems—which could result in a chemical spill of some sort or a squandering of water—would be a gigantic step in the right direction. Studies show that millions of gallons of water are lost every day through faulty pipes; in 2009-2010 alone, the water piping systems in England and Wales leaked over three billion liters of water per day. Christopher Spray, of the UNESCO Center, says that there are some companies that lose up to 40% of their final product because of leaking pipes. So if governments across the globe devised policies that would increase the maintenance of piping systems and the operations that are connected to chemical leaks or accidents, then not only would companies benefit in economic terms, but the water scarcity situation would be helped a great deal from this.

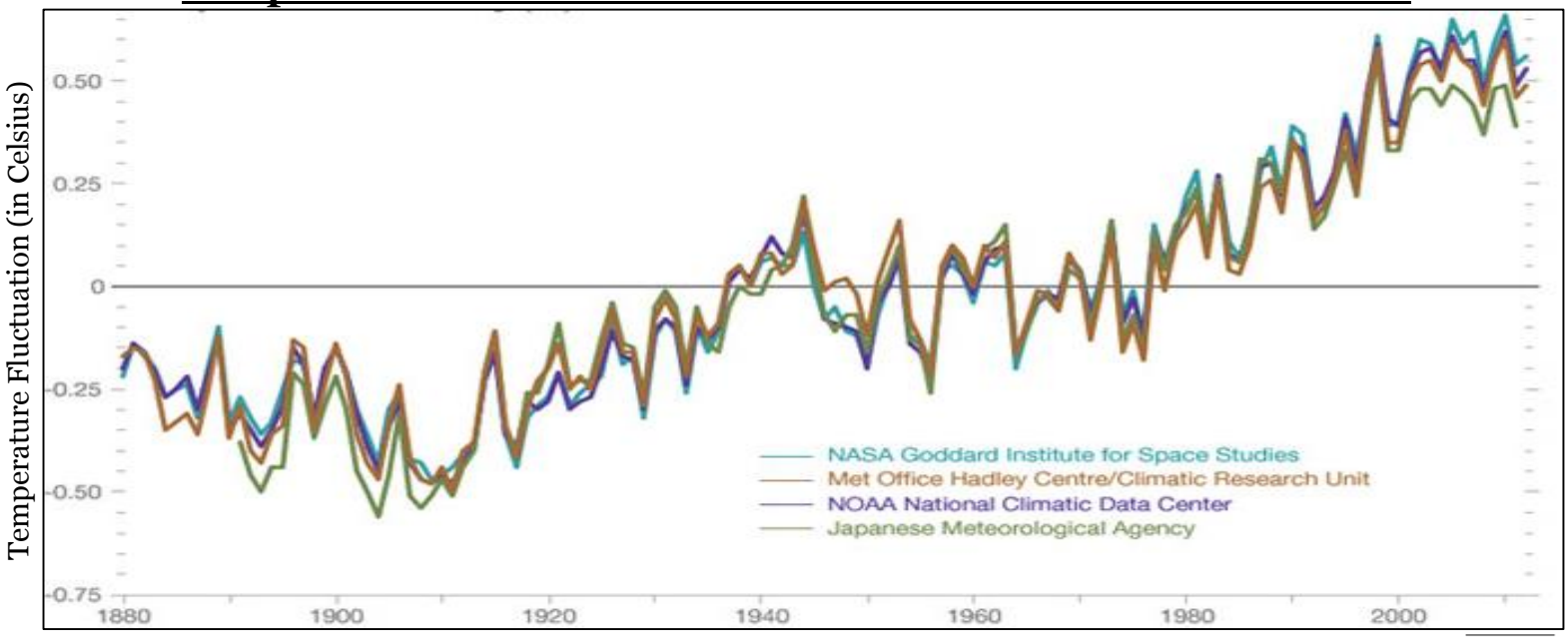


Additionally, the U.S. government is considering expanding the Clean Water Act—a bill that strengthens federal protection of water—to ensure even more protections than the initial 1972 piece of legislation provided. This is the exact type of step that needs to be taken if we want to stymie the corporate irresponsibility that surrounds a water scarcity situation, because reducing corporate water footprints and pollution is essential—especially since industrial water use accounts for approximately 22 percent of global consumption. Another example of a large-scale government solution is happening in Jordan, where building codes have been changed to require waste-water recycling to be incorporated into new construction. Similarly, in Morocco, government subsidies for efficient drip-irrigation technologies are also used as a lever to encourage

farmers to grow crops that make better use of scarce water. These are just a few examples of the ever-important ideas and solutions that must be implemented by governments around the world so that a water scarcity crisis does not become a reality. A Globe Scan Water Views survey, via the Circle of Blue, indicates that most people around the world say that it is up to the governments to ensure that people have access to clean water. This survey highlights the importance that is needed from government leadership to create laws and regulations that will reduce the amount of water waste and pollution that occurs throughout the world, and to also make people pay their fair share for the amount of water they use. One thing that is clear is that enhanced government policies and regulations are an absolute must in terms of solving a water scarcity crisis.

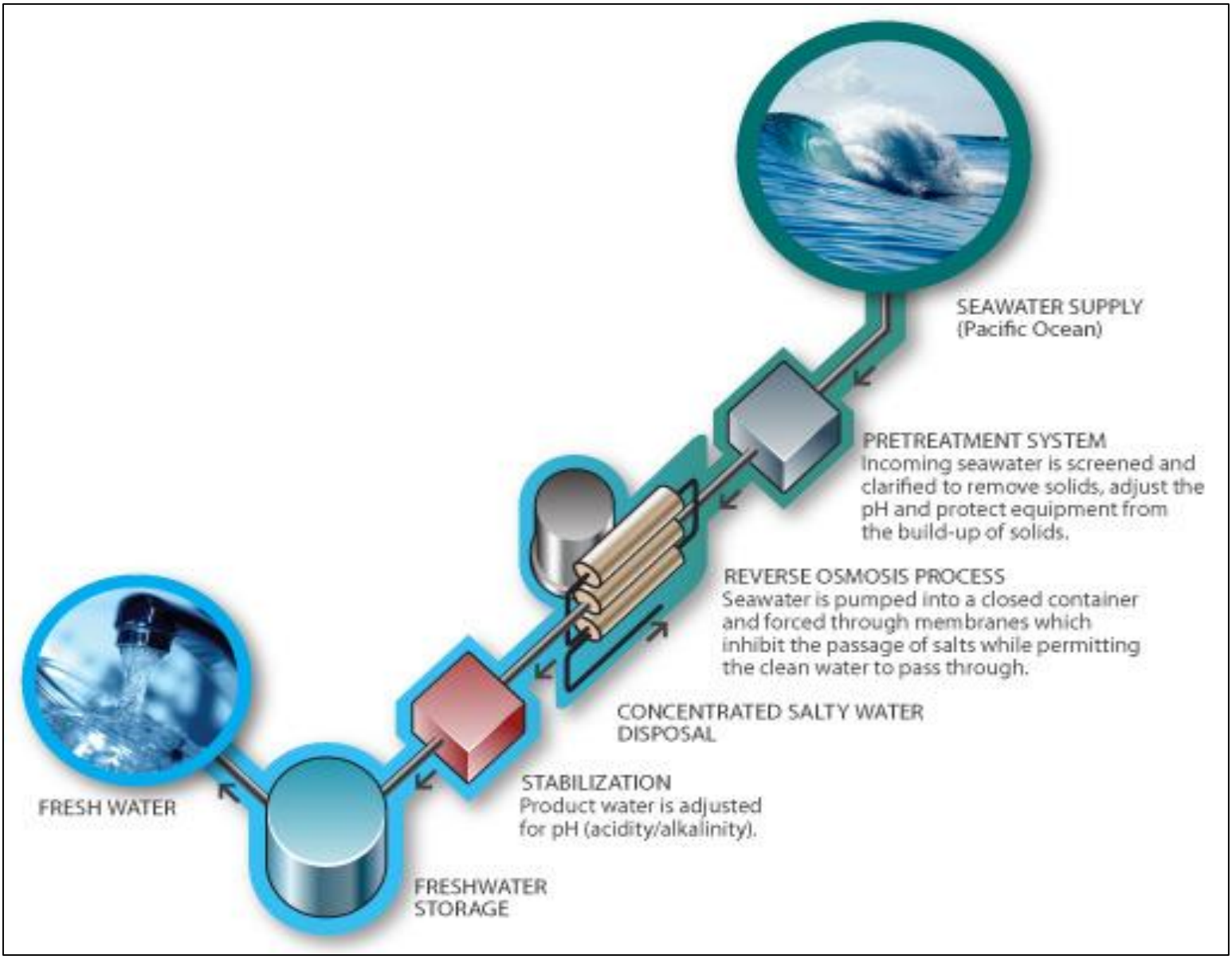
Another large-scale solution that needs to be addressed by governments around the world is climate change mitigation. Climate change and water scarcity are intertwined and result in some of the biggest challenges to the human species. The Intergovernmental Panel on Climate Change (IPCC) asserts that water management policies and other corrective measures can have an influence on greenhouse gas emission (one of the key culprits to climate change). So if we can emit less greenhouse gasses, by burning less fossil fuels and having more of a reliance on nonrenewable forms of energy—like solar, wind, bio-energy, and hydropower—then we can correct the potentially devastating climate change patterns that are already being noticed. This is pivotal, because climate change, if not addressed, could raise sea levels and make storms and droughts more severe—the results of which would be a major detriment to a water scarcity crisis. Governments and coalitions around the world must come together in harmony, rely on the 97 percent of scientists across the world that say that climate change is a serious threat, and take action to reduce the amount of pernicious toxins we emit, and invest in nonrenewable energy sources. If this happens, this will be another great leap forward in the water scarcity mitigation.

Temperature Data From Four International Science Institutions



wastewater, while reducing the water they import—thus becoming more self-sufficient in the process. They are still in the early stages of this technology, but if it proves to be successful, this system could be a paragon for the rest of the world to follow and reap the phenomenal benefits that recycling wastewater presents. Adrian McDonald, professor of environmental management at the University of Leeds agrees that there is merit to this idea, and it is scientifically feasible to treat wastewater so that it is safe for human use. But he does mention that it is quite expensive to treat dirty water, especially due to energy price fluctuations, so clearly this idea needs more development—but the foundation of this idea is there, and it is bright. Similarly, converting salt water to freshwater (desalination), at first thought seems like another very bright and promising solution—and in my view, it is.

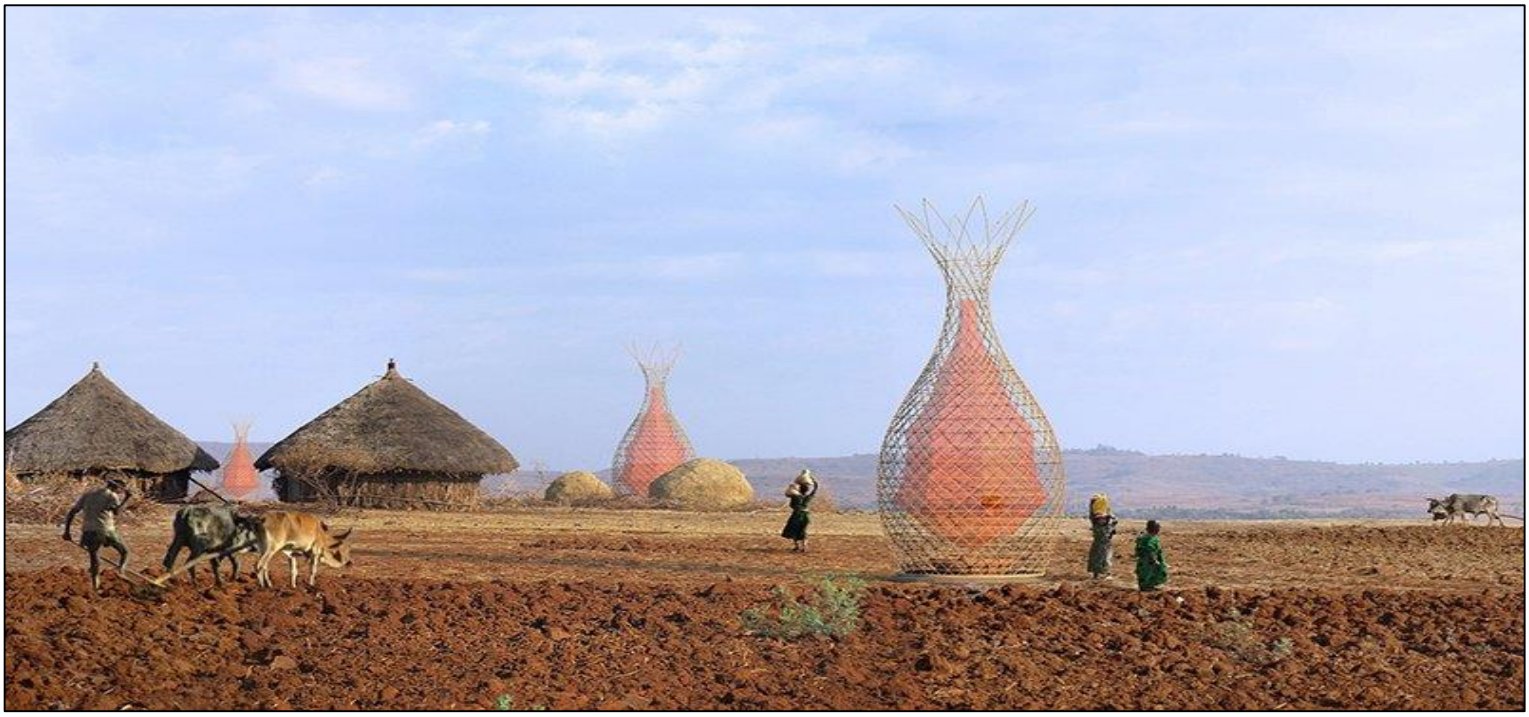
Desalination Process



of those limitations are valid, but I also think that desalination could potentially be a game-changer in the water scarcity conversation, and for that reason alone there should be action taken to overcome any current hurdles. At the very least I think desalination should be researched further so it can become a more cost-effective, ecofriendly, and viable option.

Technological innovation, by way of research and development, are a material element to coming up with large-scale solutions for a water scarcity crisis. One form of innovation that has already been fruitful is water filters and tanks. Impact Nations have already created such a device, called the Sawyer Water Filter. It uses a rain collection system with a filter on the end of their tanks, which end up providing clean water for entire communities. In areas where rainfall is adequate, the 10,000 liter Sawyer tanks are a cost-effective savior to a plethora of people—the Sawyer Water Filter costs roughly $65 and provides continuous clean water for at least three families. This isn't mind-numbing technology, but it is incredibly efficient and viable, and the only reason it exists is because people took the time to invest in ideas that could help those being affected hardest by water scarcity. Another fruit of research and development could actually be mistaken for a piece of art. A device from Architecture and Vision—a company that revolves around art and architecture, with an emphasis on developing ecological and economic solutions for our planet—called the Warka Water, can pull water out of the air; up to 25 gallons per day, to be specific.

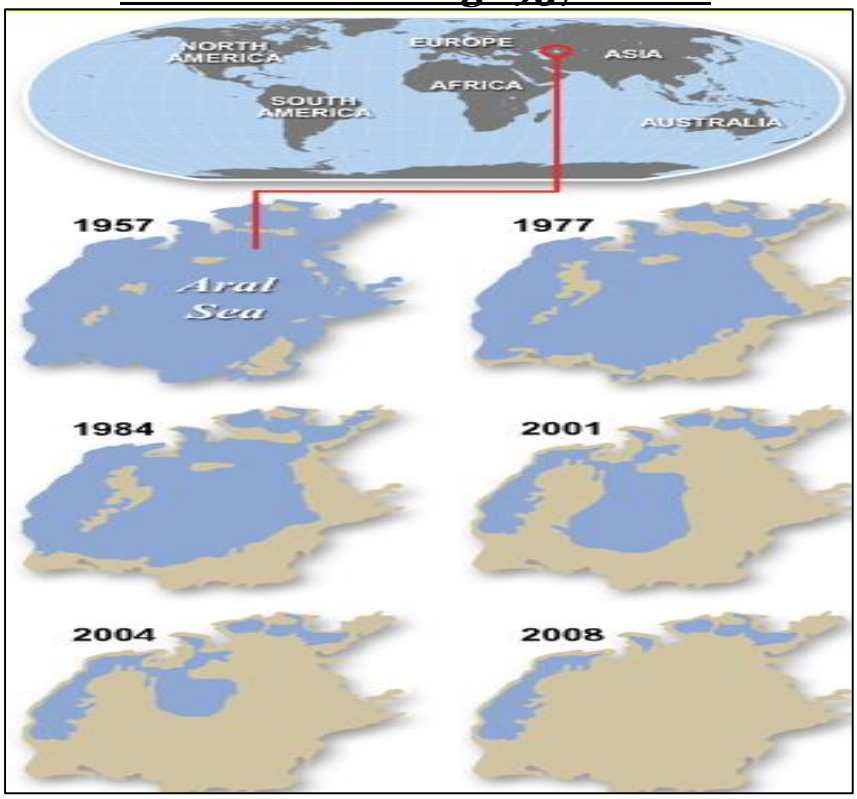
Warka Water Towers



The 30-foot gourd shaped tower works anywhere, even in deserts, and cost roughly $500 - $700 to make—so it also makes great economic sense. The Warka Water is biodegradable and can be built, without complex tools, in less than a week—the key materials are bamboo and mesh. In an interview with Smithsonian, Architecture and Vision director, Arturo Vittori, has stated, "Once locals have the necessary know-how, they will be able to teach other village communities to build the Warka." Vittori went on to say, "We can say a Warka could provide drinking water for a small rural community of 40 inhabitants." The process itself is fairly straightforward: Inside the exoskeleton is a mesh net that is designed to attract water condensation, and once this happens, the drops of water make their way down the mesh walls to a container at the bottom—essentially creating water from thin air. Vittori hopes that each Warka will last four to eight years with regular maintenance. They are still in the testing phase, but this is an extremely promising form of innovation that has the potential to provide water for those in the areas being hit the hardest by water scarcity. Innovations like this, founded on research and development, with the greater good of humanity in mind, are the types of steps needed to cease a water scarcity crisis.

Solutions are an absolute must in terms of improving irrigation and agricultural practices—this is the case because roughly 70 percent of the world's freshwater is used for agricultural related purposes. Improving irrigation systems, specifically used in the farming industry, can help to close supply and demand discrepancies. In some instances, profligate irrigation practices—with old technology—have weakened the capacity of farmers to provide food to the constantly growing human population, and have depleted natural water sources in the process. Examples of this are occurring at the Murray-Darling basin in Australia, Central Asia's Aral Sea, and the Southwestern United States.

Aral Sea Shrinking 1957 - 2008



New technology is a welcomed and appealing solution to the damaging effects that excessive or improper farm irrigation systems can have on water. The beauty is that more efficient and environmentally friendly irrigation systems are already available. And perhaps an even more sanguine notion comes from global water expert Peter Gleick; he asserts that in some cases, success stories can happen just by improving the irrigation and farming systems that are already in place. This is very encouraging news, especially when you consider how much of the world's freshwater is used for agricultural practices.

Personally, I think some of the greatest solutions could derive from out of the world ideas—literally. What I mean by that is that the earth is just a tiny spec in the greater scheme of things—there are mind-boggling amounts of space in our universe and solar system, and this could present an extraordinary opportunity for resources. We could potentially obtain resources from other planets or asteroids, which are a realistic and plausible distance away via space travel. By acquiring such resources we could create new opportunities in terms of our energy sources, which could ultimately benefit the water scarcity situation a great deal by reducing our dependence on nonrenewable forms of energy. Additionally, we could also find water, or chemical forms that could lead to water. This discovery of water or the ability to create water, on planets or asteroids in outer-space, could be one of the most beneficial sources for us, because, at least in theory, there could be an infinite supply from all of the myriad planets and asteroids that exist within a reasonable distance from Earth.

Eric Anderson, entrepreneur and aerospace engineer, is already taking great strides forward in outer-space exploration. He is the co-founder and co-chairman of Planetary Resources, a company that does many marvelous things, but one of the most recent ventures is a mining mission on what is called Near-Earth asteroids—objects that are in a near-Earth orbit and feasible to travel to. Asteroids contain valuable and useful materials like iron, nickel, water, and rare platinum group metals, often in significantly higher concentration that found in mines on Earth (see graphics on the next page from the Planetary Resources website). Anderson is confident that these asteroid mining expeditions will produce a tremendous amount of resources that could help humans in very significant ways; he says a five to ten billion dollar initial investment could aggregate to a $500 billion return. The good news is that they have an incredible amount of financing and partnerships—like with Larry Page, James Cameron, Richard Branson, Elon Musk, Eric Schmidt, and many other titans of industry with very deep pockets. This outer-space mining project will be taking initial test runs in October 2014, and I think it is one of the most unique, yet exciting ideas that could not only correct our energy issues, but also a potential water scarcity crisis.

High Value Asteroid Materials

ASTEROID ELEMENTAL ABUNDANCE RELATIVE TO EARTH'S CRUST

- **H** Hydrogen — 17x
- **C** Carbon — 75x
- **N** Nitrogen — 74x
- **O** Oxygen — 1x
- **Fe** Iron — 4x
- **Co** Cobalt — 27x
- **Ni** Nickel — 155x
- **Ru** Ruthenium — 810x
- **Rh** Rhodium — 180x
- **Pd** Palladium — 44x
- **Os** Osmium — 440x
- **Ir** Iridium — 540x
- **Pt** Platinum — 196x

VOLATILES AND H_2O

to fuel the growth of humanity into new frontiers

Potable Water Radiation Shielding · Fuel · Refrigerant · Agriculture Metallurgy

INDUSTRIAL METALS

to construct and sustainably service space platforms

PLATINUM GROUP METALS

to support demand growth on Earth

Catalytic Converters · LCDs · Advanced materials · Cancer treatments

Despite desire to reduce dependency, one-in-four manufactured goods require PGMs.

PLANETARY RESOURCES

MORE ASTEROIDS DISCOVERED NEAR EARTH EVERYDAY

- 1,500 — EASIER TO REACH THAN MOON
- 8,800 — DISCOVERED TO DATE
- 1000+ — NEARLY 1K+ FOUND EVERY YEAR

NEAR-INFINITE SUPPLY OF PRECIOUS RESOURCES

WATER-RICH ASTEROID

One water-rich asteroid could produce **enough fuel for every rocket launched in history.**

USES OF WATER IN SPACE

- ROCKET **FUEL**
- BREATHABLE **AIR**
- DRINKABLE **WATER**

ONE SINGLE 500M water-rich asteroid

$ 5 trillion — would produce over $5 trillion worth of water for use in space.

It currently costs **$20,000** to send a liter of water from Earth to Deep Space

Ultimately, changing the current water scarcity trajectory involves education that will motivate new behaviors, as well as building international frameworks that are reliant upon institutional and governmental cooperation. If people receive education on altering their consumption rates, pollution rates, and their lifestyles as a whole, then meaningful results would follow. When people are informed of the severity of a potential water scarcity crisis, and educated about the ways that they can prevent it, as well as the ways they can change their overall lifestyle to one that is still comfortable, but ecofriendly, too, then this alone could be the only step needed in stopping a water scarcity crisis. The reason being is because once people across the world are motivated by new behaviors, with a focus on a more environmentally friendly way of living, there is no stopping the intellectual power of the human species. As a result, we may even be able to bridge the gaps across the world, building international accords that work towards correcting water scarcity. If achieved, we could begin to see water projects in developing countries, and a transfer of technology, as well as human and economic capital being dispersed from the wealthiest nations to the neediest. But in order for any of this to happen, people need to learn the perils and possibilities that surround water scarcity, and then they must come together as individuals, corporations, governments, and nations, to cohesively and harmoniously solve what could be one of the gravest problems mankind has ever faced.

I recently had the chance to sit down with Dr. Roberts, professor of science at NYU. We spoke about many of the key areas surrounding the water scarcity conversation. He provided an authoritative perspective, replete with information, reviewing some important topics that have already been covered in this paper thus far; he has also provided numerous new pearls of wisdom that offer an enlightening view on water scarcity. As follows is the breakdown from our conversation (I'm asking the questions, Dr. Roberts is answering):

Q: What do you think is the major cause of a water scarcity problem?

A: Quantity, the amount of water there is; quality, which is the pollution problem; location, where the water is. One of the major global problems is the fact that some countries—especially Canada—has only one or two percent of the world's human population—even less than that, perhaps .5 percent of the human population. But Canadians have something like 20 to 25 percent of the world's freshwater supply. While countries like Africa and those in the Middle East have so little water; China has so little water in comparison to the amount of population. So, even though there is water, it's in the wrong places. And of course the oceans are salt water, which could be mentioned under the pollution discussion, in that desalinization is so expensive and energy inefficient at the moment, so if you have more energy input than you benefit from, it is a net loss—this is another big problem that exists. There is also the explosion of

pollution from water bottles accumulating in various spots of the ocean or waterways—and they don't dissolve naturally so it can be devastating to animals and biodiversity from the chemicals they can emit. There is also the problem of privatization of water; some countries thought one of the ways of dealing with an insufficient water supply is by privatizing the water, where some company would take over the water supply. And the moment you privatize it there is a cost that is associated. They try to make it very cheap, like five cents for several gallons, but even that, for a very poor person, the small cost is a big part of their budget. So this has resulted in a huge problem for the poorest of the poor not having access to water. So that's another dimension to this, and there have been very good demonstrations, almost civil war kind of things in certain countries just trying to get the water. Of course there are related problems of border states and countries that are adjacent to each other, where they share water because of linking and connecting rivers and water systems, so water goes beyond national boundaries, so that's another dimension of the problem. Still another major issue is the climate change related issues. You know, it's still early in terms of the climate change studies, but I think one of the big concerns in the future is the implications of climate change. What does climate change do to certain countries, including a variety of relating factors? Like if sea levels rise then certain areas could well go under water, and that kind of thing would be a water related problem, because if certain areas go under water then the population living there has to move to other areas. So the climate change would be one. The other related problem would be population growth; the global population is expected to be at about 10 billion by the year 2050, building that in, the demand for water significantly increases. Almost the entire growth of the population will be in the poorest countries of the world, so along with the resource demands like food, housing, and so on, it's also the water equation. And many of these countries have very little water, and that's one of their big problems—especially Africa, the water will be one of the major challenges for survival in regions like this.

Q: What do you think are a couple small-scale solutions to remedy a water scarcity crisis?

A: Well, problems relating to pollution, like the need for recycling and water conservation are key. We waste a great deal of water—especially in technologically sophisticated countries, like the United States. We waste a lot of water by our lifestyles. Like when you shower, you soak yourself and you don't stop the water because it's not pleasant, otherwise you get cold and you would want to turn it back on, so we've got used to certain methods of doing things. Similar methods of leaving water running while washing dishes, brushing our teeth—these little things add up. So, cultural educational programs can teach people to take these small steps of changing our methods and lifestyles, helping with the water conservation. Then of course, there is the article by Garret Hardin, "Tragedy of The Commons." Hardin's response to many of these problems would be the principle of the commons. In that there is a tendency for humans to act as if the earth is a commons, maximized for our own good, and Hardin's view is that the only thing that will work is the term "cohesion mutually agreed upon," where everyone has to agree that we have to have policies to prevent ourselves from doing bad things like overusing resources and water. And in some ways we do that, like if you look at the smoking laws that we agreed on, that was sort of mutual cohesion; we decided this was bad for us so we stopped doing it. So, you could actually use the Hardin study as an example of what we need to do with water; basically, you need laws, policies, tax systems, and things that

people don't like, because if you switch gears and look at the energy problem, the only way we can really solve the energy switch from nonrenewable to renewables is unfortunately through taxation and an increase in the cost of oil. Studies have shown that even a little increase in the cost of gasoline, people drive less, even in New York, and when prices go down they will drive more—so one way is to tax people. But then there is another effect here, because if these taxes increase costs then it's the poorest who are affected the most and ultimately pay the highest price. So when any of the basic need supplies have an increase in price it completely impacts their lifestyle. It's a very interesting problem, but on a smaller level people making more of an effort to conserve water is key.

Q: What do you think are some large-scale solutions to correct a water scarcity crisis?

A: Humanitarian response is one key. One of the problems, just like with climate change problems, is that self-interest is at the root. So there is big money, from the corporate and political connections, being linked to resource use, which includes water, especially in the case of countries that have already privatized water. The water industry has created a huge pollution problem, and corporate America has to recognize the risks of tying water to big business—it's a huge concern. So there is definitely a political and corporate correction that needs to be addressed to really have an impact.

Q: Do you think desalination can be a cheaper, more viable option in the future—and if it were a more cost effective solution, with a lower energy input, do you think it would be a game-changer?

A: It could be. There are some things that are being worked on now, and have been in labs for a very long time—desalinization is one of them. At the moment, the big problem for desalinization is the energy input cost, it is just so high. Nuclear fusion has the same kind of problem, because the input needed to produce the energy is so high that it cannot be done. So a lot of people are working on a nuclear-coal-fusion option, which is still in the early stages. Some countries do a little bit of desalination, but if there were signs that it would be more widely achievable the Arabs would have discovered it because they have the money, and water is a big problem in the Arab states. So for some reason it seems like a simple method of taking the salt out of water, but it just hasn't been worth doing because of the energy costs associated with doing it. Science has certain limitations as to what kinds of solutions can be created, so there are just some things that all the technology in the world cannot solve—humans haven't been able to resolve issues like this yet, and we see the limits. But humans have survived as a species for so long, so there is hope.

Q: In your opinion, what do you think are some unconventional, out-of-the-box solutions that don't get much publicity?

A: This is pure speculation, but if you look at water as a molecule, you can figure out a way of taking atoms and molecules—like hydrogen is an atom, oxygen is an atom—and if you combine two hydrogen atoms linked with an oxygen atom it becomes water. So if someone can figure out a way to create this combination of hydrogen and oxygen atoms, on a wide-scale, then you can create water, which would solve a great deal of the problems relating to water scarcity. Science has done a lot, as we've all seen in the medical field, so you can see something like this having a possibility as well. From a futuristic point of view, some breakthroughs can have very great implications for humanity—like some brilliant person is able to solve the problem of fusion energy that produces large quantities of energy at lower temperatures, for example, and energy becomes very cheap, and everyone can buy gasoline for very little cost. That would revolutionize human lives, because energy is a very big part of our lives. If you actually sit down and calculate how much of our income goes towards energy it is a significant amount; heating, travel, food—it could even come to like 60% going towards energy. So if the energy problem is solved, the time and the resources could go towards solving other problems, like water scarcity. In a sense, thinking out-of-the-box would be looking at new solutions to some of the greatest challenges, like energy, and that would free humans to solve the other problems.

Q: How integral do you think governments and other high ranking officials are in terms of correcting the water scarcity issue?

A: Obviously with a structure like in the United States and so on, the Senate and the Congress don't have as big a role in it, but in poorer countries, the leaders have a very big influence. Powerful people in these instances can change public opinion on things, including aspects like water scarcity. So research and science might not be as powerful as these leaders. So leaders play a very important role in many public policy issues. And water is a very important public policy issue.

Q: How important do you think corporate responsibility is in terms of water scarcity? And do you think corporations will end up doing the right thing more times than not?

A: I think it's extremely important, because corporations have to be sensitive to giving up some of their profits and so on for the greater good of the public. In countries like India, Africa, and so on, many companies got very rich there from selling Coke bottles or Pepsi bottles and so on. So that's an example where they probably put the profits ahead of the negative environmental impact. It's hard for corporations, because your immediate reaction is to compensate people and shareholders, so by the nature of the business you have to fight this, and this is where the dynamic of ethics and corporate profits come in, and it is often incompatible with each other.

Q: We touched on this earlier, but how much of a factor do you think the tragedy of the commons plays in a water scarcity crisis?

A: Misuse of water, overuse of water, pollution of water is a tragedy of commons—where the people and corporations are polluting, or wasting water because they don't want to pay the costs or change lifestyles for the greater good. So this irresponsibility is directly linked to the tragedy of the commons, where the commons are misused by humans. And of course Hardin would say you need policies, guidelines, penalties, and so on to really correct problems—and that will do it.

Q: How realistic or viable do you think any of the previously mentioned solutions are to actually correcting a water scarcity crisis?

A: Well, you know, it can be done. The reason I'm saying that is because I think if you look at major challenges that humans have faced, like disease threats, especially around the times of the Bubonic Plague, where humans almost became extinct. And then we recovered and we had exponential population growth, with the agricultural, industrial, medical, and technological revolutions and so on. So humans have the capacity to change things; it is solvable, but it needs commitment and will. The other good thing about many of these issues is that some of the financial leaders of the world—like the Warren Buffets, Bill Gates, Bill Clintons—they focus on problems of poverty and global problems. So when you think about it there is lots of good things going on; when people who are very wealthy or have great influence work together and put their funds together in these initiatives they do great things. In human history we have had many challenges that humans have overcome, so it seems like water scarcity should be solvable if you could have solved some of the other major challenges that almost made humans extinct. So when you look broadly it could seem gloomy, but there is a lot of potential—human potential for change.

Q: What do you think will happen to the biodiversity of ecosystems around the world if we get to a point where there isn't enough clean, fresh water to keep up with the various forms of demand—both in nature and for humans?

A: Obviously that's one of the big problems of water, the quality aspect of it, in that it could be a major threat to extinction. In the food chain, if one species becomes extinct it has a multiplying effect on everything else—on the predator and the prey—so when the water problems result in the extinction of species it has a multiplying effect on other species as well. So it's something that needs to be addressed, because water, it flows, so the nature of it is that it can't stay in one place, so once it's been polluted it just flows wherever the water goes—where the water goes the pollution goes.

Q: Last question, if no changes or solutions are carried out, what do you think the effects will be in the short and long run?

A: It could be much worse because of the population problem, long term, an increase from 7.22 billion humans to about 10 billion humans in 2050, is a significant increase in the population, and that means that many more people will need all of the resources—food, water, energy, and so on. So then the question of course is if nothing is done, you have to deal with the larger population needing these resources. Then things could be much worse and there is an urgent need to address the problem, because if we wait for another 20 years it will be too late. Just like if you addressed the climate change problem 10, 20, or 30 years ago, we would be much better off now. And we don't exactly know that, but many violent storms, like Katrina or Sandy might have been avoided, if only we addressed climate change sooner. So, I think we should learn from climate change and so on for addressing problems of water, because they are serious enough that they need to be addressed because of major implications and results.

From Dr. Roberts' insights, as well some of the additional solutions covered in this section, we can begin to see how essential, and how feasible large and small-scale solutions are to quelling a water scarcity crisis. One thing that seems unequivocal, regardless of who you speak with, or what you research, is that water scarcity is a potentially crippling problem that could have catastrophic implications. I have yet to come across anyone, or any piece of information, that does not agree that a water scarcity problem could affect people all around the world. Even politicians and those in big business realize the severity of this situation—yet so few around the world are taking the necessary steps forward to quell the potentially calamitous situation before it is too late. Urgency is the key, and we—as a global society—need to act quickly if we have any chance of correcting a water scarcity crisis. As Dr. Roberts astutely mentioned, humans have been overcoming grave challenges for centuries, and aside from those challenges making life interesting, it gives us the hope that we too can overcome this form of adversity. The silver lining is that there are a plethora of positive ideas and solutions that could potentially stop a water scarcity crisis in its tracks—and overcoming this challenge will certainly be one of the challenges that makes life meaningful…in more ways than just one.

Conclusion

"Forever is composed of nows."
Emily Dickinson

Water is one of, if not, the most fundamental resources that enable humans and all other species on Earth to live. Without it, life as we know it would cease to be the same. For some, a water scarcity crisis would result in an economic burden, but for many, life would cease to exist altogether. The goal is to remove any detrimental threat—whether it be societal or economic—that the world faces, and to treat the earth with the level of respect that it rightfully deserves. If this does not happen, the consequences may be too dire to have a chance of reversing—because forever is an incomprehensible amount of time, and if action is not taken now, the human race may forever be plagued.

People take water for granted, they don't think about where it comes from—they just turn on the tap and expect it to always be there. Those days are ending. This notion that we will have water forever is seriously flawed. For example, estimates cite that California has 27 years of water remaining, and New Mexico and other states in the Southwestern U.S. have only ten years of water remaining. Not to mention the various other states and regions of the world that will face significant demand increases in the coming years, with the subsequent diminishing amount of freshwater coming into the equation. The conception that these types of problems are far away are absurd and idiotic. We need to correct these issues now, and we need to fix things completely, because a water scarcity crisis is around the corner. To this point, scientists with decades of study and millions of pieces of data and statistics recognize that we are on the verge of the sixth great mass extinction on Earth—the fifth was the asteroid hitting the planet, which resulted in dinosaurs becoming extinct. The next asteroid is coming, we can see it, and it's called water scarcity.

The UN asserts that by 2020 half of the world's population will be without access to water. If this does not capture people's attention and move them towards action, I don't know what will. Perhaps it stems from the notion that water has always had a public aspect to it, not owned by anybody. Water is a finite gift of life, so what happens when hundreds of thousands, millions of people, all around the world find their household economies, their livelihoods collapsing—all because this gift of life is no longer there? It could be the breeding ground for civil disobedience and uprisings around the globe, because there is no alternative for clean, fresh water. This is why it is so important that water must be protected everywhere, otherwise protests and civil discord will be more likely.

We have wars going on in the world, largely due to oil—if we don't correct the water scarcity situation, we could be encountering wars because of water. With the increase in privatization of water we are likely to encounter a scenario where people will do anything to get water. This will include killing others, or starting battles to maintain dominance of water supply. The battle against water privatization is a fight, a fight or death. Since water is so important, no amount of fear or consternation can stop a person from drinking it—they need it, and a result there could be a whole new wave of terrorists inspired. Radicals that realize people will do anything for water and they will try to get involved in malicious or sinister ways. This is yet another reason why action must be taken now to prevent a water scarcity crisis.

One of the most important areas that needs to be corrected, or at the very least scrutinized, is that elections are bought, not won. In most developed nations—like the U.S., for example—money is the bloodline of modern elections. When the cap-and-trade bill was debated (a piece of legislation that puts a mandatory cap on emissions while providing flexibility and incentives to those who comply, rewarding innovation, efficiency, and early action), groups in favor of it spent roughly $22 million on lobbying and campaign contributions; the opposition spent over $210 million—they bought their victory. To look at the things from a wider lens, in 1974 you could win a House of Representative race with just $57,000 on average, but now, it takes $1.3 million on average. The candidate who raises the most money wins 94 percent of the time. So it's only natural that candidates chase the money, and chase the backing of big money donors, right? The system requires it. Candidates with a viable chance of winning any election—especially the more illustrious ones, like Governor, President, and so on—are dependent on donors, and in most cases, those types of donors want something. They aren't noble donations by people that just support a candidate and his or her ideas—they want something back, and more times than not, they get it. To this premise, in 1971 there were only 175 lobbying firms, today there are 2,500 firms and well over 10,000 lobbyists—in one year alone, they spend $3.5 billion. In my view, the previously mentioned aspects are the biggest problems in American politics. If they are fixed, the door to fix many things, like all of the issues surrounding water scarcity, opens wide and solutions become tangible.

Keeping within the vein of legal corruption and large sums of money, water is currently a $400 billion dollar global industry—it is the third largest behind electricity and oil. Simply put, water is already a commodity akin to oil, the only differences are that many people do not realize this and the price is not yet as high as oil. The UN estimates that it would require an additional $30 billion per year to provide safe, clean drinking water to everyone on the planet—last year alone we, as a global society, spent three times that amount on bottled water. Water is the most precious commodity in the world—even more than oil. Water is the crux for survival and if someone owns water, they own the leverage to your survival. But water is not a property, at least not in theory. It is a nature made resource. Do companies like Nestle, who own more than 70

bottled water brands around the world—including some of the most popular brands, like Poland Spring, Perrier, and San Pellegrino—have the right to use water as if it is part of their plant, property, or equipment assets, and then demand a high price for this free, nature made resource? Nestle alone is pumping upwards of 450 gallons per minute worldwide, which means that streams are lowering and what used to be bodies of water are being depleted due to the pumping systems. The real kicker here is that there are speculative estimates that cite Nestle is making $1.8 million per day in profit off that water—water that essentially belongs to all of us.

If we—in developed nations—truly want to quell a water scarcity crisis, we need to reevaluate the way we do business. In that, the American, and really Western zeal as a whole, that economic progress and development will solve all problems for everyone needs to be reassessed. It is not just flawed political systems, that are reliant upon money that is a major hurdle that needs to be overcome, but it is the fundamental mindsets of many in the business world that put profits before all else. I say this as a utilitarian and pragmatic capitalist in every sense of the definition, and I don't think there is anything wrong with wealth or big business, but I do have an issue with putting profits and money before the right thing. In terms of this element of the water scarcity conversation, I think the right thing is always taking the proper, and extra safety precautions to ensure that the earth's freshwater supply doesn't get polluted or wasted. It may result in losses in the short run, but if water gets to point where it is trading near $100 a barrel—just like crude oil currently is—then things will be far more costly in the long run. So aside from keeping one of the greatest gifts the earth has to offer—that is a staple to the human species living—as pure and bountiful as possible, it makes economic sense to correct this issue before it is too late. The way I see it, the global corporate community could have a win-win scenario, in that they can continue to generate profits and create wealth for people, while operating in an environmentally friendly way—it all comes down to always acting with integrity, always doing the right thing regardless of who is looking.

Keeping with the reevaluation of business practices theme, the agricultural industry needs to take a long look in the mirror and realize they need to make some big changes. Since the farming sector is the single largest user of freshwater—accounting for around 70 percent of demand—and often is the biggest polluter and waster of water, reassessing the way they operate makes very sound sense. Farmers can reduce soil erosion (which exacerbates water scarcity and can also lead to soil becoming a non-renewable resource) via several realistic and feasible methods. Additionally, they can reduce the amount of fertilizer that contaminates surface waters by using slow-release fertilizers (or other less pernicious fertilizers), using no fertilizers on steep-sloped land, and devising buffer zones between crop land and nearby surface waters. Also, by applying pesticides only when needed, and relying more on more natural pest management solutions, farmers can greatly reduce pesticide runoff. Lastly, more efficient irrigation systems and water management systems would reduce the amount of

agriculture related water squander. These are the issues farmers across the world would see if they took some time to really look in the mirror and reevaluate the way they operate; not only would altering the current status quo have tremendous economic benefits for them (and consumers), but it would be one of the most singular achievements in avoiding a potential water scarcity crisis.

Humans, on an individual level, need to take the longest look in the mirror, and really question if the way they are living their lives is the most responsible. I think this is the most important step of all, because if people realize that they can, fairly easily, reduce their ecological and water footprints, while living more ecofriendly lives that have long term sustainability in mind, it will be a realization that has profound results. And when the societal and cultural foundations of how we live our lives on a day to day basis is altered for the better, the effect will magnified as more and more people get on board. It won't be easy, any serious or major change never is—especially in the beginning—so there may be discomfort or a learning period that takes time to fully adjust to. But before long, more environmentally responsible ways of living will become as natural and comfortable as the current irresponsible ways—and with this, the long run benefits, both on a societal and economic basis, will be astounding.

When individuals across the globe begin to realize how much impact they can make—just from altering their own day to day actions—grassroots campaigns can begin. Having a bottom-up approach, founded on common goals and a shared passion to reduce water waste and pollution will aggregate to an evangelical uprising. In that, there will be a transcending mindset and philosophy that leads to ideas and action. Once a cornucopia of people are passionately driven, they can then motivate their elected officials and regulatory bodies to do something about the potential water scarcity crisis—because when the voices of many humans unite, and get loud, even the most opposed government official will be forced to act, otherwise they know a revolt and a changing of power is imminent.

The good news in regards to political policies and regulations is that they actually can make a difference when they are implemented in smart, sensible ways. According to the EPA, the Clean Water Act of 1972 has resulted in a plethora of improvements to the quality of water in America. For instance, between 1992 and 2002 alone, the percentage of Americans served by community water systems that met federal health standards increased from 79 percent to 94 percent, and the proportion of the U.S. population served by sewage treatment facilities rose from 3 percent to 74 percent. Additionally, the percentage of U.S. streams deemed to be fishable and swimmable increased from 36 percent to 60 percent of those tested, and annual wetland losses decreased by 80 percent. These are rather laudable achievements, especially when you consider the increases in the U.S. population and its subsequent per capita consumption of water use. But no one is anywhere near close to waving a victory flag—there are tremendous strides that still must be taken. A noteworthy facet of this part of the conversation derives from a 2010 New York

Times study that discovered thousands of America's largest water polluters (roughly 45 percent of them) were relying on a U.S. Supreme Court decision that essentially created ambiguity over which waterways are to be regulated for pollution. Subsequently, these companies are violating the highest court's decision and are escaping prosecution by the EPA, avoiding fines or penalties in the process. This is why it is essential to not only devise new forms of smart and sensible laws and regulations, but to enhance and improve upon the already existing legal parameters.

Continuing and creating new forms of laws, regulations, and tax systems are some of the most important steps in thwarting a water scarcity crisis. There should be a shift of the focus of the law, so instead of revolving more around the end-of-pipe removal of specific pollutants, it should revolve more around water pollution and waste prevention. Another improvement to the current regulatory system would be to increase the monitoring for violations of the law, and much larger mandatory fines for those who do violate. Additionally, there absolutely must be more regulation in regards to the irrigation of water—currently there is none. Another step in the right direction, in regards to the legal aspects, it to increase the rights of people; enabling them to have more of a chance of bringing lawsuits to court, and a more equitable system once in court, that allows them to speak up and ensure that water related laws are enforced. Perhaps the most intensive idea is to rewrite already existing forms of legislation altogether—essentially reducing any confusion about which waterways are covered, thus reducing the major polluters from using ambiguity as an excuse to keep polluting. However, many oppose the previously mentioned ideas, on the basis that many forms of regulation are already too restrictive and costly as is. Having said that, we must stay sanguine and continue to enhance and create smart and sensible laws and regulations; especially since we have encouraging facts, like this: Since 1970, most of the world's more developed countries have enacted laws and regulations that have substantially reduced water pollution and waste. These steps in the right direction were in large part a result of bottom-up political pressure, brought on by likeminded individuals and organizations of people. The next step in this aspect of the equation is to increase the amount of grassroots campaigns to reduce and prevent water waste and pollution in the poorer, less developed nations of the world. If this happens, we can have worldwide unity that demands that laws and regulations are created to prevent water waste and pollution in the areas that need them the most.

Wealth and income inequality and the resulting disparity of living conditions are another essential aspect to the water scarcity conversation that needs to be corrected. Governments, corporations, and people need to come together for the greater good of the human species and work to make things more equitable. This is an issue that really needs to have leadership from the more developed, wealthy nations of the world that can help the most indigent correct this pivotal part of the challenge. But even in countries like America this is an issue that needs to be corrected. For instance, a water scarcity crisis—in the most severe case—will have very different meanings for different sets of people living in Manhattan. More specifically, a water scarcity crisis will impact a set of people living in

Manhattan that are financially below the average, at an average level, and an above average level much differently. A person, or group of people living in Manhattan with below average financial means will be devastated by a water scarcity crisis; the increase in the price of goods and services due to the economic ramifications will make survival elements like housing, eating, and getting around virtually impossible. With this, work and education become that much more trying, and they are essentially stuck at their place in society—with no real chance or hope of climbing up to the next level of financial stability. For the person or group of people in Manhattan, with average financial means, a water scarcity crisis will present a life-altering set of challenges, but not as impactful as the former set of people. They would have to curtail the luxurious activities that they engage in, and reduce the quality of life that they are used to. In this regard, it could mean going to a less desirable school, which as a result, could restrict the advancement opportunities they have. This could prove to be very damaging to their goals and morale, and the reduction in the quality of life as a whole could be so discouraging that it could lead to substance abuse or other pernicious activities that could result with them in very precarious situations. As for those in Manhattan with above average financial means, a water scarcity crisis would not be as big of a deal. Sure, they will be impacted, since they will have to pay higher prices and deal with the societal and economic repercussions that will come as a result of a water scarcity crisis. And if things spiral out of control, in an economic or societal regard, then their lives could be altered in a much more significant way because of the widespread unemployment, potential for civil discord and realignment of the political system—as well as other more wide-scale implications that could come via a water scarcity crisis. But even still, their lives won't be challenged like it could be for the two former sets of people. And it certainly would not have the slightest connection to people living in the poorest areas of the world that will be affected the hardest by a water scarcity crisis, like those in the Sub-Saharan Africa region. A person or group of people in Sub-Saharan Africa, which are financially below average there, will face an imminent death. The poorest people in regions like the Sub-Saharan will not have the slightest chance of survival if we encounter a full blown global water scarcity crisis. In large part, people in this region are already dying in astounding numbers every day due to water scarcity, but if this becomes a globally calamitous situation, they would be doomed. Due to the fact that people in the Sub-Saharan region are already facing dire consequences because of water scarcity, even those who have average financial means will face a dubious chance of survival. Perhaps they will have a slight advantage, in that they may have some access to some water—via privatization or other pay for water options—as well as access to medical aid, but given the already dire conditions in both of those regards, their chance of survival would be marginally higher than the poorest set of Sub-Saharan people. The financially above average person, or set of people, living in the Sub-Saharan region would not be much better off; in large part because the foundation does not exist to offer them opportunities of advancement or aid, even if they can afford it. So here we can begin to get an idea as to how different sets of people—in some of the safest areas of the world, and some of the areas of the world that will be hardest hit by a water scarcity crisis—will be impacted. Everyone will be impacted in some way, but for many, it will just be a form of

discomfort, and sadly for many more, it will be an imminent result of a downward-spiral, disease, or death.

Without water we have nothing—no society, no economy, no culture. Without water the earth would not be what it is. Our planet is one massive organism, and it is the water that circulates through, like veins of blood, constantly enabling life. Humans, too, are comprised mainly of water, so we also have an integral dependence on it. This is why quelling a water scarcity crisis, and all the surrounding and connected issues to it, is the most important thing the human species currently faces. We have seen the numerous causes and effects, as well as the potentially calamitous societal and economic ramifications that could be a result of a water scarcity crisis. Fortunately, there are already people realizing this and banning together, like the people responsible for the documentary film, "Flow: For The Love of Water." Impresario of the film, Irena Salina, and the rest of her team are launching a petition that is asking the United Nations to add the Right To Water as a Universal Declaration of Human Rights; more specifically, this declaration states: "Everyone has the right to clean and accessible water, adequate for the health and well-being of the individual and family, and no one shall be deprived of such access or quality of water due to individual economic circumstance."

This is the exact type of message that is needed, that will begin to make changes to the larger systems of the world—all because a small group of thoughtful and committed individuals came together with the goal of positive change. We need to pass this message on to as many people as possible, so that we can inspire hope and inspiration, and more importantly, so that we can teach the next generations that water is a beautiful gift that should be cherished and treated with great respect. The future of the human species and ecosystems around the globe depends on this. And if the people of the world come together and work in harmony to reduce and prevent water pollution and waste, curb fossil fuel dependence and pollution as a whole, reduce poverty, and slow population growth, while coming up with environmentally responsible ideas that can aggregate to a long term, sustainable existence, then there really is no limit on the potential of the human race. So this is what we strive for; it all comes down to people really asking what matters to them, then making the changes necessary and taking some action—and doing it now. But it all must begin with introspection, and we must realize that we are taking everything nature has to offer and not giving anything back in return. As long as this dichotomy exists, the human species and planet will not be able to achieve long term survival. This is why it is so crucial that everyone realizes this and comes together, so that we, as a collective group of humans, can push for the changes needed—getting everyone involved in a ground-up effort. Emily Dickinson was spot-on when she said that forever is composed of nows, because if humans want to live on this beautiful planet we call Earth forever, action to quell a water scarcity must be taken right now.

In the end, we really won't know the true worth of water—until the well is dry.

Bibliography

"10 Facts about Water Scarcity." *WHO.int*. World Health Organization, Mar. 2009. Web.

"Access to Water Critical for Emerging Markets Says Frontier Report for HSBC." *Frontier-Economics*. Frontier Economics LTD., 2014. Web.

Appelgren, Bo G. "Appendix 3: Keynote Paper - Management of Water Scarcity: National Water Policy Reform in Relation to Regional Development Cooperation." *FAO.org*. Food and Agriculture Organization of the United Nations, 1998. Web.

Baehr, Leslie. "This Bizarre Structure Could Provide Drinking Water Even In A Desert." *Business Insider*. Business Insider, Inc, 22 Apr. 2014. Web.

Balakrishnan, Angela. "Starbucks Wastes Millions of Litres of Water a Day." *Theguardian.com.* Guardian News and Media, 06 Oct. 2008. Web.

Barford, Vanessa, and Lauren Everitt. "Eight Radical Solutions for the Water Shortage." *BBC News*. The BBC, 4a Apr. 2012. Web.

Barlow, Maude. *Blue Covenant: The Global Water Crisis and the Coming Battle for the Right to Water*. New York: New, 2008. Print.

Barnett, Cynthia. *Blue Revolution: Unmaking America's Water Crisis*. Boston: Beacon, 2011. Print.

Bawden, Tom. "Water Shortage to Hinder World's Economic Growth." *The Independent*. Independent Digital News and Media, 11 June 2012. Web.

Berfield, Susan. "There Will Be Water." *Bloomberg Business Week*. Bloomberg, 11 June 2008. Web.

Bjerga, Alan. *Endless Appetites: How the Commodities Casino Creates Hunger and Unrest*. Hoboken, NJ: Bloomberg, 2011. Print.

Boccaletti, Giulio, Merle Grobbel, and Martin R. Stuchtey. "The Business Opportunity in Water Conservation." *Mckinsey.com*. McKinsey & Company, Dec. 2009. Web.

Brisbois, Nicholas. "The Economics of Water: How We Value This Scarce Resource."*Wind4Water*. Wind4Water USA, 20 June 2013. Web.

Brown, Lester R. *World on the Edge: How to Prevent Environmental and Economic Collapse*. New York: W.W. Norton, 2011. Print.

Bryson, Donna, Katy Daigle, D'Arcy Doran, Boyd Farrow, Orion Ray-Jones, Mairi Mackay, Caroline McCarthy, Conor Purcell, Adrian Sandford, and Ian Wylie. "Outlook on the Global Agenda 2014." *WEF Global Agenda.* The World Economic Forum, Nov. 2013. Print.

Case, Karl E., Ray C. Fair, and Sharon M. Oster. *Principles of Economics*. Boston: Prentice Hall, 2012. Print.

Case, Karl E., Ray C. Fair, and Sharon M. Oster. *Principles of Macroeconomics*. Boston: Prentice Hall, 2012. Print.

Case, Karl E., Ray C. Fair, and Sharon M. Oster. *Principles of Microeconomics*. Boston: Prentice Hall, 2012. Print.

"Clean Water Act Proposal Would Strengthen Federal Protection." *Circleofblue.org*. Circle of Blue, 11 May 2010. Web.

Dale, Stephen. "Smart Solutions to a Worsening Water Crisis." *Idrc.ca*. IDRC|CRDI, 2014. Web.

"Drought Will Magnify Water Scarcity Issues." *ThinkProgress.org*. Think Progress Is a Project of the Center for American Progress Action Fund., 30 May 2013. Web.

"Ecological Footprint." *WWF.Panda.Org*. WWF Global, 2014. Web.

Etkin, Dagmar Schmidt. "Twenty Year Trend Analysis of Oil Spills in EPA Jurisdiction: Freshwater Spills Symposium 2004." Environment Protection Agency, United States, 2004. Web.

Feldman, David Lewis. *Water*. Cambridge, UK: Polity, 2012. Print.

Finley, Bruce. "Colorado Absorbs 179 Oil and Gas Spills as Parachute Cleanup Continues." *Denverpost.com*. The Denver Post, 23 May 2013. Web.

Fishman, Charles. *The Big Thirst: The Secret Life and Turbulent Future of Water*. New York: Free, 2011. Print.

Food and Agriculture Organization of the United Nations. The United Nations, 2014. Web.

"Forbes Powerful People List." *Forbes*. Forbes Magazine, Sept. 2013. Web.

"Freshwater Crisis." *National Geographic*. National Geographic Society, 2014. Web.

Fuentes-Nieva, Ricardo, and Nick Galasso. "Working For The Few: Political Capture and Economic Inequality." *Oxfam Briefing Paper*. Oxfam GB for Oxfam International, Jan. 2014. Web.

Gabriel, Trip. "Thousands Without Water After Spill in West Virginia." *NYtimes.com*. The New York Times, 10 Jan. 2014. Web.

"A Good Education." *thewaterproject.org/education.asp*. The Water Project, 2014. Web.

Gillis, Justion. "U.N. Climate Panel Seeks Ceiling on Global Carbon Emissions."*The New York Times* 28 Sept. 2013, sec. A: 1. Print.

"Global Climate Change." *Nasa.gov*. NASA, 2014. Web.

"Global Footprint Network: Advancing the Science of Sustainability."*Footprintnetwork.org*. Global Footprint Network, 2014. Web.

Hadhazy, Adam. "Top 10 Water Wasters: From Washing Dishes to Watering the Desert. "*Scientificamerican.com*. Scientific American, Inc., 23 July 2008. Web.

Hao, Xiaodi, Vladimir Novotny, and Valerie Nelson. *Water Infrastructure for Sustainable Communities: China and the World*. London: IWA, 2010. Print.

Hardin, Garrett James. *The Tragedy of the Commons*. N.p.: n.p., 1968. Print.

Ingram, B. Lynn, and Frances Malamud-Roam. *The West without Water: What past Floods, Droughts, and Other Climatic Clues Tell Us about Tomorrow*. Berkeley: University of California Press, 2013. Print.

Interlandi, Jeneen. "The Race to Buy Up the World's Water." *Newsweek.com*. Newsweek LLC, 10 Aug. 10. Web.

"Intergovernmental Panel on Climate Change." *Ipcc.ch/*. IPCC - Intergovernmental Panel on Climate Change, 2014. Web.

"I Thirst Water Program." *Impactnations.org*. Impact Nations, May 2014. Web.

"Koch Industries: Secretly Funding the Climate Denial Machine." *Greenpeace.org*. The Greenpeace USA Fund, 2010. Web.

Kolbert, Elizabeth. *The Sixth Extinction: An Unnatural History*. New York: Henry Holt and Co,, 2014. Print.

Kriken, John Lund, Philip Enquist, and Richard Rapaport. *City Building: Nine Planning Principles for the Twenty-first Century*. New York: Princeton Architectural, 2010. Print.

Lappe, Anna. "What Dow Chemical Doesn’t Want You to Know about Your Water." *Grist.org*. Grist Magazine, 9 June 2011. Web.

Lessig, Lawrence. *Republic, Lost: How Money Corrupts Congress--and a Plan to Stop It*. New York: Twelve, 2011. Print.

McWhinney, James E. "Water: The Ultimate Commodity." *Investopedia*. IAC, 17 July 2011. Web.

Miller, G. Tyler, and Scott Spoolman. *Sustaining the Earth*. Belmont, CA: Brooks/Cole, Cengage Learning, 2012. Print.

Pearce, Fred. *When the Rivers Run Dry: Water, the Defining Crisis of the Twenty-first Century*. Boston: Beacon, 2006. Print.

"Population Growth Rate." *Worldbank.org*. The World Bank Group, N.d. Web.

Proctor, Cathy. "Colorado Health Dept. Working with Williams on Parachute Creek Cleanup." *Bizjournals.com*. Energy Inc., Denver Business Journal, 16 May 2013. Web.

Richter, Brian D. *Chasing Water: A Guide for Moving from Scarcity to Sustainability*. New York: Island Press, 2014. Print.

Sedlak, David L. *Water 4.0: The Past, Present, and Future of the World's Most Vital Resource*. Hartford, CT: Yale University Pess, 2014. Print.

"Sierra Club." *Explore, Enjoy and Protect the Planet*. The Sierra Club, 2014. Web.

"Singapore Will Cut Water Imports from Malaysia, Pursue Self-Sufficiency."*Circleofblue.org*. Circle of Blue, 20 May 2010. Web.

Smith, S.E. "Seven Companies Polluting the World Without Consequences." *Truth-out.org*. Truthout, 2 June 2013. Web.

Prud'homme, Alex. *The Ripple Effect: The Fate of Freshwater in the Twenty-first Century*. New York: Scribner, 2011. Print.

"The Looming Water Crisis." *HBR.org*. Harvard Business Review, 08 Feb. 2010. Web.

Uddin, Waheed, W. Ronald. Hudson, and R. C. G. Haas. *Public Infrastructure Asset Management*. 2nd ed. New York: McGraw-Hill Professional, 2013. Print.

"UNICEF Tap Project." *Unicefusa.org*. UNICEF, 2014. Web.

United States. US Department of Agriculture. California Department of Food and Agriculture. *USDA.gov*. California Department of Food & Agriculture, 2012. Web.

United States. US Department of Agriculture. Agricultural Marketing Service; Economic Research Service. *USDA.gov*. UNITED STATES DEPARTMENT OF AGRICULTURE WORLD AGRICULTURAL OUTLOOK BOARD, 10 Mar. 2014. Web.

United States. Cong. House Committees, Senate Committees: Transportation & Energy State, Veterans; Military Affairs; Finance Appropriations. First Regular Session, Sixty-ninth General Assembly STATE OF COLORADO. Cong HOUSE BILL 13-1267. N.p., 3 May 2013. Web.

United States, State of Michigan Supreme Court. Circuit Court For The County of Saginaw.*Gary and Kathy Henry, Et Al., Vs The Dow Chemical Company*. Leopold P. Borrello, Hon. 2011. Web.

"UnlockPotential." *TheWaterProject.org*. The Water Project, N.d. Web.

Versace, Christopher. "How To Profit From The Next Big Scarce Resource." *Forbes*. Forbes Magazine, 25 July 2013. Web.

"Volcanic Ash -- Effects on Water Supply and Mitigation Strategies." *Volcanoes.usgs.gov*. U.S. Department of the Interior | U.S. Geological Survey, 2010. Web.

Walton, Brett. "The Price of Water 2012: 18 Percent Rise Since 2010, 7 Percent Over Last Year in 30 Major U.S. Cities | Circle of Blue WaterNews." *Circle of Blue WaterNews*. Circle of Blue, 10 May 2012. Web.

"Water Conservation Goals & Progress." *Starbucks.com*. Starbucks Corporation, 2013. Web.

"Water Footprint." *Waterfootprint.org: Water Footprint and Virtual Water*. Water Footprint Network, 2014. Web.

"Water for Life, 2015." *un.org/waterforlifedecade/scarcity*. United Nations, 2014. Web.

"Water: Mapping, Measuring, and Mitigating Global Water Challenges." *Wri.org*. World Resources Institute, 2014. Web.

"The Water Problem." *projecthumanity.org/water-problem*. Project Humanity RSS, 2013. Web.

"WaterAid America - Clean Water & Sanitation for Africa, Asia & Central America." *WaterAid.org*. WaterAid America, 2014. Web.

Watkins, Kevin. "Beyond Scarcity: Power, Poverty, and the Global Water Crisis." *Human Development Report 2006*. The United Nations Development Programme, 2006. Print.

"We’re Building Economies through Clean Water and You Can Help." *projecthumanity.org*. Project Humanity RSS, 2014. Web.

"WMB:New York Stock Quote." *Bloomberg.com*. Bloomberg, 20 Feb. 2014. Web.

"World Population Clock." *Worldometer.info*. Worldometers: Real Time World Statistics, 08 Feb. 2014. Web.

Zetland, David. *Living with Water Scarcity*. Amsterdam; Mission Viejo; Vancover: Aguanomics, 2014. Print.