Water Conservation Law and Technology Reform

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1. INTRODUCTION

Water is one of the most abundant and useful resources the earth has, and for these same reasons, it is one of the most polluted. Water is, by nature, a strong solvent characterized by its ability to dissolve and disperse other substances. This characteristic makes water vital to many industrial applications, agricultural applications, and, of course, life. Given the solvent characteristic of water, any pollution introduced into a body of water is exacerbated by the water itself. In other words, water serves as a vehicle for quick and effective contamination. Since water is so important to all living things on this planet, efforts to conserve our water resources are of utmost importance. Addressing water pollution requires both legal force and the technology required to implement.

Effective efforts to address water pollution begin with enacted law, rather than a person's own desire to protect water resources, because meaningful water conservation practices will not be fully adhered to naturally. Unfortunately, it is an economic reality that law must force society to operate in an environmentally friendly manner because not doing so is usually far less expensive and burdensome. Enacted conservation law seems to be most practical in the form of preventative restriction laws and not so practical in laws focusing on cleanup measures. This is because it is easier to monitor and restrict current sources of pollution than it is to hold accountable those that polluted in the past and then require them to make reparations. Thus, the government also looks to more economically pragmatic avenues for driving cleanup efforts.

There is, of course, a counterpart to enacted law and incentives and that is technological advancement. Typically, the action involved in meeting the legal standards and receiving incentives requires advancement in technology. For water conservation, advancements in technology address the two main issues: conserve and replenish. The enacted law and government incentives drive each type of advancement technology. However, conserving and

replenishing are not easy tasks and, not surprisingly, a great deal of technology emerges from these difficulties.

The United States Government has approached the intersection of water conservation and technology in three main ways: 1) preventative measures, 2) retroactive laws and incentives, and 3) intellectual property approaches. Both preventative measures and retroactive laws and incentives drive particular types of technology.

2. WATER CONSERVATION PREVENTATIVE MEASURES

The United States first addressed the environmental issues with restriction in the monumental environmental laws of the late 1960's and early 1970's. The first modern-day environmental law passed was the National Environmental Policy Act (NEPA), which set out major environmental goals for the country and further established required environmental assessments of federal activities. *U.S. Environmental Laws,* http://www.nrdc.org /reference/laws.asp (2016). The main thrust of the act was to ensure that the environment was considered as an equally weighted factor in any proposed project that required Federal permit. 42 U.S.C. § 4321 (2012). While NEPA was a significant step in environmental awareness and the indication that legislation is taking environmental protection seriously, the main thrust for water conservation was yet to come. Two major water conservation acts followed NEPA; the Clean Water Act and the Safe Drinking Water act.

A few years after NEPA, the United States significantly overhauled the original Federal Water Pollution Act of 1948 into what is now the Clean Water Act of 1972. The Clean Water Act's objective is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251 (2012). Specifically the Clean Water Act set out to eliminate discharge into navigable waters, regulate the discharge rate of toxic pollutants and ensure adequate local waste treatment facilities. *Id.* Of particular interest is § 1251(a)(6) which states,

"it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans." *Id.* The phrase "within the limits of available technology" can be found in every performance standard within the Clean Water Act. This phrase indicates that, in many cases, it is not the willingness, cost, or any other reason that limits water conservation; it is technology.

Closely following the Clean Water Act, the Safe Drinking Water Act was enacted and further urged the need for water conservation. The Safe Drinking Water Act requires minimum standards for water purity levels for drinking water and any future drinking water sites. The Safe Drinking Water Act puts a particular onus on any owner of public water to maintain its purity levels. And similar with respect to the Clean Water Act's performance requirements, the containment levels can only be set to "feasible" levels, which are defined as "feasible with the use of the best technology, treatment techniques and other means which the Administrator finds." 42 U.S.C. § 300g-1 (2012).

a. PREVENTATIVE TECHNOLOGY

In order for industry to abide by water conservation requirements, a vast array of technical requirements must be met with the help of innovation. There are two main technical areas where industry adjusts to regulations which limit the amount of contaminants that are released into the water. These two areas can be illustrated by the technical areas of 1) filtration technology and 2) efficient use systems, respectively.

i. FILTRATION TECHNOLOGY

One of the main areas where water conservation technology has blossomed is water filtration. This technology stems from toxic contamination output regulations stemming from the Clean Water Act. Because companies can no longer expel contaminated water used in their

facilities, it must be filtered to an prescribed purity level before it is emitted into the local waste water system. There are a number of filtration technologies which are all designed to capture certain contaminants within water.

First there is the traditional mechanical filter, which removes solid debris from water. This type of filter works by allowing only small particles through and trapping larger particles. *The Nitty Gritty of Filter Types and Technologies,* http://www.ewg.org/research (February 27, 2013). These filters are simple and usually reusable but they cannot remove any type chemical contaminants.

The most common and arguably the most effective filtration technology is the carbon-based filter. Carbon has the unique characteristic of both attracting contaminants and also having an incredibly high surface area to volume ratio. *Water Treatment*, http://www.activated-carbon.com/application/water-treatment (2015). The latter fact is due to filtration carbon's very high levels of micro-porosity. *Id.* At its highest effectiveness rate, filtration carbon can remove all forms of contamination except for inorganic chemical compounds.

Ion filtration technology is based on the removal of ionized contaminants. The idea behind this type of filter is to induce either a positive or negative electric charge onto a surface then allow contaminated water to flow over it. *The Nitty Gritty of Filter Types and Technologies.* Any oppositely charged contaminants will be attracted to the charged surface and will be captured. *Id.* Ionic filters will obviously have no effect on non-charged contaminants, which can include volatile organic compounds.

Distillation serves as a useful contaminant removal system for removing many types of contaminants including some chemicals. *Id.* Distillation works by heating water to its boiling point and then condensing the steam back to water. During this process, insoluble contaminants, bacteria, viruses, and any chemical compound that has a higher boiling point than water will be

removed from the condensed liquid. *Id.* However this process does not remove volatile organic compounds because they become gaseous at a lower boiling point than water and they are, therefor, condensed along with the steam.

Reverse osmosis is yet another filtration method that is very effective in eliminating a wide variety of contaminants. The only contaminants that reverse osmosis water cannot remove are chlorine and volatile organic compounds. *Reverse Osmosis,* http://puretecwater.com/what-is-reverse-osmosis.html (2016). In operation, reverse osmosis uses a semi-permeable membrane and pressurized water to extract contaminants from water. *Id.*

Ozone and ultraviolet light are yet two other forms of filtration that specifically combat bacteria and microorganisms. However, they are not effective in eliminating chemical compounds of any type and do not remove any solid debris. Ozone attacks the cellular structure of living organisms such that their cellular membranes are destroyed when contacted by ozone. The ruptured cellular membrane causes cellular death. *Effect of Ozone on Bacteria,* http://www.ozonesolutions.com/info/effect-of-ozone-on-bacteria (2015). Ultraviolet light kills bacteria and microorganisms by catalyzing a chemical reaction between two existing DNA building blocks. The chemical reaction destroys the DNA of the cell causing death. Anne Rammelsberg, *How Does Ultraviolet Light Kill Cells?* http://www.scientificamerican.com/article/how-does-ultraviolet-ligh/ (August 17, 1998).

While filtration technologies have been around for a long time, there is certainly room to improve as evidenced by the number of different filtration technologies that it takes to clean water of all types of contaminants. For instance, industrial filtration applications will combine mechanical filters with carbon filtration and reverse osmosis to properly decontaminate water used in a manufacturing process. Further, most of these filtration technologies are consumable and not reusable.

ii. EFFICIENT USE SYSTEMS

The most effective method of clean water conservation is simply to limit the use of clean water. This sentiment is a semblance to the alternative energy industry in that the best form of alternative energy is energy that is not used. There are a variety of ways that technology has impacted the efforts to expand on the Earth's clean water resources. Many of which involve limiting the flow rate that is supplied to a particular site by the public utilities. These technologies typically involve simple variations of restriction valves.

However, another approach to extending the natural supply of clean water is to utilize existing building structures to capture rainwater. The concept is called rainwater harvesting and the idea is simple: collect rainwater from the roof of a building using a gutter system, and run it through a simple mechanical filter to remove solid particles. *Rainwater Harvesting*, http://www.conservationtechnology.com/rainwater.html (2008). See figure 1. There are varying degrees of water purity that can be achieved based on filtration systems, as well as types of roof material that the rain would be collected on. *Id.* The innovative crux of the rainwater harvesting system is that it utilizes existing roofs and gutter systems, which are particularly suitable for rainwater gathering. This factor dramatically reduces new infrastructure needed to implement the system.

Figure 1. Rainwater collection system.

3. WATER CONSERVATION RETROACTIVE LAWS AND INCENTIVES

As previously mentioned, enacted law is most useful and prevalent in preventative water conservation enforcement but not so apt in retroactive clean up of contaminated water. However, when there is a particular area that has been heavily contaminated that serves as a source of water contamination, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) becomes extremely important. In 1980, CERCLA, more commonly known as Superfund, was enacted requiring those liable for sites contaminated with toxic waste to provide substantial cleanup to specified degrees of purity. *About the Superfund Cleanup Process,* http://www.epa.gov/superfund/about-superfund-cleanup-process (2015). Generally, Superfund identifies contaminated sites, assesses their danger, enacts cleanup plans and holds liable those who are responsible for the contamination. *Id.* Interestingly, any cleanup plan that is developed through Superfund requires a thorough assessment and recordation of the technologies that are to be used during the cleanup. A Superfund cleanup plan requires thorough representation of the "[p]rocedures and techniques to be employed in identifying, containing, dispersing, and removing oil and hazardous substances." 33 U.S.C. § 1321 (2012). The effectiveness and overall success of the clean up plan hinges on the cleanup technology available.

Since retroactive laws to clean already contaminated water are hard to implement without an identifiable contamination source, the government is left with incentivizing cleanup efforts and also incentivizing cleanup technology. With respect to technology, the most direct incentives are subsidies and grants. The government subsidizes many environmentally friendly endeavors including brownfield developments, various waste management programs, alternative fuel development and usage, pollution control, renewable energy, and electric vehicles. *Subsidies for Pollution Control*, http://yosemite.epa.gov/ee/epa/eerm.nsf (2001). The ability to grant funds to water conservation research and development is specifically enabled by both the Clean Water Act.

The Clean Water Act states that the Environmental Protection Agency is authorized to grant funds directly to any State or municipality in order to assist in the research and development of

> 1) preventing, reducing, and eliminating the discharge into any waters of pollutants from sewers; or
>
> 2) advanced waste treatment and water purification methods.

33 U.S.C. § 1255 (2012). This section of the Clean Water Act emphasizes the importance of water conservation by allowing States and municipalities to try new methods and technology without fear of massive losses to their annual budgets. Similarly, Superfund authorizes the Environmental Protection Agency to grant funds to Universities, which have established Hazardous substance research centers. 42 U.S.C. § 9660 (2012).

a. RETROACTIVE TECHNOLOGY

Superfund, as well as grants, provide for a field of innovation that is generally focused on hazardous waste cleanup technologies. These technologies include ocean solid waste and oil recapturing. Specifically, major innovation efforts are focused on surface cleaning devices that capture floating plastic waste that will otherwise never degrade.

Ocean solid waste recapturing addresses the problem of non-biodegradable waste, such as plastics, that find their way into the ocean either from waste barges or senseless waste dumping. Ocean plastic harms to ocean animals that either ingest plastic waste or get caught in it to chemical emission of the harmful plastic manufacturing chemicals, i.e. Bisphenol A (BPA). Social media and water conservation websites are fraught with disturbing pictures of the effects of plastic waste on ocean life illustrating the very real consequences of this type of contamination.

Generally, ocean solid waste recapturing devices operate at the surface of the ocean or any other body of water. These devises then reclaim plastic and other solid waste that is floating on the surface. Locating these devices on the surface of the water serves the purpose of both enhancing the ease of maintenance and recaptured waste removal but it is also because most consumable plastics, e.g. polypropylene (PPT), polyethylene (PET), and polystyrene (PS) are either less dense or approximately the same density as pure water. *Polymers-Physical Properties*, http://www.engineeringtoolbox.com/polymer-properties (2015). Some of these systems can also be fitted with filters such that they can then reclaim oil and other non-soluble chemicals that float on the surface.

The Seabin® is an example of ocean solid waste recapturing device that is intended to mount to floating docks, private pontoons, inland waterways, residential lakes, harbors, water ways, ports and large boats. http://www.seabinproject.com (2016). The idea behind Seabin® is to capture solid waste and oil in marinas and ports which are large contamination sources. See Figure 2 below.

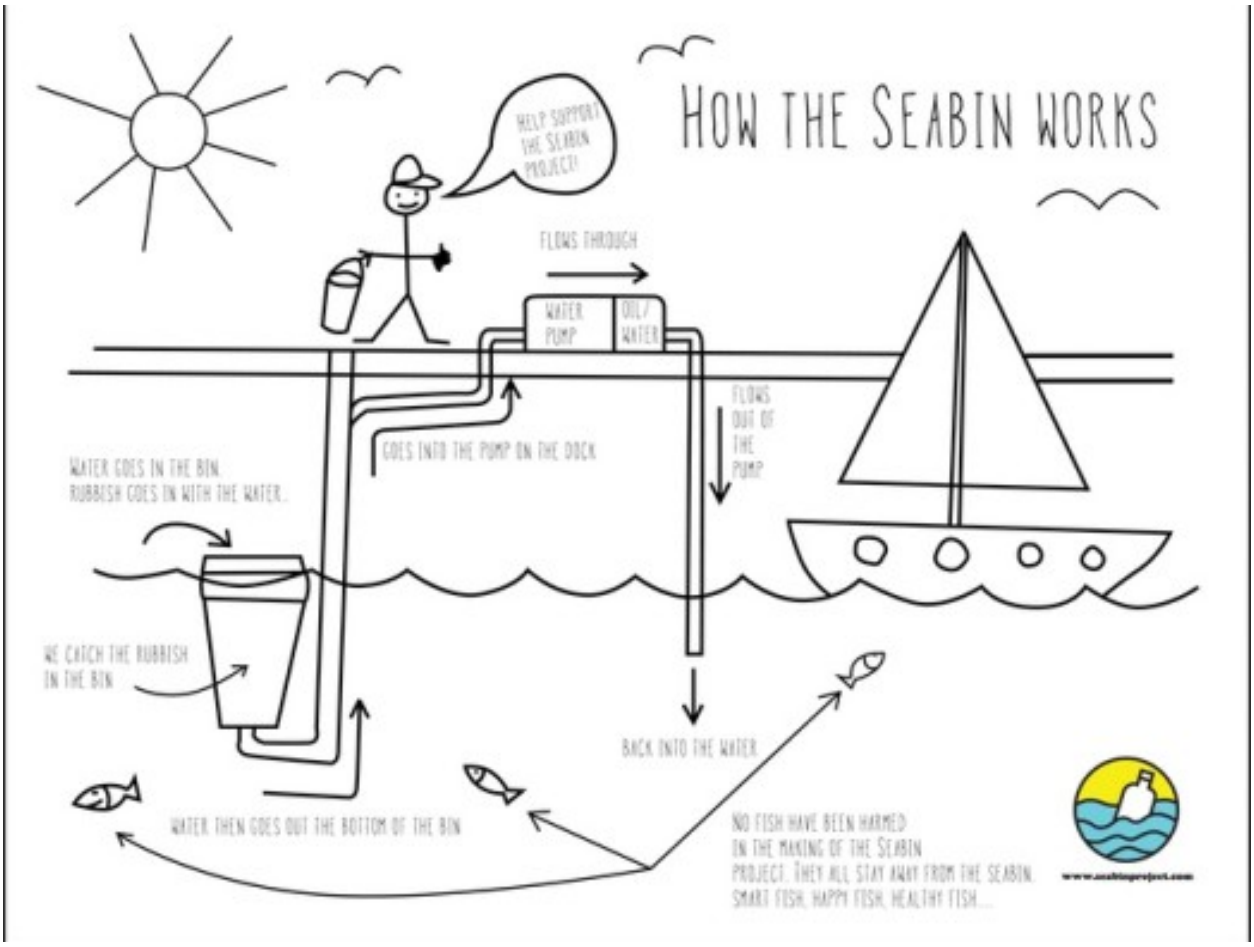

Figure 2. Seabin® basic design.

For deep ocean garbage, there are a few independent-type systems that are designed for the middle of the ocean where they reclaim floating waste at particular areas of the ocean. *The Plastic Pollution Problem,* http://www.theoceancleanup.com/problem.html (2015). Interestingly, the areas where solid floating waste accumulates are a known design element. Because of predictable motion through tidal forces and current flow, there are five areas within the Earth's oceans where the currents merge. *Id.* These convergent points are called gyres. *Id*. At these points, solid floating waste accumulates and rotates about the central points of current convergence. One of these gyres is speculated to contain one third of the earths floating solid waste and it is aptly named the Great Pacific Garbage Patch. *Id.*

To combat deep ocean garbage located in the gyres, the Ocean Cleanup Array® was developed and is currently undergoing prototype testing. The idea behind this device again utilizes the density characteristics of plastic. The device uses a floating boom and non-permeable screen, which is designed to catch the low-density plastic yet direct water-density-neutral life forms under the screen. *Id.* See Figure 3 below. The insightful element here is that the combination of the boom and the non-permeable screen produce a flat surface that is perpendicular to natural surface currents. Once the surface currents hit the boom or the screen, it is directed downward and underneath the non-permeable screen with increased velocity and decreased pressure; the very same fluid dynamic principles that allow airplanes to fly. The altered current directs animal life that is near the surface underneath the device where the animal life would have been trapped by a permeable screen. *Id.* Yet the floating plastic has a low enough density to remain at the surface. *Id.*

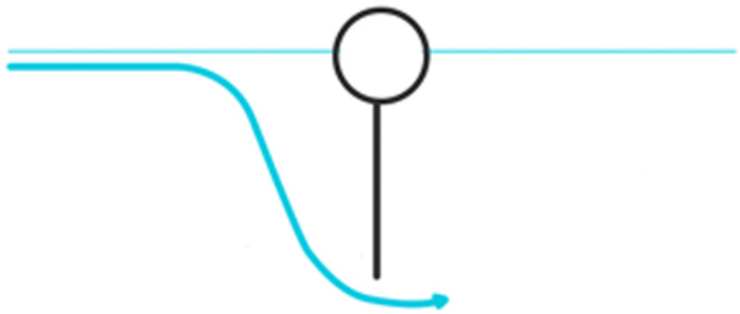

Figure 3. Ocean Cleanup Array boom and screen design.

The Ocean Cleanup Array® is designed to remain in operation in the gyres for decades at a time due to its passive design. *Id.* In other words, it is designed to allow the floating plastic to trap itself within the device without positive mechanical motion. *Id.* See Figure 4 below. The projected effectiveness is that the device will recapture over 40% of the floating debris in the

Great Pacific Garbage Patch within ten years. *Id.* The device is set to launch full scale in 2020. *Id.*

Figure 4. Ocean Cleanup Array sitting stationary within a gyre.

4. INTELLECTUAL PROPERTY APPROACH

Subsidies, though powerful, have certain downfalls. Primarily, subsidies are temporary. Subsidies are meant to provide an initial boost to entice an environmentally friendly decision over the traditional alternative but will not, and cannot, go much further. To many, the temporariness of subsidies is transparent enough to fail in this mission. This leads to another downfall, specifically in the area of new company investing. The government subsidizes environmental companies substantially at startup but investors know that this is temporary. Thus, the subsidy may help the company get off the ground but lasting investors look at these companies as higher risk than what their initial face value shows. Further, subsidies are in themselves not sustainable and remain only good policy for short periods of time. They must be successful in jumpstarting the environmental technologies industry such that it can thrive on its own.

An alternative to subsidies is a progressive approach, which aids the advancement of this industry through technology patent rights. The premise here is to utilize the statutory right to a temporary monopoly to entice innovative growth in the water conservation field. If properly incentivized through patent rights, leading innovators may begin to view water conservation technologies as a more enticing and lucrative field than it was with the mere promise of a subsidy. Patent rights, once received, are huge assets that last for 20 years, which is an asset most subsidies cannot match.

Environmental patent incentives can be approached in three ways: 1) licensing existing patented technologies at a lower price than they would normally license for, 2) utilizing an opensource approach, and 3) reducing the burden of acquiring a patent on technologies. Each will be considered in turn.

a. REDUCED RATE LICENSING AND POOLING

Licensing existing patent technologies at low royalties or low licensing fees induces companies that want to enter an existing market with proven technology at a low upfront cost. In other words, the intellectual property barriers are much lower. This approach may also induce more innovation-based companies to be able to acquire foundational patents at low cost and develop subservient or improvement technologies without the worry of blocking issues.

A leader in this idea is a conglomerate effort known as the Eco-Patent Commons developed by technology leaders and now hosted by the Environmental Law Institute. The idea behind Eco-Patent Commons is to provide an avenue to freely license environmental patents in order to entice entrepreneurs to enter the market and encourage faster innovation. *About the Eco Patent Commons*, www.EcoPatentCommons.org (2015). The Eco-Patent Commons includes a database of over 100-patented technologies including: energy conservation or efficiency, pollution prevention, use of environmentally friendly materials, reduction of materials, and recycling

innovations. *Id.* These technologies were developed by various world technology leaders that have pledged to freely license their patents within the Eco-Patent Commons. *Id.* In distinguishing the Eco-Patent Commons with dedicating the patents to the public, the members retain the right to utilize the patents defensively.

The World Intellectual Property Organization (WIPO) also plays an important role in low-cost licensing. WIPO Green is an operating marketplace for intellectual property in the environmental field. *About WIPO Green,* www3.wipo.int/wipogreen (2015). The marketplace is a vast network of manufacturing and development firms constituting all levels of the supply chain for all environmental industries. *Id.* The goal of WIPO Green is to create a collaborative, rather than strictly competitive, marketplace for new manufacturers or seasoned manufactures of environmentally friendly products to help produce products faster and at lower cost. *Id.*

Interestingly, Superfund also created a very progressive approach to collaborative technology and sharing when it enacted the Superfund Innovative Technology Evaluation Program (SITE). In relevant part, the Superfund act states that an innovation program of "research, evaluation, testing, development, and demonstration of alternative or innovative treatment technologies…which may be utilized in response actions to achieve more permanent protection of human health and welfare and the environment." 42 U.S.C. § 9660 (2012). The SITE program developed from this enactment and encourages research and development into treatment, monitoring, and measurement innovations as they pertain to hazardous waste cleanup. *Superfund Innovative Technology Evaluation Program, Technology Profiles,* 11th Ed. NRMRL Vol. 1 at 1 (September, 2003). The collaborative effect comes from the program's cooperative agreements with technology developers. *Id.* Superfund allows these technology developers to test and develop their technologies on actual Superfund sites. *Id.* The advantage to hazardous waste site technology developers is that they get access to actual test sites and therefore don't have to

allocate funds to creating simulations in order to test their products. Further, this collaboration provides the technology developers with an immediate customer if their technology works well. Integral to this agreement however is the technology transfer agreements in place in the cooperative partnerships. The SITE technology transfer program clause includes the development, collection, evaluation, coordination, and dissemination of information relating to the utilization of alternative or innovative treatment technologies for response actions." 42 U.S.C. § 9660 (2012). In order to enhance the dissemination of innovation to the public, the SITE clause further requires the EPA to "establish and maintain a central reference library for such information" unless that information precludes any proprietary rights of the technology developers not previously agreed to. *Id.* This clause lacks the specific language that ensures fair and reasonable licensing at reduced rates but it still provides a central location for innovation and its contacts.

b. OPEN SOURCE INNOVATION

Another approach to inducing innovation in the environmental technology industry is to approach environmental challenges from an open source perspective. Open source development is used most often in software development where a base program is presented and the public is free to copy or modify the program to make it better and fit different needs. The idea is that the program begins to grow and advance organically as people add their own programming to it. This idea has most recently been brought to the environmental technology industry by tech tycoon Elon Musk. Elon Musk, founder of SpaceX, Tesla Motors, and SolarCity has famously been known to share his technological advancements with the world and invites the world to expand on them. An illustrative example is Elon Musk's idea for high-speed public transit called Hyperloop.

The idea behind Hyperloop is that a pod can travel at very high speeds with low energy when travelling through a near vacuum environment. Alexander Chee, *The Future of Everything, The Race to Create Elon Musk's Hyperloop Heats Up*, *The Wall Street Journal*, (November 30, 2015), http://www.wsj.com/articles. The target speed is 760 miles per hour with a proposed line from San Francisco to LA taking less than 35 minutes. *Id.* Elon Musk originally challenged the public with creating the Hyperloop and has seen tremendous feedback. *Id.* Currently there are two leading start-ups working and developing the system. *Id.* Recently Elon Musk has challenged universities worldwide to develop a half scale pod to be used on a test track slated for 2016. *Id.* Again the feedback and participation is surprising.

So is opensource or crowdsource the best way to incentivize the water conservation technology field? For the very few technologies that are extremely exciting and newsworthy, maybe crowdsourcing is the most effective way to improve the technology. However, the majority of needed water conservation technologies may not capture the imagination quite like ultra high-speed bullet transportation. In fact, Elon Musk has been known to doubt the patent system in favor of crowdsourcing for effective incentive for innovation. Again, this may be true for space exploration and cutting edge innovations on high-end electric vehicles, but the crowdsource concept can't be implemented for all technologies. Purely crowdsourced innovation would lead back to the pre-patent era where there was no incentive to innovate because any innovation was ripe for copying.

c. LESS BURDENSOME INTELLECTUAL PROPERTY ACQUISITION

As an alternative approach, obtaining patent rights in the first place could be made less burdensome on the inventor. Obtaining a patent takes approximately two and a half years and many thousands of dollars. Those two facts alone add substantial deterrence to anyone, whether it is a solo inventor or a Fortune 500 company. However, there are two principle factors that

could be manipulated by the United States Patent and Trademark Office (USPTO) to stimulate patent applications on environmental technologies: Application timeline and Application Fees.

The USPTO currently incentivizes applicants to file their environmental innovation applications by offering an accelerated prosecution option called Accelerated Examination. *Petition to Make Special*, MPEP 708.02. Under the Accelerated Examination proceeding, an applicant can get pushed to the front of the examination list if a Petition to Make Special is made and granted. *Id.* A Petition to Make Special is generally granted when an applicant's inventive subject matter is deemed substantially beneficial to the cause of sustainability. *Id.* Specifically, any technology that is either directed to environmental quality or energy is accorded special status. *Id.* With respect to technology directed to environmental quality, the PTO states that special status is given to "all patent applications for inventions which materially enhance the quality of the environment of mankind by contributing to the restoration or maintenance of the basic life-sustaining natural elements, i.e., air, water, and soil." *Id.* Similarly, the PTO will give special status to "patent applications for inventions which materially contribute to (A) the discovery or development of energy resources, or (B) the more efficient utilization and conservation of energy resources." *Id.* This quick pass prosecution could be extremely advantageous for fast moving technologies that could very rapidly change within the typical three-year prosecution period. While the PTO has made provisions with respect to the timeliness of sustainable patent grants, it has not made the same provisions for application fees.

The USPTO currently has three levels of fees that are set based on various dispositions of the inventor or inventing entity, i.e. micro entity, small entity, and large entity. However, there is no fee reduction specifically for environmental technologies or energy. *Claiming Small Entity Status* MPEP 509.03. The USPTO could utilize its flexibility in fee structure to lower the fee tier for inventions that have a substantial impact on the sustainability. This would provide a clear and

obvious incentive for an applicant to file her environmental innovation. While the majority of costs for prosecuting a patent are generally for attorney's fees, the visible advantage will still serve some level of enticement at a reasonably small cost to the USPTO. With regards to lowering fees, 37 C.F.R 1.102 (c) states that "[a] petition to make an application special may be filed without a fee if the basis for the petition is…(2) [t]hat the invention will materially: (i) Enhance the quality of the environment; (ii) Contribute to the development or conservation of energy resources." 37 C.F.R §1.102 (c), (2011). However, this fee waiver only applies to the Petition to Make Special and not the base application fees. *Id.*

5. CONCLUSION

An integral part of water conservation laws are their correlation to water conservation innovation. Therefore, it is important that future amendments and new state laws keep this relationship at heart and provide for alternative solutions that enhance water conservation technology. Enacting technology-driven environmental laws as well as streamlining patent acquisition powerfully incentivizes water conservation efforts. Water conservation can only progress as fast as technology will enable true conservation of Earth's clean water resources.

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