*Class #10*

# H2Opportunities DRAFT v.2.5b

**Our bodies and our planet are ~70% water (**[**Wharton, 2008**](#_ENREF_34)**). We cannot live for more than a few days without it, there is no substitute for it, and water crises – global *and* local – are a current and growing reality. The focus of this paper is on entrepreneurial solutions to the social and environmental crises posed by freshwater shortages. The aim is to provide an overview of the issues and systems, inroads to resources for further learning and collaboration, and a review of corporate and nonprofit activities in the space. In short, this paper explores “the business of water” – a $425 billion a year industry – while respecting the range of challenges inherent in what many see as a public resource, and thus presumed to be a *right* more than a *good*.**

In the documentary film “Flow,” Rajendra Singh maintains an important distinction between water as *property* versus *resource* ([Salina, 2008](#_ENREF_25)). This distinction is at the heart of water rights law in the western United States and the petition to add water as a right (article 31) to the UN’s Universal Declaration of Human Rights[[1]](#footnote-1). Legislation varies from region to region, complicating the matter for all stakeholders and making universally adaptable solutions improbable. Business, on the other hand, has taken a more consistently “values-agnostic” approach, perhaps best personified by T. Boone Pickens, the Texas oil billionaire. He believes that, regardless of the social issues at play, water *will* be monetized. To wit, he has begun purchasing water rights in the Ogallala Aquifer with the intention to sell the water via pipeline to Dallas ([Wharton, 2008](#_ENREF_34)).

Reframed, global freshwater shortages can be viewed as opportunities. In fact, 63% (119) of respondents to the Carbon Disclosure Project water security survey (CDP[[2]](#footnote-2)) identified opportunities. In one specific case, Cisco Systems now saves over $1 million each year with no adverse impact on product quality as a result of exploring one water conservation opportunity ([Deloitte, 2011](#_ENREF_8)). The focus of this paper is on entrepreneurial solutions to the social and environmental crises posed by freshwater shortages. The aim is to provide an overview of the issues and systems, inroads to resources for further learning and collaboration, and a review of corporate and nonprofit activities in the space.

## Water Commerce and Capitalism – The New “Liquidity”?

Commerce and capitalism have tremendous influence on the allocation of resources. Thus, many people share a well-founded fear that corporations will own our water. In fact, three French companies, RWE Thames, Suez and Veolia, own the water service contracts in Chicago, New York City, Jakarta and many other major cities (Fig.1)([Salina, 2008](#_ENREF_25)).

Water development projects, such as those funded by the World Bank, are typically large infrastructure projects, like major dams, desalination and treatment plants, and water transportation systems, some of which can be useful and some of which arguably do more harm than good. Most large-scale projects concentrate wealth and power in the hands of multinational corporations whose capacity for objective participation in studies to guide our water future can justifiably be called into question. The too-typical tale of marginalizing and even literally displacing the disenfranchised continues in the context of major dams in China and elsewhere. Such projects have displaced 30-60 million people ([IRN, 1998](#_ENREF_18)).

If companies own our water, but they’re accountable to their shareholders, is that a better system than leaving it solely in the hands of government? The documentary *The Yes Men* provides an interesting example of what can happen when companies take responsibility for their most egregious actions in the context of the disaster in Bhopal ([Smith et al., 2005](#_ENREF_27)). It also raises other interesting questions; can corporations *afford* to be accountable for the skeletons in their closets? If there is a “truth and reconciliation” initiative, would it work better than a persistent political regime? All these questions are outside the scope of this work, though we invite you to consider and explore them on your own. Developing sound answers, models for predicting appropriate courses of action, and sustainable solutions are important goals for business, government, and the environment.

Our water crisis is a challenge daunting in scale with daily life and death consequences[[3]](#footnote-3) and will not be solved only by corporations, governments, *or* NGOs, but by creative combinations that take into account the needs and rights of humankind and the systems in which we prosper. Small entrepreneurs working on narrow margins seem to be able to thrive in poor communities whereas the large margins and out-of-touch corporate approach taken by Suez in Cochabamba resulted in revolt and bloodshed ([Finnegan, 2002](#_ENREF_11)). Success will require more creative approaches than selling traditional goods and services. NGOs may hold corporations accountable in ways where they might be more responsive than governments. Corporations may be more agile than governments and more willing and able to invest in risks than NGOs. Regardless of your feelings about the social issues entwined with water, most can agree with this statement from the UNDP: “Overcoming the crisis in water and sanitation is one of the greatest human development challenges of the early 21st century.” ([Engineering, 2011](#_ENREF_9))

Deloitte’s Will Sarni accurately describes the landscape in his division’s report for CDP: “While the term ‘water scarcity’ is frequently heard, we are more specifically experiencing greater competition for water. The amount of fresh and accessible water is static; we do not create new water or ‘use up’ existing supplies. Instead we are placing greater demands on an irreplaceable natural resource” ([Deloitte, 2011](#_ENREF_8)). Stewardship of such resources cannot be overemphasized. Pollution is an important issue in the context of water, from the Cuyahoga river catching fire to persistent pharmaceuticals to nuclear contamination in Japan to more tangible pollution like the Great Pacific Garbage patch. Since we cannot ‘make’ new water, processes that contaminate our finite supply effectively reduce that supply. From industry, one of the best point source examples is mining, wherein water is often polluted with persistent contaminants like Mercury. Mining processes also represent an opportunity, insofar as paste tailings methodology[[4]](#footnote-4) reduces water use profitably ([WRG, 2009b](#_ENREF_37)).

While big business and industry grapple with material issues of water risk, the OECD predicts that half of the world’s population will have insufficient fresh water by 2030. Even today, according to the World Water Council, more than 1.1 billion people lack sufficient drinking water ([Trends, 2009](#_ENREF_30)). We in the United States are not immune; even under non-drought conditions, no fewer than 36 states anticipate water shortages by 2013 ([Meyers, 2008](#_ENREF_19)). The water crisis is unambiguous, and it’s here. Within the next 15-20 years, the worsening water security situation risks triggering a global food crisis, with shortfalls of up to 30% in cereal production ([WRG, 2009b](#_ENREF_37)). Seen through the lens of capitalism, “Water is a $425 billion a year industry, which ranks as the third largest business in the world, behind fossil fuels and electricity.” ([Trends, 2009](#_ENREF_30)) Another important facet of the challenge is that water use is dominated by agriculture (70%), relative to personal (10%) and industrial uses (20%), so the biggest opportunities for leveraged impacts are in agriculture ([Trends, 2009](#_ENREF_30)). Stakes like this beg the questions, “Who pays? Who owns?” and, “What are some examples?”

The answer to this question is surprising and simple: “Mostly, Suez, Veolia, & RWE Thames.”

**Figure 1: Blue Gold (**[**Bozzo, 2008**](#_ENREF_4)**) Unveils *The Invisible Economy of Water***

|  |  |  |
| --- | --- | --- |
| **RWE Thames** | **Suez** | **Veolia** |
| Pittsburgh | New York City | Chicago |
| Buffalo NY | Houston | Grand Canyon |
| Seattle | Buenos Aires | Tampa |
| Jakarta | Las Vegas | New Orleans |
|  | Riverside | Santiago Chile |
|  | Atlanta | Puerto Rico |

The 2030 Water Resources Group, led by McKinsey & Company, the World Bank, and a consortium of corporations with water business interests (WRG[[5]](#footnote-5)), measured the gap between projected demand and supply under different scenarios, accounting for economic growth and climate change, etc. They reported an anticipated shortfall of ~2,800 BCM or billion cubic meters in 2030: almost 5 times current municipal and domestic use (600 BCM)([WRG, 2009b](#_ENREF_37)). This is one answer to the question, “How big is the gap?” It does not answer the arguably more interesting questions of who will solve it and how. McKinsey/WRG provide good insight into how, and even point to business or profit seeking drivers as the who, but their study leaves the details of which measures provide what returns behind a proprietary wall.

Regardless, the resource allocation story is familiar to anyone with global cultural awareness; Americans use about 100 direct gallons at home, daily. By contrast, millions of the world's poor subsist on less than 5 gallons per day ([NationalGeographic, 2010b](#_ENREF_21)). So what is “sufficient”? Nat Paynter of “charity : water”[[6]](#footnote-6) indicates that the rule of thumb is 20 liters per person per day, and notes that the reality can be much different, with a low of 5 liters per person per day ([Paynter, 2012](#_ENREF_24)). This scarce resource is used primarily for drinking, cooking, and dishwashing. Charity water communities are encouraged to contribute user/maintenance fees to cover the routine operating and maintenance costs and Paynter sees, “a critical role in the small, local, private sector to help maintain water systems as a skilled repair resource.  Additionally, the local private sector can help with self-supply, although there is a danger that the quality of the work will be poor” ([Paynter, 2012](#_ENREF_24)). Part of this is the luck of the draw with respect to geographic distribution of freshwater resources.

The US EPA provides insight at the local level – watersheds. Their Watershed Central[[7]](#footnote-7) site includes insight that 70% of water we drink in the US (as well as a similar proportion for agriculture and industry) comes from domestic lakes ([EPA, 2012](#_ENREF_10)). Consequently, our access to fresh water in the US is relatively easy and convenient. In turn, this leads to wasteful use and a relationship with water that is significantly different than in India, for example, where newborn babies are given a drop of the Ganges in their mouths and last rites include the same. In Kenya, people walk an average of 3.7 miles per day for their water ([NationalGeographic, 2010b](#_ENREF_21)). We are also fortunate to have one of the world’s largest aquifers (see Ogalalla in table, below), water rich Canada to the north, and Alaska, a lesser-known water treasure. 2.76 million trillion gallons of earth’s fresh water (~30%) are beneath the ground in soil and aquifers (see below) and ~70% is frozen in the form of glaciers, permafrost, permanent snow cover and ice sheets, while only 0.3% is made up by lakes, rivers, and wetlands ([NationalGeographic, 2010b](#_ENREF_21)).

**Fresh Water: Where is it?[[8]](#footnote-8)**



## Virtual Water

At the subsistence level, the focus is on direct usage and does not take into account “embodied water” – the proverbial iceberg beneath the surface. Embodied, embedded, or virtual water refers to the water used in the production of a good or service ([Schendel, Macdonald, Schreier, & Lavkulich, 2007](#_ENREF_26); [Waterwise, 2007](#_ENREF_32)). While agriculture and power generation account for an overwhelming majority of *direct* water withdrawals (90%), a majority of water use (60%) is indirect, with 96% of industrial sectors using more water indirectly in their supply chains than directly. The food and beverage industry has the largest share of indirect withdrawals, accounting for 30% ([Blackhurst, Hendrickson, & Vidal, 2010](#_ENREF_2)). If we take this into account, Americans *eat* about 2,000 liters per day of virtual water, to say nothing of the embodied water in other water-intensive consumer goods like cell phones, aluminum cans, and even energy, which consumes ~12 liters per kWh ([Ostman, 2009](#_ENREF_23)).

Industrial use and attendant risk is explored in great detail in CDP’s Water Report; Utilities and Energy, the only two industries larger than water, each report direct exposure to water-related risk greater than 70% ([Deloitte, 2011](#_ENREF_8)). This recent report provides unprecedented insight by sector and individual firm cases. Deloitte and CDP are blazing the trail and setting the tone for the conversation in the corporate sector. Their 2011 report is an excellent resource to help understand the issues at play and frame shortages in the familiar context of risk exposure.

Below is a table compiled to help drive home the concept of virtual water through commonly consumed goods.

**Figure 2: Embodied Water Resources in Common Goods[[9]](#footnote-9)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Goods** | **Liters** |  | **Goods** | **Liters** |
| 1 kg  wheat | 1,300 |  | Pint of beer, 568ml | 170 |
| 1 kg rice | 3,400 |  | Glass of milk, 200ml | 200 |
| 1 kg beef | 15,500 |  | Cup of coffee, 125ml | 140 |
| 1 pair of jeans (1000g) | 10,850 |  | Sheet of A4, 80 g/m² | 10 |
| 1 cotton T shirt (500g) | 4,100 |  | Egg, 40g | 135 |
| 1 disposable diaper (75g) | 810 |  | Apple, 100g | 70 |
| 1 bed sheet (900g) | 9,750 |  | Glass of orange juice, 200ml | 170 |

One area of interest is the “virtual water trade”, which plays a growing role in balancing the global water budget and improving the food security. In theory, the global food trade can increase efficiency in water resources utilization. According to researcher Yang Hong ([Hong, 2004](#_ENREF_15)), “For many water scarce countries, it is often cheaper and environmentally less destructive to import food, especially the water intensive cereal crops, than to pipe water to produce the same commodity locally.” Seven of the largest food exporting countries – USA, Canada, Australia, France, Argentina, Thailand and Brazil – account for about 80 percent of the global total net virtual water export through major crop commodities. But such trade has its consequences for both exporting and importing countries, in regards to food security, energy consumption, and water availability, among other issues.

While this model can work in a limited sense when the trade dynamic is *to* a relatively water poor country, some argue that when relatively water wealthy countries *import* virtual water-intensive resources, they effectively export drought. [China](http://knowledge.wharton.upenn.edu/article.cfm?articleid=2059) is the main importer of virtual water and the U.S. and Canada are the two largest exporters ([Wharton, 2008](#_ENREF_34)). It stands to reason that, as countries with more water resources awaken to the reality of water crises, they will be more reluctant to export this wealth, which may bring conspicuous consumption under increased scrutiny and have a significant impact on geopolitics.

## Awareness and Opportunities

The issues are diverse and omnipresent. So what can we do about it? The goal of system intervention at the household level measured in liters or gallons ought to be considered not so much as a direct conservation measure to be compared with irrigation efficiency, measured in BCMs, as much as a question of increasing awareness and potentially making changes with respect to lifestyle and levered choices taking embodied water into consideration. Installing low flow faucets and waterless urinals is the equivalent of rearranging deck chairs on the Titanic when it comes to direct conservation. However, better quantifying and understanding our own direct and indirect use and putting this in the context of true levels of “sufficiency” opens the possibility of living a more “considered life” ([e.g. Hollis, 2008](#_ENREF_14)). Further, it may inspire innovation and levered action through corporate actions, nonprofits, and decisions that take embodied water into consideration. First, waterless urinals, next rainwater recapture and supply chain risk reduction through improved stewardship of all resources.

Decentralized demand-side efforts *can* have meaningful impacts in the aggregate. Since 2005, GPT Group[[10]](#footnote-10) has saved 3.9 million kilolitres of water, and in 2010 alone saved 1.1 million kiloliters, avoiding costs of US$3.8 million by taking action such as working with tenants to reduce their water use, installing water efficient appliances, using recycled water, harvesting rainwater, implementing black-water recycling plants, and planting to suit the local environment ([Deloitte, 2011](#_ENREF_8)). This suggests opportunities for applications to be used to help guide consumer behavior through game mechanics: not only can such actions have an important impact on the demand side, but also demonstrate interesting cost avoidance which may help galvanize support from private sector players. Such an app could find a market on the utility side once sufficient adoption had reached a critical mass (volumetric) to observe significant impact on a local system through collaborative action. One example currently available in the iTunes marketplace is “waterprint.” Such applications will primarily serve the function of increasing awareness, which may ultimately trickle up to government and business decision-makers, where more levered influence might be achieved. Pop-up suggestions to users about where to look for such opportunities, increasing awareness, might be effective and provide a PR boost for a corporate partner who might be willing to fund further application development.

In their quarterly report from 2009, McKinsey & Company break the opportunities in the space into three major categories: improving the productivity of water treatment & distribution, of water-intensive industrial and power processes, and of water use in agriculture ([Boccaletti, Grobbel, & Stuchtey, 2010](#_ENREF_3)). All but 15% of our crops are watered by rainfall, but since ~70% of fresh water withdrawals are for agriculture, efficiency opportunities in the space will be an important part of healing the system ([IGD, 2012](#_ENREF_17)). *Natural Capitalism* provides one excellent suggestion to increase irrigation efficiency ([Hawken, Lovins, & Lovins, 1999a, p. 217](#_ENREF_12))

“A common technique uses a one-dollar block of gypsum, the size of a lump of sugar, buried at the root zone. Wires embedded in the gypsum run back up to the surface to a clip-on meter that indicate soil moisture. In many areas, such readings are saving one-third to two-thirds of the water with no change in crop yields, and are allowing farmers both to distribute water more evenly across a field and to schedule irrigation more efficiently. This technique also cuts pumping costs and reduces runoff of soil salts and agrichemicals.”

Such cost-effective improvements are the most likely way to “move the dial.” If an opportunity of this scale (23-46% of global fresh water withdrawals!) can be explored *profitably*, it seems a likely candidate for early adoption. Provided the business case is as strong as Lovins et al suggest, it is surprising that the opportunity has not yet been explored. Backwards policy can be a hurdle, like the use-it-or-lose-it system of water rights in the western US, but such hurdles can be overcome with creativity, collaboration, and persistence.

We will need to explore opportunities at every scale and at every point in the system from supply to pollution and treatment to demand if we intend to avoid the worst of the water crisis. This is confirmed elsewhere in the literature; Lester Brown in *Plan B 4.0* writes, “Future gains from irrigation will likely come more from raising irrigation efficiency than from expanding irrigation water supplies” ([Brown, 2009](#_ENREF_5)). *So, why the hold up?* “It does not pay to invest in improvements in crop production and management or water resources at today’s low prices. But because of the long gestation period, the failure to invest could exacerbate the problem of water scarcity and threaten food security” ([Barker, 2000](#_ENREF_1)). Our notoriously poor capacity to make net present value calculations may land us in a position of taking yet another cure approach when a prevention model would have been *much* less costly – even profitable! As bleak as the situation sometimes seems, the McKinsey study indicates that an annual capital investment of approximately $50 to $60 billion could close the water resource availability gap, if done in the least costly way available – a figure that is almost 75% less than a supply-only solution ([WRG, 2009a](#_ENREF_36)). WRG outlines billions of dollars of opportunities for 5 specific private sectors in making the transition to more efficient water use:

**Water Efficiency Opportunities by Sector (**[**WRG, 2009a**](#_ENREF_36)**)**

|  |  |
| --- | --- |
| **Sector** | **Nature of Opportunity** |
| Agricultural producers and other agricultural value chain players | operational savings and increased revenues could offer an $83 billion increase in aggregate agricultural income by 2030 |
| Financial institutions | lending and equity investments in drip irrigation: likely to grow 11% annually |
| Large industrial water users | dry cooling and fluidized-bed combustion in power generation, and paste tailings in mining |
| Technology providers | 56x growth in low pressure membrane technology (2005-2030) |
| Construction sector | $1.4 billion / year |

McKinsey pegs the global opportunity between $2.9 and $3.7 trillion, with ~70% of the projects providing a return on investment of greater than 10% ([Thompson, 2011](#_ENREF_29)). Just as Al Gore pointed out many of the opportunities to reverse climate change in 2006, we now have a roadmap of profitable opportunities to reduce the impact of our water crisis. We must be about the business of exploring these opportunities through creative public private partnerships, direct private investment, and public works, without delay.

As is so often the case, the bad news is the good news; our mismanagement of water, specifically with respect to irrigation efficiency, leaves tremendous room for improvement. The US has about 4% penetration of drip irrigation systems which are much more efficient than standard flooding practices, and India and China boast only 1-3%. This is good news only insofar as it presents an opportunity to achieve meaningful efficiency gains with an excellent return on investment: “…drip irrigation systems... pay for themselves in 1 year by simultaneously raising yields and reducing water costs.” ([Brown, 2009](#_ENREF_5)) 2030 Water Resources Group identifies other opportunities along a spectrum of their impact and profitability. McKinsey & Company recognizes that many water productivity investments yield positive returns in 3 years ([Boccaletti et al., 2010](#_ENREF_3)). Another profitable, high-impact opportunity is repairing leaky municipal infrastructure. The primary water tunnel supplying New York City, for example, leaks 35 million gallons/day ([NationalGeographic, 2010b](#_ENREF_21)). In such persistent and dramatic cases of poor stewardship, the system is most easily questioned; “Who owns the infrastructure? Who is providing what services to whom and under what terms? What are the incentives to maintain and improve infrastructure? How can we align those incentives to steward the health of the system?

Certain policies are barriers to exploring such “no-brainer” opportunities. Rob Harmon gives an exceptional TED talk[[11]](#footnote-11) about a successful example of one tenable solution in the American West where once-broken market mechanisms are being creatively leveraged to restore ecosystem health and a sustainable future. Creative approaches like these will be an important part of developing solutions for the kaleidoscope of location-specific circumstances, where government, business, and nonprofits must learn to dance without crushing the toes of an unassuming public. Wharton’s [Witold Henisz](http://www.wharton.upenn.edu/faculty/henisz.html) shares the view that coordination will be essential to solving global water problems ([Wharton, 2008](#_ENREF_34)). Another important demand-side tool is embodied resource consumption. Americans, for example, eat a disproportionate amount of red meat per capita. Finding other, less water-intensive protein sources, like mushrooms, and substituting them could provide an important safety valve for levered water consumption (see Figure 2, above: 1 kg beef = 15,500 Liters water).

Water and Sanitation for the Urban Poor[[12]](#footnote-12) is committed to creative solutions. They have brought corporations including RWE Thames Water, Halcrow Group, and Unilever to the table with CARE, WaterAid, WWF and government entities to build projects that have a designed 7-10% return: sustainable yet attractive to commercial participants. Another variation on this theme might include municipal bond issues to help facilitate transactions during constrained capital periods and provide an additional feedback loop to build community ([SustainAbility, 2007](#_ENREF_28)). The role of appropriate technology[[13]](#footnote-13) should not be overlooked in the context of low-cost, culturally appropriate, decentralized solutions to the vast challenge of clean drinking water for all. Rajendra Singh of Ghopalpura village in India, for example, used local appropriate technology wisdom of water conservation to help construct 7,600 water harvesting structures ([Salina, 2008](#_ENREF_25)). These stand in contrast to the wells springing up in India at an alarming rate: one of the proverbial canaries in the coal mine – in 1960 there were 100,000 wells, by 2006 this number had climbed to ~12 million ([Wikipedia, 2012](#_ENREF_35)). Coca-Cola has experienced challenges in India much as Nestle has in the United States, being accused of lowering the water table beyond the depths small farmers can reasonably reach with lesser equipment ([Burnett & Welford, 2007](#_ENREF_6)).

Stepping way back to the economic theory of the situation, a brief exploration of market failure theory ([e.g., Cowen, 1988](#_ENREF_7)) is appropriate in the context of water. The public good is extremely vulnerable to externalities – fragile and easily contaminated, even by non-point-source contaminants, and difficult to restore. Because of the inherent challenges of allocating a public good (“my use does not diminish your use until the resource is gone”), the moral hazard is tremendous. Information asymmetry is another unfortunate consequence of the dominant monopolistic/oligopolistic industry structure. Inappropriate government intervention further complicates the industry and our relationship with water. The World Bank model, for example, represents an uncomfortably close interplay of private and public interests. Multi-billion dollar contracts are meted out to few large corporations capable of major infrastructure projects rather than implementing innovative (and often small and distributed) approaches to steward resources and deliver services to those who need them.

Supply side solutions tend to be big public works projects, but demand side solutions can’t be delivered that way. Lowering transaction costs and facilitation of micropayments in a smartphone world where demand side opportunities lie in smaller transactions might point the way to an open source platform for micro-entrepreneurs. The easieist, sexiest lever to pull on the demand side is embodied / embedded resources; the opportunities for reductions, especially for industrialized nations / firms, are significant and typically easier than managing direct water consumption: “Pass on one steak dinner and you can claim over 7,000 Liters in reduced consumption!”

There is no silver bullet solution. There are, however, quite a number of profitable opportunities to be explored, many of them at scale and others much more decentralized like the implementation of no-till farming ([Huggins & Reganold, 2008](#_ENREF_16)). In addition to those already identified, McKinsey notes that repairs & improvements to municipal water infrastructure in China carry a 22% rate of return ([Boccaletti et al., 2010](#_ENREF_3)).

Because of the unique nature of water and the challenges involved in maintaining and delivering it, it seems likely that sustainable solutions will neither be an exclusively privatized effort nor an exclusively public endeavor, but rather a creative blend.For an overview of nonprofit projects in water systems management, see the list at Guerilla Green[[14]](#footnote-14).Volumes could be written about water as a resource versus water as property. Water has unique and potent social, cultural, and religious dimensions and can never be viewed as a purely economic good ([WEF, 2011](#_ENREF_33)). The Skoll Foundation[[15]](#footnote-15) adds, “The key point is that a range of social, environmental, and governance challenges increasingly demand something more than corporate citizenship responses. They require innovative, entrepreneurial, and – often – disruptive strategies which incumbent companies are often ill-prepared to develop or deliver.” ([SustainAbility, 2007](#_ENREF_28)) In part due to the complexity and inseparability of these issues, attempts to privatize water have gone horribly wrong in places like Cochabamba Bolivia, where in 2000, people were killed during protests of Suez International & Bechtel’s privatization of water ([Finnegan, 2002](#_ENREF_11); [Salina, 2008](#_ENREF_25)). In Mexico, public waterways are contaminated by private firms, sometimes irreparably. Globally, system failures allow pharmaceutical companies to indirectly contaminate the water supply with prescription medications not yet designed to be easily removed or to biodegrade: another opportunity. In the U.S. Nestlé, Coca-Cola, and others have run afoul of citizens from Michigan to Maine, pumping local water supplies to sell bottled water, which has a host of sub-issues from social to economic to health, covered in *Tapped*[[16]](#footnote-16) and other films.

The systems involved are complicated. While the water cycle is, in a vacuum, easy enough to teach grade school children, human interaction with it has dramatically complicated the simple story with which we’re familiar. Unconscionable perversions typify our relationship with arguably our most precious nonrenewable resources; we flush our wastes with it and nearly half of urban water use is for landscaping, billions of gallons of that for golf courses. It is not surprising, then, that our systems are broken: impervious surfaces in Los Angeles result in $500 million in annual expenditures on flood control to take water ‘away’ and $1 billion to import it ([Hawken, Lovins, & Lovins, 1999b](#_ENREF_13)). Why don’t insurance companies intervene to redesign such systems with the express intention of reducing flood claims and risk in their customer territories? Other major industries with significant, quantifiable risk exposure to water security include mining and energy. In 2007, a drought forced the US Tennessee Valley Authority to reduce its hydropower generation by nearly a third, losing $300 million in power generation ([Boccaletti et al., 2010](#_ENREF_3)). We persist in developing systems that are out of harmony with the overall system at our own peril. As David Brower is famous for saying, “There is no business to be done on a dead planet.”([OPFTP, 2012](#_ENREF_22)) We must exercise caution when devising solutions, even to the problems we ourselves have created, heeding cautionary tales from *Natural Capitalism* and others mindful of destabilizing system dynamics with unintended consequences; instead of allowing the context to be competing interests in a zero sum game, it behooves us to seek multiple benefits from single interventions. As we develop these interventions, it is also critical to consider who is providing direction on how to address the issues – think corporate governance; of course Dow wants fertilizer to be part of the solution, and it may well be, but their input must be taken in context and they ought to recuse themselves after providing third-party verified data to support their argument for how and why fertilizer should play a role in avoiding water crises. So too, they should be required by law to vouchsafe their products and provide mechanisms for removing them from our water systems. This point rings particularly true in the context of the Pharmaceutical industry and their myriad problems with persistent pharmaceuticals in the water supply. It is unconscionable that we do not more closely regulate this industry to prevent indirect and unintentional / unwitting consumption of compounds that change brain chemistry. If human use is not compelling, add to this the livestock loads and stir in the chemical cocktails that run off from agricultural application… Rachel Carson warned us about such pollutants in the 1960s and we have yet to develop systems to ensure the health of our own water supply. Myriad forms of pollution represent additional opportunities for creative problem solvers in Chemistry, Biology, and Engineering.

## Metrics: Tools that span social, environmental, and fiscal

Straight from one of the better big-picture overviews of the water space: “One missing piece has been the lack of a rigorous analytical framework to facilitate decision-making and investment into the sector, particularly on measures of efficiency and water productivity.”([WRG, 2009b](#_ENREF_37)) This lack of tools, itself, is an entrepreneurial opportunity in the space.

In conjunction with Deloitte, the [Carbon Disclosure Project released their first report in 2011](https://www.cdproject.net/CDPResults/CDP-Water-Disclosure-Global-Report-2011.pdf) in an effort to raise corporate awareness of global water issues on behalf of 354 investors with $43 trillion in assets.

**We largely take for granted nature’s filtration system, especially wetlands.**  
“Wetlands can remove 20 to 60% of metals in the water, trap and retain 80 to 90% of sediment from runoff and eliminate 70 to 90% of entering nitrogen.”([ESA](#_ENREF_8)) New York City has a checkered past with these specific issues; their Fresh Kills landfill was originally a wetland and, more recently, the State spent $1 billion to restore a watershed to provide comparable services rather than spend $8 billion on a water treatment facility in New York City.([ESA](#_ENREF_8))

When it comes to water, the issues are legion and the systems are complex. The stakes could not be higher and sustainable solutions will require the collaboration of a proverbial village: from Economists to Chemists, from corporations to citizens to governments, there is no one who cannot relate to and help solve our water crisis. This is fortunate, because work this heavy requires many hands to make it manageable. Given the complexity, scale, and sheer momentum of the issues, it can be daunting to tackle “water” as a challenge. Interdisciplinary teams with stakeholders from far-flung points along the value chain, working together can solve the issue for a given watershed, an isolated community, and even whole cities. In fact, we have little choice but to do so, leaving the initial questions, “When and how will you start acting to foment change to set your community on the path to a sustainable water future?”

# References

Barker, R. 2000. Global water shortages and the challenges facing Mexico. ***International Journal of Water Resources Development*** 16: 525-542.

Blackhurst, M., Hendrickson, C., & Vidal, J. S. I. 2010. Direct and Indirect Water Withdrawals for U.S. Industrial Sectors. ***Environmental Science & Technology***, 44(6): 2126-2130.

Boccaletti, G., Grobbel, M., & Stuchtey, M. R. 2010. The business opportunity in water conservation. ***McKinsey Quarterly***(1): 67-75.

Bozzo, S. 2008. Blue Gold: World Water Wars: 90 minutes.

Brown, L. R. 2009. Plan B 4.0.

Burnett, M., & Welford, R. 2007. Case study: Coca-Cola and water in India: episode 2. ***Corporate Social Responsibility & Environmental Management***, 14(5): 298-304.

Cowen, T. 1988. ***The Theory of Market Failure: A Critical Examination***. Fairfax, Va.

Lanham, MD: George Mason University Press ;

Distributed by arrangement with University Pub. Associates; Co-published by arrangement with the Cato Institute.

Deloitte. 2011. CDP Water Disclosure Global Report 2011.

Engineering, N. A. o. 2011. Provide access to clean water, ***Grand Challenges***, Vol. 2012.

EPA, U. 2012. Clean Lakes. In U. EPA (Ed.): United States Environmental Protection Agency.

Finnegan, W. 2002. Leasing the Rain. ***New Yorker***, 78(7): 43-53.

Hawken, P., Lovins, A. B., & Lovins, L. H. 1999a. Aqueous Solutions, ***Natural Capitalism: Creating the Next Industrial Revolution***, 1st ed.: pp. 213-233. Boston: Little Brown and Co.

Hawken, P., Lovins, A. B., & Lovins, L. H. 1999b. ***Natural capitalism : creating the next industrial revolution*** (1st ed.). Boston: Little, Brown and Co.

Hollis, J. 2008. ***What Matters Most: Living a More Considered Life***: Gotham.

Hong, Y. 2004. Virtual Water Trade. ***Corporate Knights Magazine***, 3(2): 10-11.

Huggins, D. R., & Reganold, J. P. 2008. No-Till: The Quiet Revolution. ***Scientific American***, 299(1): 70-77.

IGD. 2012. Embedded Water in Food Production.

IRN. 1998. Major Problems Found in Three Gorges Dam Resettlement Program: A joint report by the International Rivers Network and Human Rights in China.

Meyers, T. 2008. trend: green. ***Entrepreneur***, 36(12): 57-61.

NationalGeographic. 2010a. Groundwater. ***Part of a special issue: Water: Our Thirsty World***, 217(4): 130-131.

NationalGeographic. 2010b. Water: Our Thirsty World, ***National Geographic***, April 2010 ed., Vol. Special Issue: 56. Washington, D.C.

OPFTP. 2012. 1% For the Planet Pamphlet.

Ostman, J. V. a. K. 2009. UK Water.

Paynter, N. 2012. Defining Sufficiency in Water. In J. Lowell-Bellew (Ed.).

Salina, I. 2008. Flow: For Love of Water.

Schendel, E. K., Macdonald, J. R., Schreier, H., & Lavkulich, L. M. 2007. Virtual Water: A Framework For Comparative Regional Resource Assessment. ***Journal of Environmental Assessment Policy & Management***, 9(3): 341-355.

Smith, C., Ollman, D., Price, S., Bonanno, M., Bichlbaum, A., Moore, M., Lichty, P., Salamone, S., United Artists, C., Free, S., & Inc, M. G. M. H. E. 2005. The Yes Men, Vol. Widescreen. Los Angeles, CA: MGM Home Entertainment.

SustainAbility. 2007. Growing Opportunity: Entrepreneurial Solutions to Insoluble Problems: SustainAbility Ltd.

Thompson, F. 2011. Setting Priorities For Resource Productivity.

Trends. 2009. The Great 21st Century Water Opportunity. ***Trends Magazine***(73): 19-22.

water, c. 2012. Water Changes Everything: charity : water.

Waterwise. 2007. Hidden Water, ***A Waterwise Briefing***.

WEF. 2011. Water Security: The Water-Food-Energy-Climate Nexus, ***The World Economic Forum Water Initiative***. Washington Island Press.

Wharton. 2008. Ebb without Flow: Water May Be the New Oil in a Thirsty Global Economy, ***Knowledge @ Wharton***, Vol. 2012.

Wikipedia. 2012. Groundwater, Vol. 2012: Wikipedia.

WRG. 2009a. Charting Our Water Future: Water Resources Group 2030

WRG. 2009b. Charting Our Water Future: Water Resources Group 2030

Zackowitz, M. G. 2010. Back to the Source. ***Part of a special issue: Water: Our Thirsty World***, 217(4): xxiii-xxvii.

1. http://www.un.org/en/documents/udhr/ [↑](#footnote-ref-1)
2. The CDP Water Disclosure 2011 Global Report (written by Deloitte) can be downloaded here: https://www.cdproject.net/CDPResults/CDP-Water-Disclosure-Global-Report-2011.pdf [↑](#footnote-ref-2)
3. For example, every 19 seconds, a mother loses a child to waterborne illness. (source: [charity : water](http://www.youtube.com/watch?feature=player_embedded&v=BCHhwxvQqxg#t=108s) -- water, c. 2012. Water Changes Everything: charity : water.) [↑](#footnote-ref-3)
4. http://www.tailings.info/paste.htm [↑](#footnote-ref-4)
5. http://www.2030waterresourcesgroup.com [↑](#footnote-ref-5)
6. http://www.charitywater.org/ [↑](#footnote-ref-6)
7. http://water.epa.gov/type/lakes/ [↑](#footnote-ref-7)
8. Data Sources: NationalGeographic. 2010b. Water: Our Thirsty World, ***National Geographic***, April 2010 ed., Vol. Special Issue: 56. Washington, D.C.; NationalGeographic. 2010a. Groundwater. ***Part of a special issue: Water: Our Thirsty World***, 217(4): 130-131.; Zackowitz, M. G. 2010. Back to the Source. ***Part of a special issue: Water: Our Thirsty World***, 217(4): xxiii-xxvii. [↑](#footnote-ref-8)
9. Data Sources: http://www.waterfootprint.org/?page=files/WaterStat-ProductWaterFootprints; NationalGeographic. 2010b. Water: Our Thirsty World, ***National Geographic***, April 2010 ed., Vol. Special Issue: 56. Washington, D.C. [↑](#footnote-ref-9)
10. http://www.gpt.com.au/ [↑](#footnote-ref-10)
11. http://www.ted.com/talks/lang/en/rob\_harmon\_how\_the\_market\_can\_keep\_streams\_flowing.html [↑](#footnote-ref-11)
12. http://www.wsup.com/ [↑](#footnote-ref-12)
13. http://www.appropedia.org/Appropriate\_technology#Water\_supply\_and\_treatment [↑](#footnote-ref-13)
14. http://guerillagreen.wagn.org/wagn/Water\_Nonprofits\_in\_the\_space [↑](#footnote-ref-14)
15. http://www.skollfoundation.org/ [↑](#footnote-ref-15)
16. http://www.tappedthemovie.com/; http://www.hulu.com/watch/192680/tapped [↑](#footnote-ref-16)