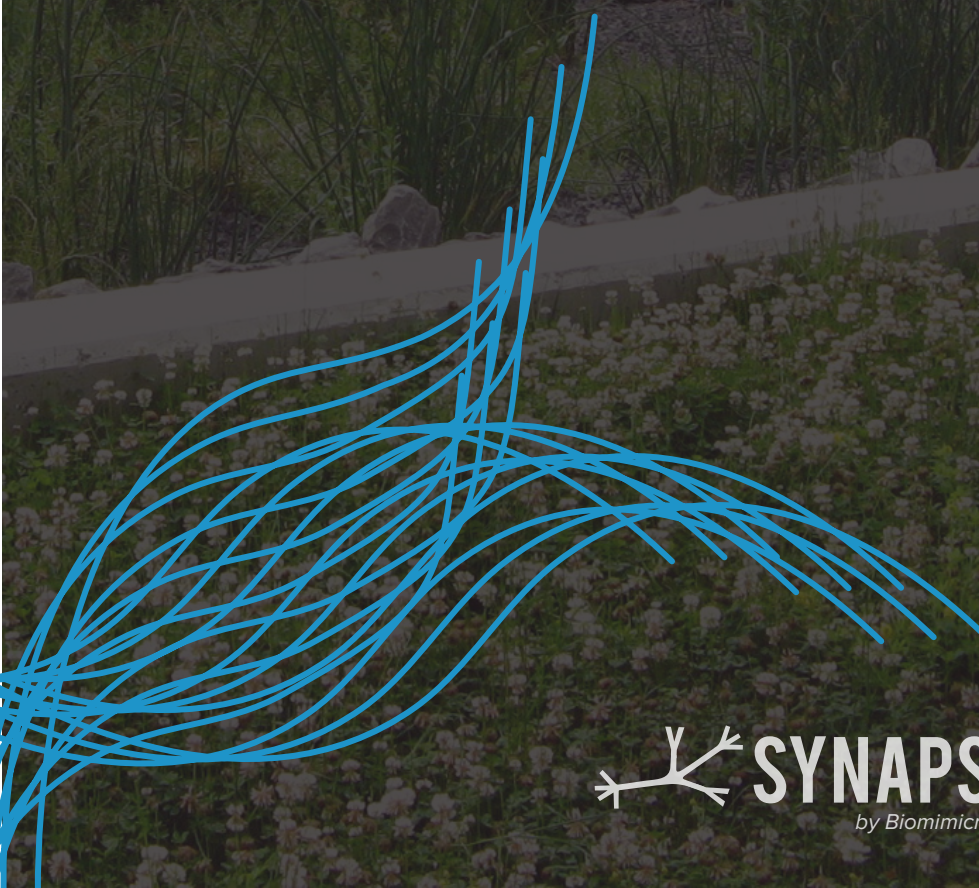


LIVING MACHINES

BY JOHN TODD ECOLOGICAL DESIGN





John Todd
Ecological
Design



SYNAPSE
by Biomimicry 3.8

A BIOMIMICRY CASE STUDY

LIVING MACHINES

BY JOHN TODD ECOLOGICAL DESIGN

The commercialization story behind the
wastewater treatment & water body remediation
process that mimics natural wetlands.

Published by Synapse by Biomimicry 3.8
Written by Biomimicry Business Intelligence



BIOLOGY

Wetland ecosystems cycle and purify water



© John Todd Ecological Design

DESIGN

Eco-Machines mimic wetlands to produce clean water

Forward

Biomimicry for Innovative Business Opportunities

Biomimicry is not itself a product but a process, drawing on strategies observed in natural organisms and practices in order to spark innovation.

*Biomimicry (from **bios**, meaning life, and **mimesis**, meaning to imitate) is a scientific design discipline that seeks sustainable solutions by emulating nature's time-tested patterns and strategies.*

The core idea of Biomimicry is that nature, after 3.8 billion years of research and development, has already developed solutions to many of the problems facing industry, government and agriculture. Such problems include packaging, transportation, energy production, non-toxic chemistry, carbon sequestration, and crop production.

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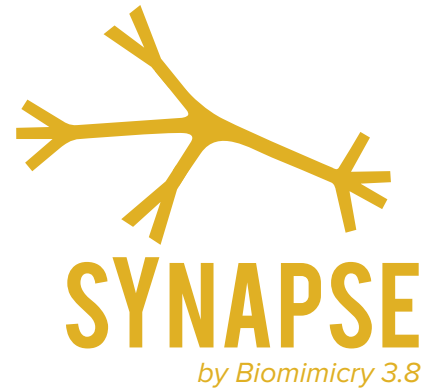
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At Synapse by Biomimicry 3.8, we are dedicated to providing biomimicry intelligence that informs, inspires, and empowers businesses to leverage nature's genius in solving their own innovation challenges.

By publishing biomimicry case studies that detail the commercialization stories experienced by biomimetic innovators, we hope to expose key insights and lessons learned about getting the most value out of the biomimicry approach as evidenced by real world projects so that others are better prepared to take advantage of nature's 3.8 billion years of research and development.

While these case studies are detailed, we have highlighted critical take aways throughout the document to provide at-a-glance learnings about market viability, the competitive landscape, the environmental issues, industry drivers, biomimetic insights, and more. Whether you are browsing or diving deep into the details, this case study will provide strategic insight for your next biomimicry project regardless of sector.



The ability to innovate is a key driver of productivity, competitiveness, and prosperity. Innovation requires entrepreneurs to rethink their strategies and adopt new approaches to their businesses, embracing new technologies and manufacturing opportunities that can be the difference between success and failure in the business world.

Biomimicry innovations are fertile hunting grounds for innovative business opportunities. Due to this immeasurable potential, corporate executives, investors, policymakers, and entrepreneurs across many industries look to this emerging field to drive sustainable growth.

But what are some powerful technology trends that can drive company success? What are the important factors that should be considered when trying to identify the next big trend? Biomimicry's inherent value lies in the answers it proposes to these questions.

BIOMIMICRY ADVISORY SERVICES

(BAS) is an independent financial market research and advisory organization that provides strategic advice and ongoing intelligence on emerging biomimicry technologies. BAS is a project initiative of Biomimicry Switzerland.

MISSION

BAS' mission is to help leaders in the commercial, public, and social sectors develop a deeper understanding of biomimicry innovations and to provide a fact base that contributes to financial decision making on these emerging technologies.



Executive Summary

[John Todd Ecological Design](#) (JTED) is a Massachusetts-based sustainable water management company that designs and integrates natural systems for the treatment of wastewater and the remediation of degraded water bodies. The designs are based on robust ecological systems in nature that effectively cycle nutrients and water. [Harnessing biodiversity and natural processes in the system allows JTED's machines to treat the most difficult contaminants and human waste streams, meeting and surpassing regulatory requirements.](#)

Since it was founded in 1989, the company has worked on over 80 projects on five continents and 11 countries. These projects have dealt with domestic and industrial waste streams and remediation of contaminated urban canals, storm water ponds, landscape features, and natural lakes. JTED has experience delivering global technical support to natural water treatment projects in both rural and urban environments and in both warm and cold climates. The company employs and adapts “living machines”, including their patented Eco-Machine™, a cost-competitive living system that creates distinct treatment zones that use plants, microbial species, fungi, beneficial bacteria and aquatic species to convert “waste” into a resource. For the remediation of water bodies, the company offers Aquatic Restorers that jumpstart the ecology of a water body, digest sediments

and reduce nutrient levels, bringing the water body back to ecological health.

As the company continues to take on projects all over the world, it currently focuses on investing in research and development to further develop their tools and processes. JTED tries to source their R&D investment from clients as much as possible, using their contributions to solve challenges that the company faces. Each project is financially independent and self-funded, with additional resources coming from clients as well as government funds and research grants. The company is completely sustainable with revenues of up to \$1 million per year as each project can generate an average of \$150,000s. Key takeaways on JTED’s success revolve around the company’s culture, practices, and vision. The team is not

only invested in constantly evolving the technology, but also in making sure its projects create a positive net impact on both the community and the environment. JTED designs its ecological waste treatment systems to serve as an effective utility, an aesthetic amenity, and a healthy habitat.

INSPIRED BY NATURE

JTED’s success comes from applying time tested strategies of natural processes and creating mechanically simple but biologically complex treatment systems. The individual projects solve the contamination challenges that companies and communities face, but JTED continues to aim beyond that with their vision to reintegrate human life back into the biological cycle with natural, safe, and effective systems.

Eco-Machine at The Omega Center in Rhinebeck, New York © John Todd Ecological Design





“Water as an asset class will, in my view, become eventually the single most important physical commodity based asset class, dwarfing oil, copper, agricultural products, and precious metals.”

Willem Guitler, Citigroup’s Top Economist

Industry Overview

WATER

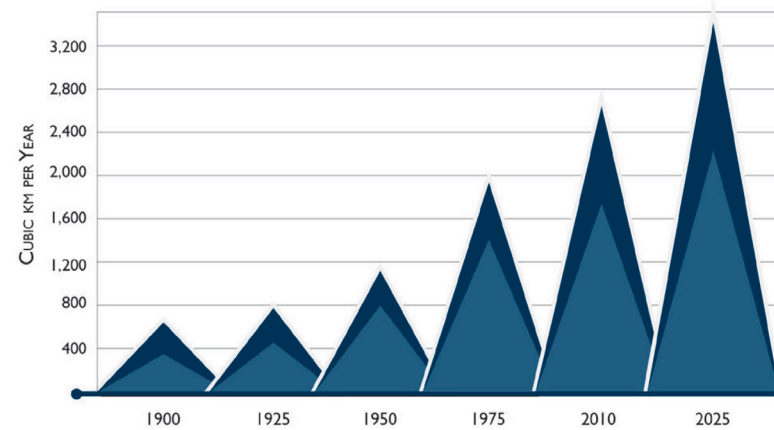
The most important thing about water is that all living things need it to survive. Water is an essential resource in almost all human activities, such as: growing and processing food, manufacture of products, transportation, mining, construction, medicine and energy production.

“Water is the petroleum
for the next century”

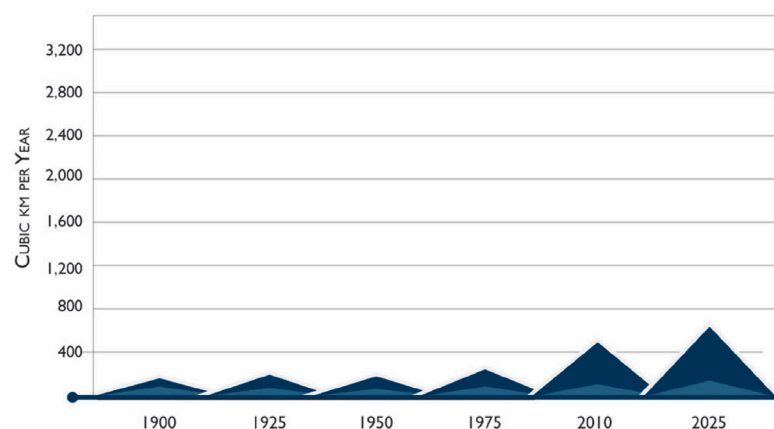
2008 Goldman Sachs Report

GLOBAL WATER USE BY SECTOR

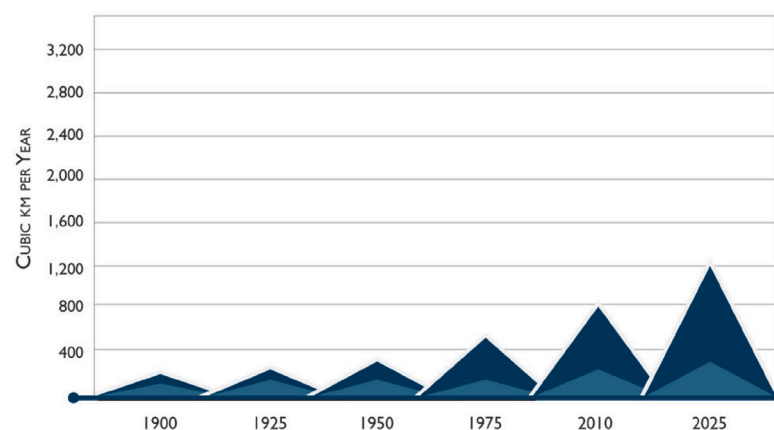
Source: Vital Water Graphics. UNEP, Nairobi (2002)



AGRICULTURE



INDUSTRIAL



DOMESTIC

■ WITHDRAWAL ■ CONSUMPTION

GROWING DEMAND

According to The Global Compact Water Mandate, the demand for water among industry and agriculture is expected to increase significantly due to population growth and economic development. Freshwater consumption worldwide has more than doubled since World War II and is expected to rise another 25 percent by 2030. We can notice, especially in the domestic and industrial sectors, that most of the water that is withdrawn is wasted at the end of the use cycle. Most water is used only once before it becomes wastewater and is discharged into natural bodies of water, which is a major concern for all living organisms.

WATER RECYCLING

A more sustainable model of water usage is desperately needed by both humans and the environment. Water crises around the world are not new, and many countries are struggling to provide their citizens with this essential commodity. There are cities on every continent that are running out of fresh water, including Tokyo, Mexico City, Los Angeles, London, Cairo, Sao Paulo, and many more. Leading cities around the globe have understood the importance of taking full advantage of this precious resource. Cities and municipalities have implemented water

recycling programs that will allow them to use water more than once, and will lessen the impact on water resources and aquifers. Water recycling is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and replenishing groundwater basins. Wastewater treatment can be tailored to meet the water quality requirements of a planned reuse. Recycled water for landscape irrigation requires less treatment than water which is recycled for human consumption. In the U.S. there

have been no documented cases of human health problems due to contact with recycled water that has been treated in compliance with regulatory standards.

Water recycling is a marvel of the 21st century, but it has limitations. In an ideal world water could be recycled as many times as needed, but that is not the case with current technologies and processes. Currently all the water that enters the human consumption cycle will eventually be transformed into wastewater.

INDUSTRY OVERVIEW



WASTEWATER

Wastewater is any water that has been adversely affected in quality by human activities. Wastewater can originate from a combination of domestic, industrial, and agricultural activities, as well as storm-water from surface runoff.



WATER DEGRADATION

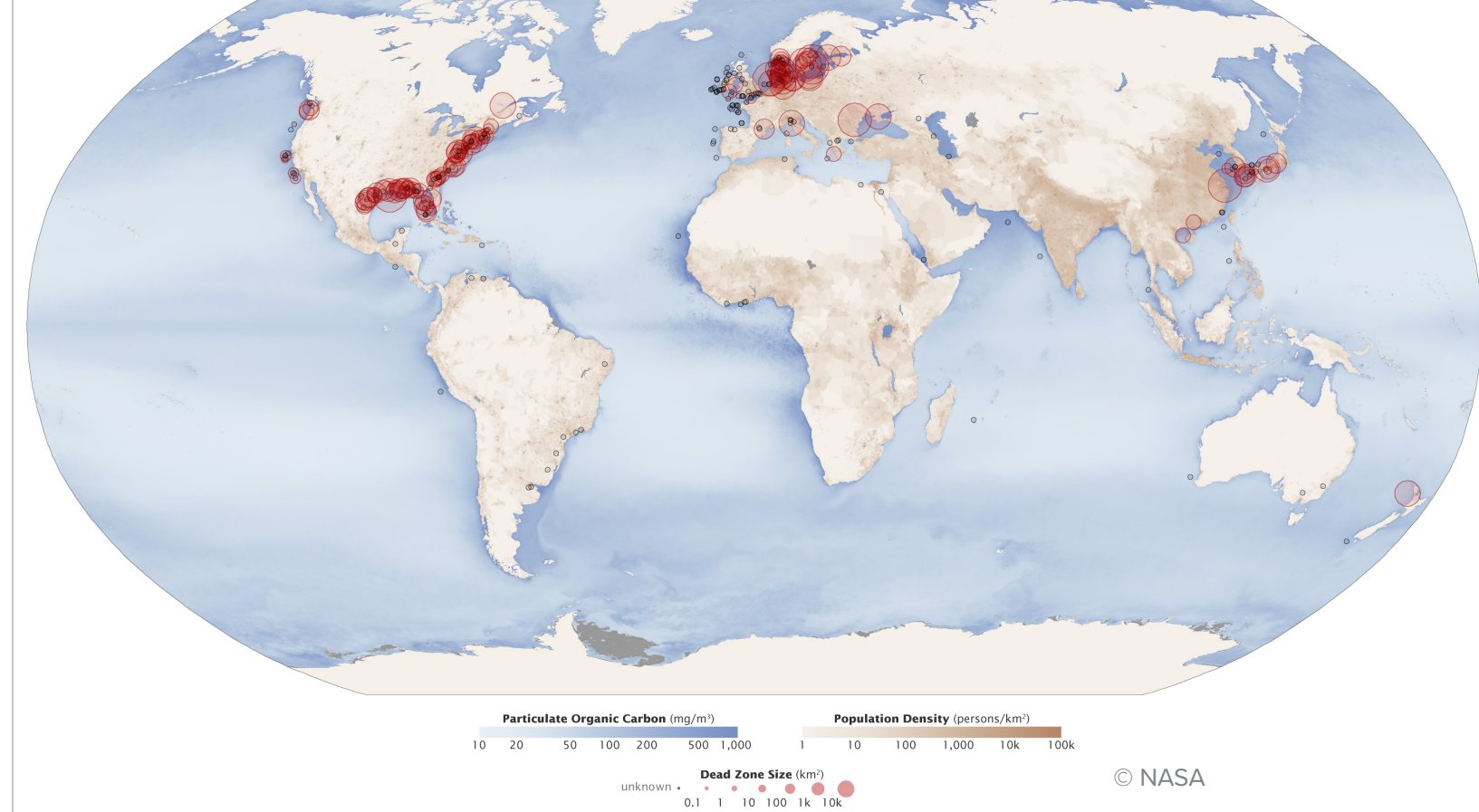
Degradation of water quality is the contamination of bodies of water such as lakes, rivers, oceans, aquifers and ground water by pollutants. Water degradation damages and harms the lives of humans, animals and plants in noticeable ways.

WATER QUALITY

Some of the sectors in need of wastewater management solutions are: manufacturing, municipal, pharmaceuticals, food and beverage, electronic components, paper and paper-board production, refined petroleum production and consumption, electricity generation, mining, and desalination. In highly developed countries, wastewater is treated to meet stringent regulatory standards before it can be discharged

into rivers or oceans. Unfortunately, this does not happen in the majority of countries around the world. The technology to treat wastewater is expensive and generally requires astronomical amounts of energy and chemicals. As a result of the lack of water treatment facilities and the inability to control wastewater runoff, major bodies of water around the country and the

world are suffering. Even cities with the most sophisticated and advanced water treatment plants are having trouble preventing pollutants from entering bodies of water, as their treatment plants have not been able to eliminate 100% of contaminants. Aquatic environments around the world are having major problems such as invasive aquatic vegetation and dead zones.



GLOBAL MARINE DEAD ZONES

The expansion of harmful algal blooms over the past 20 years is responsible for losses of approximately \$100 million per year nationwide¹. About 1.7 million tons of agricultural nutrients, nitrogen and phosphorus mainly, are discharged into the Gulf of Mexico yearly. This nutrient runoff causes significant algae blooms during summer months. As a consequence of this method of wastewater disposal, areas where algae blooms form

become dead zones. These are zones where water oxygen levels are too low for other organisms to survive². Events such as these have underlined the need for a change in our water management policies. Consequently, the restoration of degraded ecosystems to a close approximation of their remaining natural potential is experiencing a groundswell of support across the United

States. The number of stream, river, lake, wetland, and estuary restoration projects is growing yearly. Current federal initiatives call for a wide range of restoration actions, including improving or restoring 25,000 miles of stream corridors; achieving a net increase of 100,000 acres of wetlands each year; and establishing two million miles of conservation buffers.

1 Harmful Algae Bloom. (n.d.). Retrieved September 2, 2015.

2 www.nature.org/ourinitiatives/regions/northamerica/areas/gulfofmexico/explore/gulf-of-mexico-dead-zone.xml#video



John Todd, the founder of John Todd Ecological Design (JTED), began his career as a “doom watch scientist,” focusing on how pesticides were disrupting and harming the environment. At one point in his research, he became heavily discouraged by what he was finding. His wife, Nancy Jack Todd, who was very involved with his work, wondered if ecological concepts could help to serve people’s needs. At that point, John considered his knowledge of ecosystems and looked into converting them into technologies that could help solve these challenges. He knew that there were efficiencies, ingenuities, and symbiotic relationships in nature that could provide powerful solutions. In 1969, the Todds co-founded the New Alchemy Institute to conduct fundamental research into aspects of biology and related disciplines and apply this to technology for ecologically derived human support systems. After much research and testing, John founded JTED in 1989 to offer a cost-effective and renewable solution to the growing global water crisis.

Company Overview

JOHN TODD ECOLOGICAL DESIGN IS A SUSTAINABLE WATER MANAGEMENT SERVICES PROVIDER THAT OFFERS ITS CUSTOMERS INTEGRATED AND COST-EFFECTIVE AESTHETIC SOLUTIONS TO WASTEWATER AND STORM WATER TREATMENT, AQUATIC ENVIRONMENT MANAGEMENT, AND BIO-SOLIDS CONVERSION. ITS PATENTED ECO-MACHINE™ IS A BEAUTIFUL WATER GARDEN THAT CAN BE DESIGNED TO PROVIDE ADVANCED WATER TREATMENT BY ALTERING THE PLANTS, MICROBIAL SPECIES, AND DISTINCT TREATMENT ZONES TO SUIT THE CLIENT’S NEEDS.

The Eco-Machine system mimics a natural and robust ecosystem, such as a wetland, that filters and recycles waste, nutrients, and contaminants.

The result is an efficient and refined wastewater treatment system that is capable of achieving high quality water

without the need for hazardous chemicals or large amounts of energy. The methodology was conceived by the company’s founder, Dr. John H. Todd, in cooperation with Barry Silverstein, with the first U.S. patent published in Feb 11, 1992 (US 5087353 A). Additional

patent applications have further developed methods to efficiently and naturally treat wastewater and manage aquatic environments (US 5389257 A, US 5618413 A, EP 0728122 B1).

JTED offers design services, construction services, and consulting services for natural resources treatment and management. The company harnesses the biological processes that operate in nature within the form of an engineered treatment system to successfully meet state and federal requirements for water discharge. The solutions are focused on cost effective, highly diverse, and resilient systems that are both

environmentally beneficial and aesthetically pleasing. The system has no chemical additives and little to no sludge production, so the treated effluent can be used for many purposes, from recycling water to toilet flushing or irrigation.

Currently two major models of living systems available: Eco-Machine that treats wastewater and the Aquatic Restorer that reverses eutrophication in water bodies and digests

sediments. These passive systems use sunlight, reducing energy costs and maintenance. **JTED builds beautiful ecosystems that are integrated into public spaces to grow product value from waste and restore trophic layers in the land.**

ORGANIZATIONAL STRUCTURE

US HEADQUARTERS | JTED's headquarters and administration are located in Woods Hole, MA, but the company also has a research and development arm in South Africa that focuses on developing new designs and systems. Currently, this privately held company, owned by John Todd, Jonathan Todd (son) and Richard Sherman, has a total of seven members of staff. The staff includes a biologist, an architectural advisor, business manager, project manager, and project coordinator that is heavily involved with the company. JTED also employs a network of contractors, landscape architects, and engineers to fulfill the needs of each individual project. JTED has built well over 80 installations in the past 30 years. Several of these water management systems have been operating for over 20 years (and continue to perform well because the clients remain engaged). Most projects (around 80%) are located in the U.S with the rest in Europe, Latin America, and China. JTED has recently begun working in South Africa and has begun work on new projects in Nicaragua.

SOUTH AFRICA SATELLITE

JTED is currently working in partnership with Biomimicry South Africa as well as local engineers to create low cost ecological infrastructure for the Western Cape Government. The project is designed to treat greywater generated by informal settlements and has been in process since 2013, with the final two year construction phase expected to reach completion in 2017.

NICARAGUA SATELLITE

In Nicaragua, JTED's focus is on installing a wastewater treatment system for an arboretum, although this project is still in the planning stage. The team is currently working on eight projects in varying stages (3 of these projects are Aquatic Restorers and the rest were commissioned to deal with human waste). As an example of how diverse these projects may be, one of these clients wants to develop a design to treat a zoo's hippo exhibit while another is a pilot to treat effluent from bus wash water which may include road salt, industrial chemical compounds, etc.



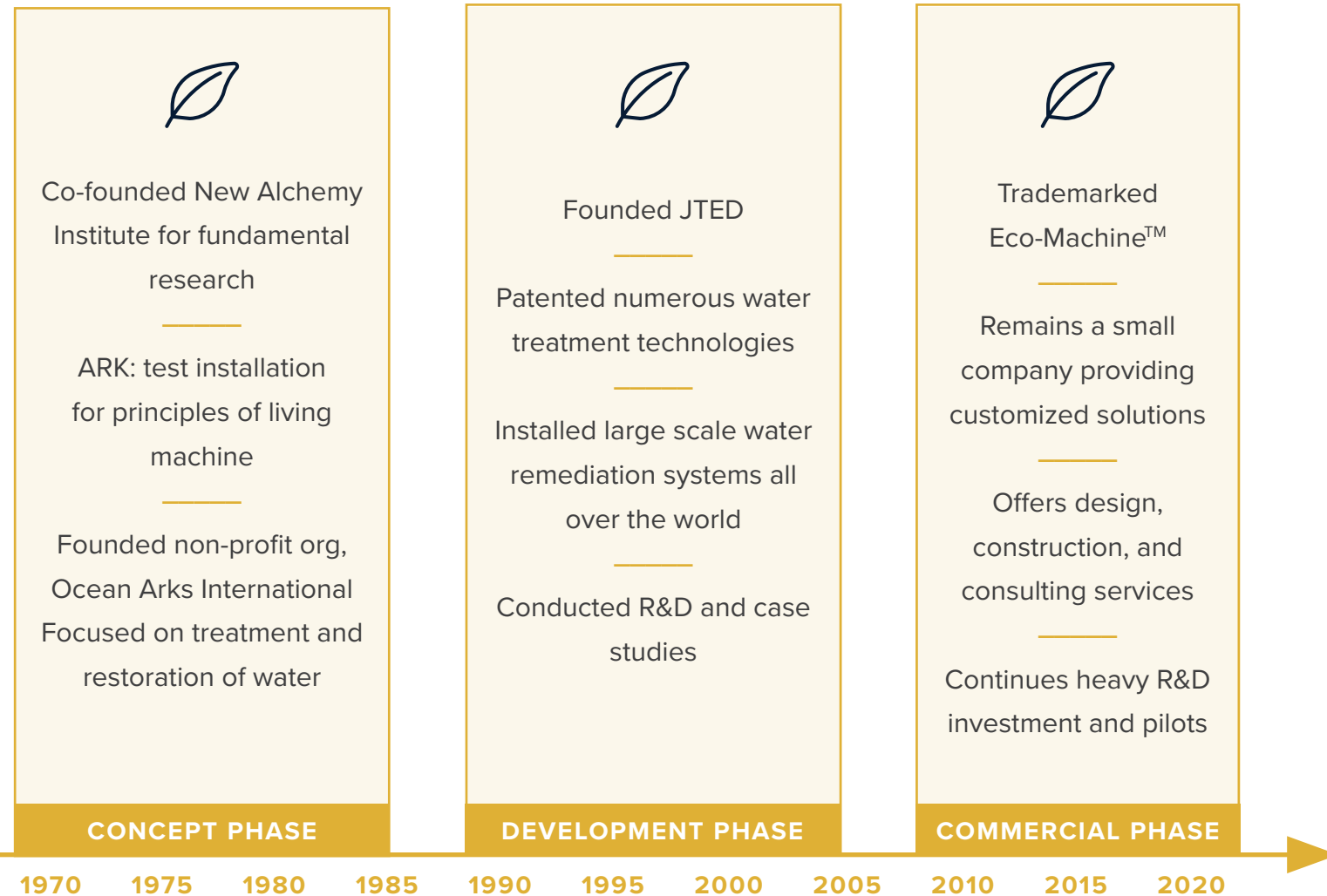
Eco-Machine at The Omega Center in Rhinebeck, New York © John Todd Ecological Design

Commercialization

Process & Strategy

After the Todds co-founded the New Alchemy Institute, Todd and his colleagues designed miniature ecosystems, largely self-perpetuating, which bring ecological principles into the service of human challenges. Aside from designing and prototyping food-producing systems and approaches for communities of people, this work has resulted in innovative new approaches to processing sewage and industrial wastewater with the use of “living machines”. Todd’s approach has involved applications of micro-organisms, fish, and plants (phytoremediation) to restore, conserve, or remediate sewage or other polluted water.

COMPANY OVERVIEW





CONCEPT PHASE

In 1974 Todd returned to his native Canada to design and build “An ARK for P.E.I.” at Spry Point on Prince Edward Island on contract to the Canadian federal government. When it was completed in 1976, the ARK had become a test bed for many of the principles that became the “living machine”. In 1982, the Todds founded Ocean Arks International as a non-profit organization with the goal of spreading the ideas and practices of ecological sustainability throughout the world. Among its major projects is the protection and restoration of the world’s waters. Here, John Todd developed a unique and effective array of ecological technologies called eco-technologies. Over the next decade, Ocean Arks developed, and in some cases patented, a number of ecological technologies for treating

waste and for water remediation. These natural systems technologies were known as Solar Aquatics, Living Machines, Restorers, Ecological Fluidized Beds and Eco-Machines. Todd worked on growing a robust ecosystem within clear-sided solar tanks to remediate water and solve pollution issues. Their first experiment was carried out in 1983 at Cape Cod, on a lagoon that leached pollutants into local groundwater resources. John seeded these tanks along the lagoon like a solar river, filled with diverse plant life, and soon after the lagoon was able to meet EPA swimming water standards with a 12-day retention time.

DEVELOPMENT PHASE

John Todd Ecological Design Inc. was formed in 1990 as a partner company and joint enterprise to focus on providing commercial ecological wastewater treatment systems. The company continued to file patents on the solutions they developed to treat wastewater and manage aquatic environments. After some time, they focused on two ranges of products, the Eco-Machines used for wastewater remediation, and the Restorer used to reverse eutrophication and reduce sediments. From this point the team continued to build and install Eco-Machines and Restorers all over the world. They also began to conduct case studies on their installations, and started to gain traction as their projects received rewards and praise.

COMMERCIAL PHASE

In recent years, JTED has successfully registered the Eco-Machine as an official trademark of the company in 2014. The small team continues to tackle new and exciting projects focused on the remediation of impaired natural water bodies and soils. The company is a pioneer in the use of natural systems for the removal of chemicals, petroleum hydrocarbons, endocrine disruptors, and other detrimental water pollutants. With each project, their array of solutions continues to grow as they develop new technologies and methods to solve the challenges of sustainable water management. JTED aims to bridge the gap between the human world and natural world, finding solutions to complete the loop to support both.

TARGET SECTOR & MARKET ANALYSIS

JTED has proven itself capable of treating water in a cost effective and environmentally friendly manner. The Eco-Machine is capable of removing not only human waste from water, but also industrial waste such as that which is generated by the food and mining industry, as well as restoring bodies of water to their natural state. And even more fascinating, Eco-Machines can achieve this without relying on large quantities of chemical inputs or energy-intensive-systems, which results in incredibly large savings for the new owners of the Eco-Machines. As a result,

JTED is capable of targeting multiple markets in need of degraded water solutions. According with United Nations University “In North America, of the estimated 85 cubic kilometers, or 22.5 trillion US gallons, of wastewater generated each year, 61 cubic kilometers, or 16 trillion US gallons, (75%) is treated. (A cubic kilometer is 1 trillion liters—about 220 billion US gallons).”³ This number is constantly increasing given population growth and market demand for clean water. As stated earlier, most of the water that enters cities or farms ends that segment of its lifecycle

as wastewater in dire need of some sort of treatment before it can be discharged back into the environment. Current water treatment technologies are highly energy- and chemical-intensive, which imposes high operations and maintenance costs, as well as environmental costs of their own. In addition to the private and environmental costs, the chlorine and other chemicals that public utilities add to drinking water to kill microorganisms can react with other materials - such as sewage and manure- to create hundreds of toxic byproducts, many of which are detrimental to human health.⁴

³ UN: Rising Reuse of Wastewater in Forecast but World Lacks Data on “Massive Potential Resource” - United Nations University. (2013, September 9). Retrieved September 2, 2015.

⁴ Chemicals used to treat your drinking water might be hurting you, environmental group says. (2013, February 27). Retrieved September 2, 2015.

ADVANTAGES OF JTED SOLUTIONS

JTED living machines use no chemicals and are thus less costly than conventional water treatment plants. They are easy to operate and maintain; caring for a living machine, such as a Restorer, is less labor intensive since the operator is working with living and growing ecologies, instead of with bags filled with tons of chemicals. Another feature of this technology is that these systems are modular, and can be arranged in various designs to meet the needs of growing businesses or communities. Living machines can be easily enhanced and improved without excessive costs. As the systems are refined and in some cases miniaturized it will be possible to integrate them

in different ways through cities and regions. These systems will be able to satisfy human needs without adversely affecting the environment, and in most cases they will actually help heal, rebuild and sustain natural spaces. Since most ecosystems are primarily solar-powered systems, they are self-sustaining, and their productive lifespan is relatively long. Living machines have the ability to be designed in a modular fashion, which means that they can be made as large as necessary. The idea behind modular design is that they could be installed to treat a specified amount of wastewater, but more units could be added to account for future demand growth.

BROAD SCALE OF MARKET

Currently in the U.S. the market for water treatment equipment is estimated to be approximately \$9.8 billion, and forecasted to grow 5.9 percent per year to a projected \$13.0 billion in 2017. These gains will be fueled by rising concerns about contaminants, chemicals, and byproducts in supply water and wastewater, and by more stringent manufacturing requirements in process water.⁵

The market is wide open for sustainable water solutions like those offered by JTED. Cities like San Diego and San Francisco are looking for decentralized water treatment plants. These plants consist of approaches for collection, treatment, and dispersal/reuse of wastewater for individual

⁵ Water Treatment Equipment - Market Size, Market Share, Market Leaders, Demand Forecast, Sales, Company Profiles, Market Research, Industry Trends and Companies. (2013, July 1). Retrieved September 2, 2015.

dwelling, industrial or institutional facilities, clusters of homes or businesses, and entire communities. It is believed that properly managed decentralized wastewater systems can provide the treatment necessary to protect public health and meet water-quality standards just as effectively as centralized systems. These systems can help promote better watershed management by avoiding the potentially large transfers of water from one watershed to another that can occur with centralized systems.

John Todd Living Machines provide a system that will allow individuals, industries and communities to manage their

wastewater without relying on large scale treatment plants, thus eliminating the dependence on these systems and lowering the operating cost. According to the EPA's Guidelines for Management of Onsite/Decentralized Wastewater Systems, "Onsite/decentralized wastewater systems serve 25% of the US population and 40% of new developments."⁶ The current drought crisis in the southwestern United States has generated a clamor for solutions that will allow cities and counties to take full advantage of every drop of locally available clean water. In the state of California, as part of recent drought relief measures, the state allocated \$200 million in grants to

jump-start those efforts and low interest rates on \$800 million more in loans. Experts believe that most of those investments will be directed towards turning human wastewater into potable water.⁷

As we will discover later, JTED's living machines are capable not only of treating wastewater, but they can also be used as a closed water loop system within buildings, allowing them to reuse water up to twelve times. Global markets for wastewater recycling and reuse technology are expected to grow from \$9.5 billion in 2012 to \$23.4 billion in 2017, reflecting a five-year CAGR of 19.7%.⁸

⁶ <http://water.epa.gov/infrastructure/septic/upload/MOU-Intro-Paper-081712-pdf-Adobe-Acrobat-Pro.pdf>

⁷ SANGREE, H. (2014, April 14). California looking to recycled water to ease drought concerns. Retrieved September 2, 2015.

⁸ FARMINGTON. (2013, February 7). Global wastewater reuse, recycling markets expected to expand, research says. Retrieved September 2, 2015.

MARKET FOR BIOSOLID BYPRODUCTS

John Todd and his team of designers and engineers did not stop with water, as they realized that their Living Machines had potential that surpassed the mere purification of water. One of the byproducts of their process are biosolids, which are nutrient-rich organic materials resulting from the treatment of domestic sewage. When treated and processed, these residuals can be recycled and applied as natural fertilizer to improve and maintain productive soils and stimulate plant growth. Farmers and gardeners use biosolids in all 50 states of the U.S. The application of biosolids

to crops reduces the need for chemical fertilizers. The National Academy of Sciences has concluded that "the use of biosolids in the production of crops for human consumption when practiced in accordance with existing federal guidelines and regulations, presents negligible risk to the consumer, to crop production and to the environment." There are many popular brands offering organic fertilizers made out of biosolids.

Among these we have Milorganite, a Milwaukee based company that sells class A biosolids.

Milorganite is manufactured by the Milwaukee Metropolitan Sewage District. Milorganite products can be purchased at places such as Home Depot and other farming equipment stores at an average price of 13 US dollars per 36 lb. bag. More than ever before people, are looking for new organic plant-growing products, and the organic fertilizer market is growing larger by the minute. In 2006, the U.S. fertilizer market was estimated at \$40 billion, with the organic fertilizer accounting for only \$60 million. With current market trends, we can expect this last number to increase significantly.⁹

⁹ MarketWatch. (2007, March 21). Organic fertilizer companies see growing market, but efficacy debated. Retrieved September 2, 2015.

MARKET FOR WATER ECOSYSTEM RESTORATION

So far we have discussed how John Todd has provided humanity with a clean, sustainable, and cost effective way of treating domestic, industrial, and agricultural wastewater, but that is not all this amazing company has done. They recognized that cleaning wastewater was not the only problem that could be solved with these living ecosystems. They created what they called Restorers, which are special machines capable of returning a degraded water ecosystem to a close approximation of its natural state. Eutrophication, which is the process by which a body of water acquires an excess concentration of nutrients, particularly phosphates and nitrates, is a big problem that

in need of a solution. Eutrophication typically promotes excessive algae growth, commonly known as algae blooms, which cause health problems for people, fish and wildlife in general.

In the past, the federal government has played the prominent role in maintaining a coalition of research scientists, natural resources agencies, academic institutions, and private sector interests for studying and managing nuisance aquatic and wetland vegetation. However, significant reductions in agency funded R&D programs have created a technological void while invasive aquatic and riparian weeds continue to spread and

cause grave environmental damage. As stated by the Aquatic Ecosystem Restoration Foundation, “The limitations to effective management of aquatic plants in their environment are time, patience, and funds, not the lack of an effective management tool.”¹⁰

The United States Environmental Protection Agency reported that climate change will have many effects on freshwater and marine environments, and these effects along with nutrient pollution (chemical fertilizers) might cause more intense and harmful algal blooms and dead zones to occur more often, in more bodies of water. During the summer of 2014, more than 400,000 people were left

without access to safe drinking water in Ohio and Michigan as consequence of an algal bloom in Lake Erie.¹¹ Algal blooms have significant economic impacts when they occur. For example, a 1976 New Jersey red tide caused losses estimated at more than \$1 billion.¹²

Dead zones such as the one in the Gulf of Mexico has led to a substantial decrease in the fish population of the affected areas. This adversely impacts the local economy, especially the fishing and tourist industries, and have the potential to affect millions of people around the world. The U.S. is not the only country suffering from degraded water ecosystems. It has been reported that there are more than 400 dead zones

around the world, and this number is expected to grow given the current trend of increasing water temperatures. 94 percent of dead zones are in areas expected to warm by 2 degrees Celsius or more by 2099. This is critical for dead zones since it has been shown that the population of invasive vegetation grows in warmer water. John Todd Restorers offer an efficient and cost effective solution for this problem. The Restorers are capable of decreasing nutrient levels in water, which removes some of the food these invasive plants use to grow at exponential rates. As a result, we expect to see a decline of dead zones and algal blooms in areas where Restorers are installed.

¹⁰ Aquatics Update: Management Minute - Aquatic Plant Management Options. (2010, March 10). Retrieved September 2, 2015.

¹¹ Abbey-Lambertz, K. (2014, August 6). These Disturbing Photos Show Why Algae Blooms Are A Growing Global Water Threat. Retrieved September 2, 2015.

¹² Prevention, Control and Mitigation of Harmful Algal Blooms. (2001, September 1). Retrieved September 2, 2015.

John Todd Ecological Design offers two major “living machine” products along with design, construction and consulting services to their clients

1

ECO-MACHINE™

Water purification system

2

AQUATIC RESTORER

Water-based ecosystem restoration system

PRODUCTS AND SERVICES

There are several factors which make them a unique player in the market. Every product created is a customized design crafted through a process of close communication with customers. Since the company already knows the customers’ preferences, they can deal with specific issues and

even train customers in the operation and maintenance procedures needed for lasting efficiency. JTED offers a broad and comprehensive range of services, and the company’s philosophy focuses on including integrated systems used in agriculture, storm water management, and watershed

restoration. The team has a deep commitment to the ecological integrity of their systems and to reducing their overall environmental impact.

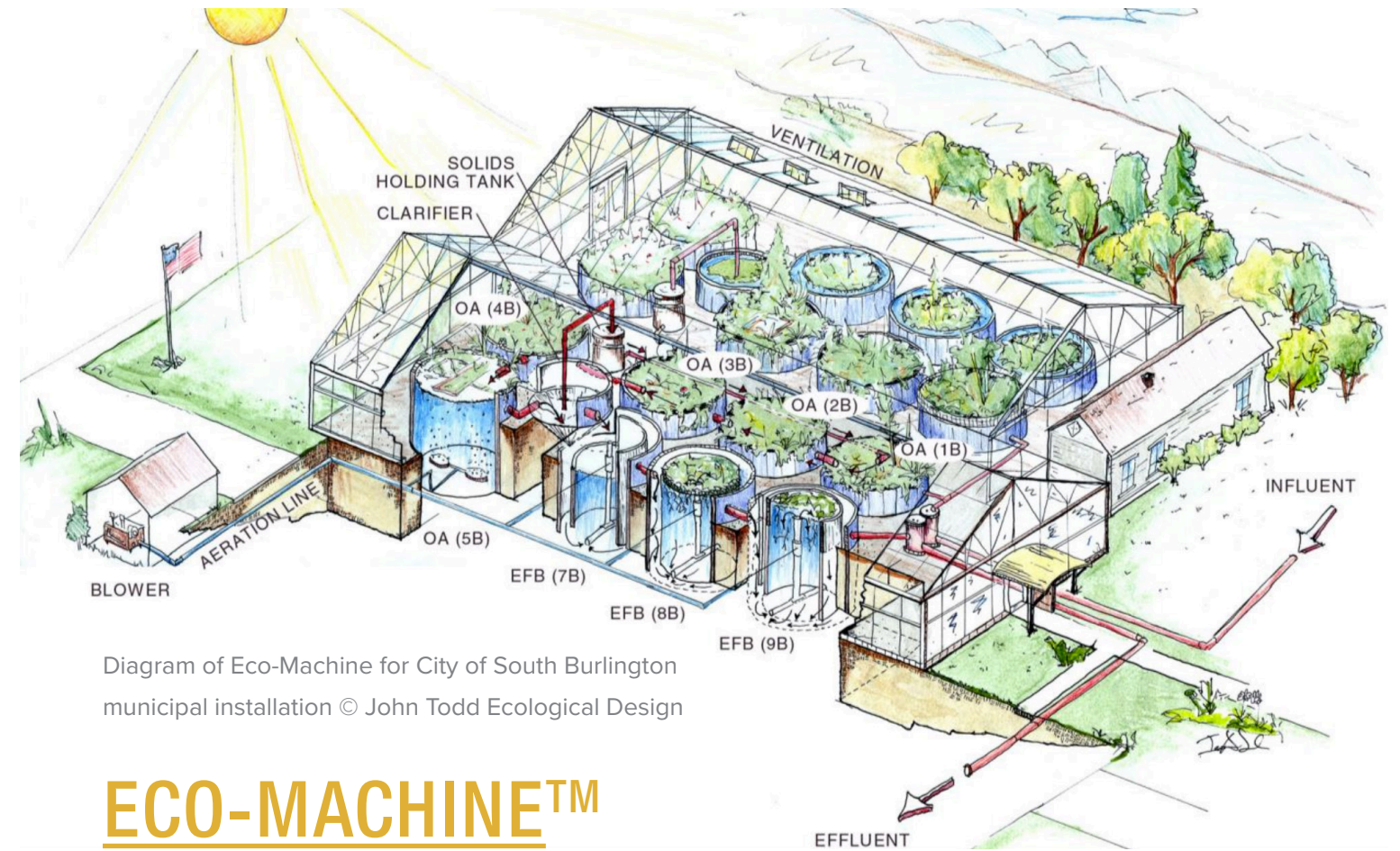


Diagram of Eco-Machine for City of South Burlington municipal installation © John Todd Ecological Design

ECO-MACHINE™

The Eco-Machine is a tank based system typically housed within a greenhouse and contains a natural and robust ecosystem that naturally cleans water. The system often includes an anaerobic pre-treatment component, flow equalization, aerobic tanks as the primary treatment approach followed by a final polishing step, either utilizing Ecological Fluidized Beds or a small artificial wetland. It is an aesthetically pleasing water garden that can be designed to

specifications and will provide advanced water treatment. The size of an installation depends on the water flow requirements which can range from tens to hundreds of thousands of gallons per day. Many clients have sites with 3,000 to 20,000 gallons of waste-water, but JTED has built Eco-Machines that treat volumes far beyond this.

The largest Eco-Machine built to date processes an impressive 80,000 gallons

of wastewater per day. Solar energy supplies 100% of the electricity necessary to power the natural water reclamation achieved by the Eco-Machines. The individual tanks and suspended racks contain all the major groups of life from microscopic algae, fungi, and bacteria to snails, fishes, shrubs, and trees. The result is an efficient and refined wastewater treatment system that is capable of achieving high quality water without the need for hazardous chemicals.



For an area of 2 acres, a Aquatic Restorer installed for Tyson's poultry processing facility in Berlin, Maryland typical installation can have 3-4 units depending on how quickly the client wants to digest the sediment. The largest installation of the Aquatic Restorer for lagoon treatment to date processes 1 million gallons per day. Photo © John Todd Ecological Design

AQUATIC RESTORER

The Aquatic Restorer is a system of floating platforms linked to an upwelling bottom filter that slows and reverses eutrophication. It is composed of planted ecologies, media to support microbial films, and an aeration system. This technology can be installed in bodies of water to enable organisms to metabolize nutrients and organic loading

within. The system helps restore the pond health and ecology by removing accumulated sediments, excess nitrogen and phosphorous, reducing organic matter, and eliminating algal blooms. It is able to accomplish this by pushing nutrient and organic rich sediment through the bottom filter and into bacteria zones to be metabolized and

made readily available for plant life and zooplankton. The Aquatic Restorer is more of a streamlined unit that can be easily installed and scaled. The cost of each unit is roughly \$60,000. Typically, one unit is installed per half acre to one acre and circulates 100,000 gallons per day, digesting as much as five inches of accumulated sediment per year.

DESIGN, CONSTRUCTION, & CONSULTING SERVICES

John Todd Ecological Design is an experienced company with more than 30 years experience of dealing with natural wastewater treatment design, general aquatic management, and project supervision. Based on Dr. John Todd's thinking, the company harnesses the biological processes that operate in nature in the form of an engineered treatment

system to successfully meet discharge standards and regulatory requirements. Based on the information from interviews with company staff, they express that each project has unique challenges based their clients' particular situations and needs. The solutions of the company are focused on building cost effective, highly diverse, and resilient systems

that are both environmentally beneficial and aesthetically pleasing. What makes John Todd Ecological Design special is that their staff can provide complete design services from conceptual design through detailed construction documents. The following sections will elaborate further on the details of this process.

PROCESS OVERVIEW

In a typical project, the JTED team will spend one or two days with the clients on site to reach a better understanding of their client’s water treatment requirements. During the onsite visit, they will identify the problem and assess the site itself. Then the team will discuss constraints and expectations with the clients and outline their recommendations. The JTED team will then research and write their report about the on-site visit and begin the process of preliminary design. After the initial

visit, the team will develop a list of questions for their client to perfect not only their understanding of the problem, but also their understanding the client’s requirements. This process lays the foundation of the eventual project. After obtaining the approval of the client, the project goes to the engineering team and then the construction team. JTED teams maintains a close relationship with its clients after completing their projects, with the goal of assisting them in the long-term maintenance of the project.

After the project is finished, they provide an Operations and Maintenance manual, onsite training for maintenance workers, email and telephone support, and site visits as desired. As part of the commissioned project, the team also offers operational training for their new customer, which is around 3-5 days.

DESIGN-BUILD CAPABILITIES

The John Todd Ecological Design team is experienced in the construction of natural wastewater treatment facilities and aquatic environmental management projects worldwide. JTED offers their clients a complete design and build option in addition to the conventional design- bid- build approach, allowing the acceleration of the project from planning and design through to construction completion and training of personnel for facility start-up promptly within the context of the project timeframe. The construction

services could provide longer term assistance for the company because the structure matters for the company rather than simply solving an immediate problem. JTED also offers integrated construction oversight services, working with primary contractors to ensure the natural water treatment element is efficiently integrated into the larger overall project. Besides offering design services and construction services, John Todd Ecological Design also has adequate

experience in consulting for a broad range of clients to help them make decisions regarding their natural resources management challenges. John Todd Ecological Design provides insights from the business planning stage of resource allocation through site visits, feasibility studies, report writing, design and construction consultations, and last, but not least, help with facility operations.

EXAMPLE PROJECTS

The team members of JTED have been working in this field for several decades and have succeeded in completing well over 80 projects during the past 30 years. These projects are located all over the world, and several of them have been in operation for over 20 years. The company currently has a list of roughly 20 case studies that detail the performance and effect of these projects. These examples cover over a dozen projects in various states of the U.S. as well as in countries such as China, Germany, England, and Honduras. Installation sites are diverse and include commercial settings such as industrial sites and resorts, and natural environments such as canals and lagoons.



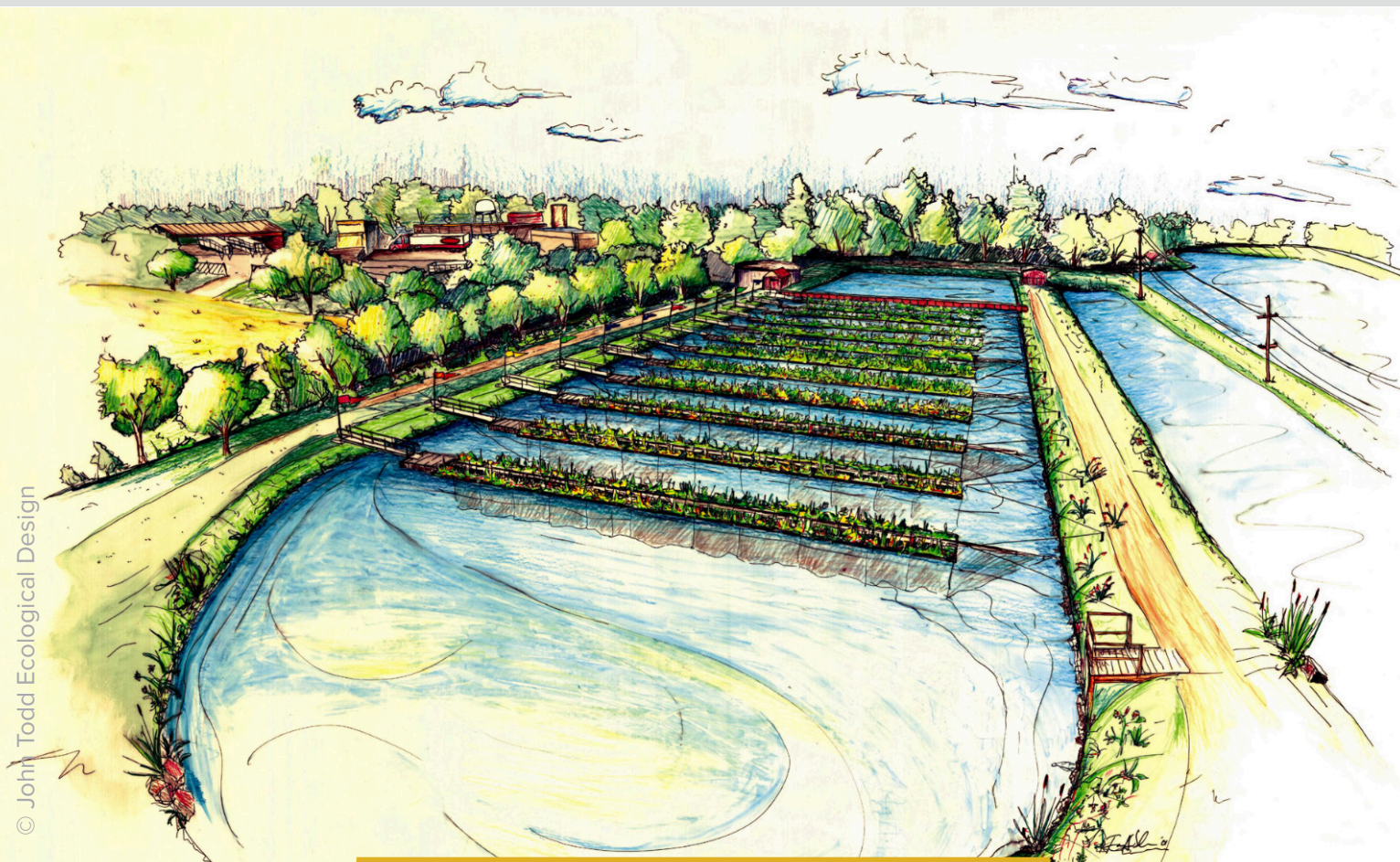
© John Todd Ecological Design

RURAL RESORT LAKE RESTORER KONA, HAWAII

This case exemplifies the company's ability to help achieve sustainable water management solutions. This EPA award-winning 3.5 million-gallon pond at the Four Seasons Resort golf course in Kona, Hawaii was designed by John Todd Ecological Design and constructed in collaboration with Ocean Arks International and Natural System Inc. The caretakers of the resort wanted to keep the pond free of algae without resorting to high flush rates that would use

valuable water on the dry side of the Big Island of Hawaii. Two Restorers were installed during the construction of the pond along with six airlifts and a subsurface filtration system. Pond water is pulled through the bottom gravel filtration and up to the center of the Restorers at a turnover rate of 32 hours. As a biological platform, each Restorer provides an ecosystem for over 26 species of native Hawaiian flora and several species of

Hawaiian fish and shrimp. This diversity of plant life provides a thriving habitat for a lot of wildlife. Some of the fish and shrimp species are supplied to the onsite restaurant as fresh seafood. Below the water surface, aerobic bacteria attach to both the gravel media and plant roots. The bacteria work to digest nitrates in the water column and out-compete algae for other available nutrients, ensuring the pond stays both clear and environmentally stable.



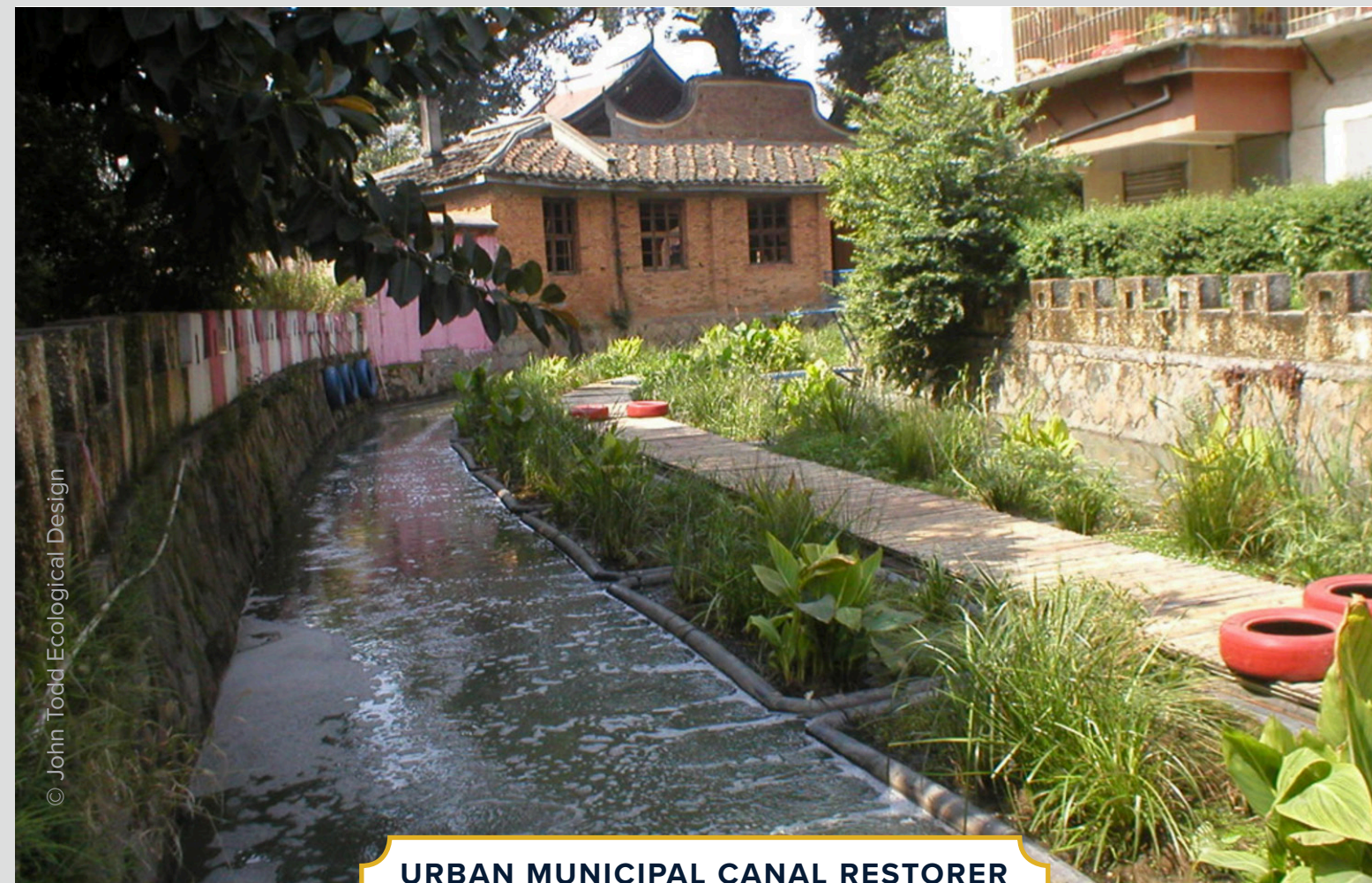
© John Todd Ecological Design

TYSON INDUSTRIAL WASTE TREATMENT
BERLIN, MARYLAND

Before consulting with Ocean Arks International and John Todd Ecological Design team in 2001, the Maryland Environmental Protection Agency levied several fines against Tyson’s poultry processing facility in Berlin, Maryland. Effluent from the Tyson lagoon was frequently out of compliance with MD-EPA standards and was unfit to discharge into

Chincoteague Bay, a local fishing and shellfishing site. With the help of John Todd’s Lagoon Restorers, Tyson Foods Inc. turned their sludge filled lagoon into a thriving ecosystem and compliant wastewater treatment site. Lagoon Restorers were installed to work in collaboration with existing traditional treatment elements. 25,000 native plants were chosen to

create a balanced and complex aquatic ecosystem which could provide a habitat for a variety of microbial communities, all of which perform a unique function in the waste-treatment process. The result was a 95% reduction in contaminants, 70% reduction in energy use, 20% reduction in sludge production, and a discharge stream that complied with Maryland’s open water effluent parameters.



© John Todd Ecological Design

URBAN MUNICIPAL CANAL RESTORER
FUZHOU, CHINA

Fuzhou, a city of 6 million people, empties its commercial wastewater and sewage into 80 kilometers of canals that run throughout the city before this canal itself flows into a large river. The polluted canals not only pose a health risk to the city’s inhabitants, but also threaten the livelihood of fishing communities downstream. A 600-meter canal named

Baima, considered one of the worst in the city, had extreme problems with odor and floating solids created by the influx of 750,000 gallons per day of untreated domestic sewage. Rather than re-piping the polluted water to a remote wastewater treatment facility, the city government sought an affordable and low-maintenance treatment system within the canal itself. In 2002, John

Todd Ecological Design collaborated with Ocean Arks International and Natural Systems, Inc. to design a restorer using 12,000 plants composed of 20 native species for their Chinese partners to place in the Baima canal. Built under an elevated central walkway surrounded by greenery, the restorer has met water quality goals and created a desirable recreational destination for the city’s residents.

PRICING STRUCTURE

For Eco-Machines, pricing begins at \$80-100 per gallon for sub-20,000 gallon per day projects, dropping to \$25-30 per gallon for 40,000-50,000 gallon per day projects, all the way to \$20 per gallon for 50,000+ gallon per day projects. JTED can adjust project size according to client-specific needs. The price also depends on the timeline of the clients. If some clients have an urgent requirement for expedited project completion, the cost can exceed the aforementioned values. The investment for a typical project is around one million dollars for a 20,000 gallon per day project from scoping to installation.

Half of the money will be assigned to the purchase of material and the other half will be used for the staff salary and overhead. JTED projects are extremely cost effective. Other solutions such as dredging can produce costs of up to one million dollars per every few hundred yards. Using a JTED project in California as an example, the client was originally spending \$250,000 per year on an activated sludge plant. JTED will be able to help the client reduce operation costs by up to \$200,000 per year and therefore provide a return of investment in just 4 or 5 years.

The company's pricing strategy varies greatly with the client, project size and complexity, timeline, and special requirements. At the same time, the wastewater treatment can be the public asset as well, as JTED projects create a positive externality that spills over into the public sphere. As indicated in the case study section, restoration of habitats provides positive externalities in both social and ecological contexts, benefiting the public. If external benefits are added to the evaluation of costs, JTED project are always exceptionally cost effective and attractive.

SYSTEM COST BY SIZE			TREATMENT COST/GALLON	
GALLONS PER DAY	CAPITAL		ANNUAL MAINTENANCE <i>(15 year period)</i>	
1,300 to 2,500	\$300,000 to \$450,000	\$180/gallon	\$120/gallon	\$20,000/yr
2,501 to 5,000	\$400,000 to \$750,000	\$150/gallon	\$120/gallon	\$40,000/yr
5,001 to 25,000	\$600,000 to \$1,500,000	\$60/gallon	\$36/gallon	\$60,000/yr
25,001 to 100,000	\$1,000,000 to \$2,500,000	\$25/gallon	\$12/gallon	\$80,000/yr

SALES MODEL

The John Todd Ecology sales model is mostly dominated by indirect sales. The annual revenue produced by JTED oscillates between half million dollars and million dollars. **The sales model and how much biomimicry plays a role in the sales process depends on clients. Biomimicry is always a part of John Todd Ecological Designs internal conversation.** For some clients who have a deep understanding of the company's process and have known John for years, saving

money by going with JTED's solutions is only part of the draw. John is still a professor in the university but he has built a reputation and network in the field as well. People know John Todd products and approach the company with their problem looking for a solution. Take the South African project for example: the government needs a solution for water treatment and they approached JTED seeking a potential design installation. So far, the company has secured clients in

Europe, the United States and China, as well as Latin America and Africa. JTED's marketing is not limited to client outreach: when former clients face a new requirement to solve an environmental and/ or water management issue, they know that few if any companies can provide an equivalent service. In these cases, it is the customer that reaches out to JTED.

GROWTH & CONSTRAINTS

Thus far, JTED has been growing over the past 25 years. Today they have a total of seven staff and eight ongoing projects. Projects are completed on a rolling basis and project duration depends on the particularities of each case. During the past 2 or 3 years, the company has begun re-thinking its entire structure. John Todd Ecological has no plans to grow much further, which means they not will expand beyond their current size and produce more of their products as a traditional manufacturing company would. On the contrary, **John Todd plans to keep his company small in the hopes of maintaining the company's founding vision.** JTED's current

focus is to push the development of product design to a whole new level. JTED plans to expand the size of its team from the current seven staff to around 15. What JTED wants to do is to do more pilot studies in the field, which is where John's passion truly lies. The water treatment market's development today really depends on government regulations. This will be the major obstacle to John Todd's plans because the company's pace of research and development does not depend on the pace of government regulations.

JTED's Eco-Machines are a unique solution to wastewater treatment, however there are competing companies with

alternative methods of treatment. Companies such as Oregon based Orenco, offer pump, disinfecting, and water reuse systems for installation. Other competitors include Triplepoint Water Technologies LLC, DO2E Wastewater Treatment, and Waltham Technologies Inc. Most competing companies are wetland based while JTED is primarily tank based. Half of JTED clients will have talked to other companies and vetted the industry to some degree, but mostly the question is whether JTED has the resources and skill set to complete the project. While some companies are to potential competitors, JTED believes that there is at present

an effectively infinite number of market opportunities in this space, allowing for all of these companies to work comfortably without entering into direct competition with each other.

Possible competitors include Roth Ecological Design International, Natural Systems International, and Ecosolutions LLC.

The features and compatibility of JTED's products and services enable them to gain a competitive edge in the market.

For example, costs of operating

machines have increasing returns to scale, therefore they could offer a larger benefit for the customers by helping them use their machines continuously.

Additionally, in terms of R&D, they have relationships not only with clients but also with academic institutions.

JTED is currently pursuing partnerships with university researchers and considering partnerships with like-minded companies, such as Biomimicry South Africa in 2014. Unfortunately, licensing rights have

been abused before in their joint ventures with Living Machine, and as a result JTED has shifted to not issuing these rights to outside their firm.

This means their licensing rights will now be more secured, which allows them to retain their competitive edge. Through their unique offer of customized products and services, JTED can be expected maintain the unique advantages they hold at present.

FUTURE POTENTIAL MARKETS

John Todd Ecological Designs wants to offer the world a new way of thinking, a radical solution to an environmental challenge. This challenge is finding a better, cheaper way to treat water in a more efficiently. The potential market for this solution is infinite because almost every industry, such as mining, energy, food processing and manufacturing, uses water for production. JTED is interested in focusing more on their research and growing their relationship with the institutes. Now JTED is focusing on domestic wastewater treatment, such as laundry water and bath wastewater. In the future, JTED also wants to work with heavy industry, such as the chemical and mining industries. One of

John's PhD students wrote his dissertation on the treatment of AEEA, one of the mining industry's principal waste products. The results of a project designed to treat this waste product were astounding: the compound was dissolved in 72 hours, rendering this process an effective solution. The potential market is huge and the challenge begs for readily available solutions that can meet environmental standards and move towards more sustainable development.

If JTED can continue to find more solutions for other industries, the scale of potential growth is effectively unlimited. JTED relishes a new challenge and enjoys thinking about ecological design in many

different contexts. John has addressed a wide variety of waste products in the past, such as confectionary waste (chocolate factory), dairy waste, etc. There are a lot of wastewater pilot projects that they plan to take on in the near future. At the time of writing, JTED had a proposal out the door to treat frack water generated by the fracking industry as well as a pilot to treat the effluent stream from bus wash water (road salt, industrial effluent). There is also a facility in the works treating a canal contaminated with petroleum hydrocarbons that is not a commercial offering, but JTED is interested in piloting and offering solutions for these dangerous contaminants.

Financial Strategy

All of the projects and work completed by JTED are completely financially independent. In the past, the company was in a more precarious place due to its size, but now it is completely sustainable. Most of their projects are self-funded by earlier reinvestment in the company. Additionally, other entities perform as liaisons between industries, including the hydraulic fracking industry. Therefore, JTED has cultivated investor relationships on and off over the past few years. Usually, pilot projects are funded by the industry,

however currently every on-going projects is self-funded to preserve the company's financial independence. JTED's fiscal situation last year was within the company's targeted performance parameter: revenues were greater than \$500,000 per year, less than \$1,000,000 per year, and each project generated approximately \$150,000 million dollars of profit. Average project scope usually exceeds \$100,000, and they obtain their money from both the specific client and earmarked overhead. Manufacturers from the chemical industry have

expressed an interest in finding solutions to their wastewater treatment problems, particularly in the current increasingly strict regulatory environment. The potential benefit for this is huge: the players in the industry stand to save as much as \$200,000 per year in operating costs and follow in the footsteps of one of JTED's clients in California. The industry has a strong incentive to fund research and develop through JTED in order to comply with government regulations.

In addition to self-funding, government funding is another important source of revenue, along with companies facing environmental challenges who also provide research funds. With regards to government funding, JTED's focus on reducing environmental impact will work well for them. Specifically, since their products and services are geared towards environmental regulations and sustainable development, there is a lot of potential to obtain funding from government compared with other industries. A lot of work has been funded by the EPA (particularly those dealing with petroleum). JTED has completed a project working with a client in the Netherlands developing

a solution for greenhouse effluent. This project was funded by the greenhouse industry when regulations began growing ever more strict. Considering that JTED would like to continue producing and maintaining innovative solutions and processes, finding many sources for funding is a good option for the company. JTED reinvests 100% of its profits into its R&D efforts. This makes their future product development more meaningful and sustainable in a long run, and also pushes the company towards continued innovation. Furthermore, the company has an R&D arm in South Africa and works with the Western Cape

Government and Biomimicry South Africa at a slower pace.

Because they built several restorers, they have clients that pay for the design and are not investing their own money or anyone else's money at the moment. JTED tries to channel its R&D investment through clients as much as possible, using their contributions to solve the challenges that the company faces as it works to provide customized solutions for its clients.

FINANCING

PILOT STUDIES

The company is privately held by John Todd, the architectural advisor, and John's son. JTED has worked with investors, but over the last 15 months JTED has received no additional investments. JTED's current strategy to secure additional financing is by pursuing research and development funding for pilot projects.

Because JTED does not have plans to expand the size of the company, most of their funding goes towards supporting research and development efforts. However, it takes a long time to see the results of this investment in new areas. No one really has the experience JTED does with pilot studies in wastewater management. It is hard to find the third party investors willing to wait the

amount of time required for the pilot study to eventually turn a profit when the technology acquired in the study is applied to for-profit projects. However, approaching this difficulty from a different perspective, the pilot project could provide a high rate of return for the right investors. Unlike risky investments such as junk bonds, the long history of JTED's successes provides a measure of security for the risk-averse investor. Because the company is privately owned and does not have any interest in going public, it could be an ideal alternative for an individual investor who wishes to diversify their portfolio while putting their money into an environmentally friendly enterprise.

Furthermore, as the interview with JTED suggests, while the potential market for JTED is infinite, this means that it is hard to choose which sector of the market to go after first.

With the current size of JTED and the lack of research funding for pilot studies, it is hard for JTED to go after multiple sectors simultaneously, especially considering that different industries face wildly different challenges.

The company is exploring the possibility of partnering with a university to pursue grant research funding from the Department of Energy or another federal agency.

FUTURE POTENTIAL

FINANCIERS

Potential investment funds for JTED are expected to come mainly from research grants for pilot studies. The ideal investors will be the people who seek to fund environmental friendly projects long investment horizon and high expected rates of return.

Risk and return tend to move together in JTED's projects. The risk is not insignificant: it is a unique risk which derives from the uncertain results of research and development efforts, especially it is cutting edge research. In this case, it is a perfect option for investors looking to diversify their portfolio into environmentally friendly activities. The fact that JTED reinvests 100% of their profit into R&D helps signal JTED's confidence in their projects.

This could provide an incentive to JTED staff to work harder to maximize their own investment. If JTED could obtain outside financing, this could provide a further opportunity and more resources for the team to attempt taking on multiple projects at the same time. John, who is still a professor, brings additional confidence in the quality of research because he is one of the leading professional in his field. All of these factors could provide an excellent motive to invest in these projects, if the potential investor has the patience to put off seeing a return on their investment until the project is complete.

ATTRACTIVENESS FOR INVESTORS

Even though they do not expect to expand their business dramatically in a short run, JTED's business model has some unique advantages in the market. Especially in the US, JTED does not face any meaningful direct competition, and there are a variety of projects underway all over the world in emerging markets. Considering this, along with the strength of JTED's custom designs, and the high reinvestment rate of R&D, the company is successfully maintaining solid relationships with their current customers. The success of JTED in their diverse portfolio of projects could make it feasible for them to enter new markets and find innovative solutions to similar challenges.

Conclusion

With each of the projects that JTED has completed, the team acquires new methods for solving challenges. The company does much of its R&D through its clients in the process of tackling the unique customization process for each new system. The clients that they work with may either have their own specific demands or will let the team approach the issue in their own way. This has allowed JTED to use the client's contribution to solve each new challenge they face and potentially gain a lesson that can be applied to other projects. **This builds the capital or brain trust that JTED holds, beyond just their products, which is their capacity to solve the problem at hand in a creative way.**

John Todd Ecological Design has been around for 27 years, but in the past few years they have begun actively restructuring and redesigning the company. As JTED continues to take on additional projects and discover new solutions, it has done some strategic thinking about its long-term future. The current team is very interested in keeping the company fairly small. **The staff, composed of creative people that like to innovate, are not interested in having a production arm to scale up. They are interested in research and creating relationships with academic institutions, and are not focusing primarily on the generation of large cash flows or profit.** As a result, the company can be found taking on new and extremely diverse projects in various contexts and industries in order to expand their design capacity and further optimize their systems. JTED also runs design workshops open to the public at the Living System Laboratory in Massachusetts, and has plans to transform it into an ecological design hub. This way, JTED can remain a voice that contributes to the world in a positive way, and offer radical solutions and a new way of thinking about water treatment infrastructure.

Lessons Learned

STAY ENGAGED THROUGH OPERATIONS & MAINTENANCE

It is important to continue to build strong relationships with the client even after installation. JTED remains involved with the system for its lifetime, providing maintenance and support to ensure the longevity and performance of their installations.

STAY SMALL YET MIGHTY

Maintaining company integrity and vision is essential to developing sustainable solutions. JTED seeks to expand the use of sustainable, living technologies as a part of everyday life and to educate others in these practices. The team would have been more restricted working in a corporate environment that focused on profit generation. Instead, JTED has a more free-thinking and innovative culture with a small yet diverse and energetic group of focused and dedicated staff.

IN-HOUSE INVESTMENTS IN R&D CAN BE CAPITALIZED ON THROUGH DIVERSIFICATION

A high focus on the R&D end of JTED has contributed significantly to the company's success in improving and adapting its core technology. As a company that offers products and services for a wide range of dynamic challenges, JTED invests heavily in R&D. The innovation that flows from this investment allows the company to offer a continuously evolving process as a unique solution for water treatment in a variety of environments. JTED aligns its R&D initiatives with the needs of each client, allowing them to take advantage of the client's contributions to find innovative solutions.

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