

TransTech Alert

Transformational Technology

Technology to Help You Clean Up in the Fracking Boom

Dear TransTech reader,

The microscopic unicellular plants known as microalgae hold a deep fascination for scientists and entrepreneurs. The source of that fascination is the unparalleled biological efficiency of these simple water plants.

Unlike plants that live on land, the aquatic microalgae don't spend biological resources on complex functions or structures. Surrounded by water and nutrients, they are unaffected by gravity, so their genetic program is focused on growth and reproduction.

This characteristic has led some scientists to conclude that the vast amounts of petroleum found in the earth's crust must have come from ancient algae. Microalgae are so efficient at converting light, CO₂, and nutrients to biomass that some common species double in mass every few hours.

For this and other reasons, proponents of alternative fuels have invested great hope in the possibility that algae will make fossil fuels obsolete. Given this backdrop, it is deeply ironic that one of the most important breakthroughs in the incredibly prosperous oil and gas industry has come out of the algae farming industry.

The technology I'm covering in this issue improves the efficiency of oil and gas extraction while solving real environmental problems associated with the massive amounts of water that are used in hydraulic fracturing, or fracking. It also offers a remarkable investment opportunity.

Issue: 1.07 • March 2014

In This Issue

- 01 Technology to Help You Clean Up in the Fracking Boom
- 12 From the Analysts
- 13 Portfolio Update

Algae and the Hype Cycle

Early-stage excitement about algae probably peaked in 2009 when Exxon Mobil announced an investment of as much as \$600 million in a company founded by J. Craig Venter called Synthetic Genomics. Venter had already made one major scientific breakthrough many years before it was expected to arrive when he led the first successful effort to sequence the human genome. Additionally, Venter created history's first living cell with a synthetic genome in 2005, a bacterium he named *Mycoplasma laboratorium*. Based on that success, it was reasonable to assume that he might genetically reprogram algae to naturally and efficiently produce valuable products, including fuels.

At the time, green advocates predicted that biofuels from algae would shortly compete with fossil fuels that were becoming scarcer. Advocates of alternative fuels felt confident that science and economics were on their side and that fossil fuels would shortly be obsolete.

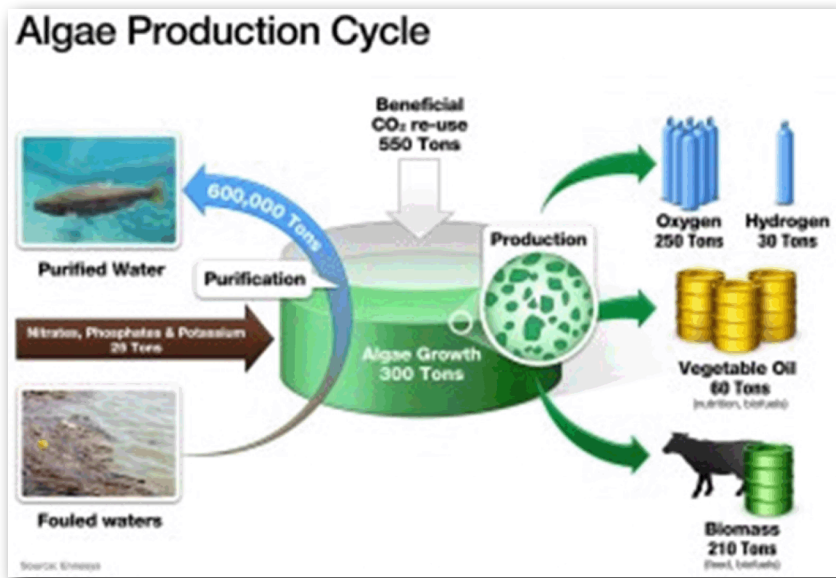
Innovation, however, does not operate according to ideology. New oil and gas extraction technologies, especially in the field of fracking, made a mockery of the peak oil prophets. The economic imperative to produce biofuels and other alternative forms of energy faded. Oil and natural gas reserves rose to vast new levels and today North American energy reserves may be greater than OPEC's.

Abundant oil and gas have made the dream of biofuels capable of competing on the open market, without subsidy, a much harder target. Concurrently, the political willingness and ability to spend tax dollars on alternative fuel programs has waned due to fiscal pressures and the highly visible failure of alternative energy projects.

In 2013, Exxon Mobil's CEO, Rex Tillerson, backed out of the arrangement with Synthetic Genomics, saying he believed technical hurdles could delay competitive algae biofuel for at least 25 years. Whether he's right, of course, nobody knows. Important innovations are almost never foreseen, and Venter or some other researcher could make the big breakthrough that changes everything at any time.

One thing is clear, however. It's going to take time for unsubsidized algae to provide a true alternative to petroleum and natural gas. Even if a miracle species were engineered today, an entire industrial infrastructure would have to be developed before it could be exploited.

Some of the largest hurdles are in mundane practical areas rather than advanced genetic science. Algae farming is very new, so we are only now learning how to grow, harvest, and process optimal crops. While algae in the wild grow faster than proverbial weeds, it's far more difficult for farmers to exploit this potential.



In agricultural settings, nutrients and wastes have to be managed carefully for algae to prosper. Even when algae populations are high, it's not easy to harvest a crop of plants that are individually so small that they require a microscope to be seen. Some algae clump together and can be harvested using conventional technologies. Always, however, significant populations remain diffused in water. Their extraction and processing has therefore been difficult and costly.

These are the challenges that the company I'm recommending today, OriginOil, Inc. (OTCPK:OOIL), was founded to address. At the heart of the company are two brothers, Nicholas and Riggs Eckelberry.

Chief Research Officer Nicholas Eckelberry is a brilliant self-taught inventor ranked by *Biofuels Digest* as one of the "Top 300 People in the Bioeconomy." His interest in wastewater treatment issues led him to Japan, a densely populated country forced by geography to take water quality and conservation seriously. There, Eckelberry worked with well-known scientist Hideto Uematsu, whose interdisciplinary approach to technology led to innovations and patents currently used in thousands of Japanese wastewater treatment facilities.

One of their discoveries, known as quantum fracturing, is a method of making CO₂ more available to algae. It can be used, for example, to increase populations of algae that clean wastewater by feeding on nutrients. The quantum-fracturing breakthrough inspired Nicholas's brother, Riggs Eckelberry, to co-found a company in 2007. OriginOil aimed to advance the technology of algae production.

While Nicholas Eckelberry was innovating water-handling technologies, Riggs Eckelberry had worked in the digital economy, scoring a number of successes that established his reputation among financial players. He was therefore able to secure funding and grants for the 2007 startup. Riggs worked as president and CEO while Nicholas continued research and development as chief research officer.

Within a few years, OriginOil was a recognized force within the algae industry, and Riggs Eckelberry had joined the National Algae Association Advisory Board. Based on OriginOil's patents, the company solved several critical problems that were holding back algae production and harvesting. Though the company hadn't reached profitability, revenues were increasing as OriginOil tapped into high-value algae markets such as specialty lubricants and oils. One example of a successful OriginOil product is astaxanthin, a carotenoid that is a particularly effective antioxidant due to its ability to cross the blood-brain barrier.

If you've ever eaten salmon that was pink in color, you've consumed astaxanthin. Salmon meat, in fact, is not naturally pink. Like flamingos, salmon get their sunset hue from astaxanthin through a food chain that starts with microalgae. For this reason, salmon farmers buy and feed astaxanthin, which can cost thousands of dollars per kilogram, to their stock.

For our purposes today, the most important of the OriginOil innovations for the algae market is Electro Water Separation™ (EWS). Designed to efficiently remove algae from large volumes of water in one step, it comprises several technologies.

The Algae Harvesting Breakthrough

The EWS system uses precise electro-pulses in long tubes through which large quantities of water can be moved rapidly. The electrical pulses neutralize the algae's charge, causing them to coagulate or flocculate into clumps.

Once flocculation takes place, the coagulated algae, still surrounded by water, moves to an electro-flotation stage where micro-bubbles are generated using modified electrolysis, which breaks H₂O into its two components, hydrogen and oxygen gas. The micro-bubbles pass through the coagulated algae, moving it to the surface where it can be harvested using various available techniques such as skimming.

In the process, by the way, several significant contaminants are dramatically reduced or eliminated. The most important of these may be naturally occurring bacteria that feed on algae, causing harvests to rot quickly unless immediately processed. The process kills bacteria by electrically puncturing their cell walls, leaving the algae untouched due to its tough outer wall. The shelf life of algae is therefore significantly extended, which translates into higher profits for producers.

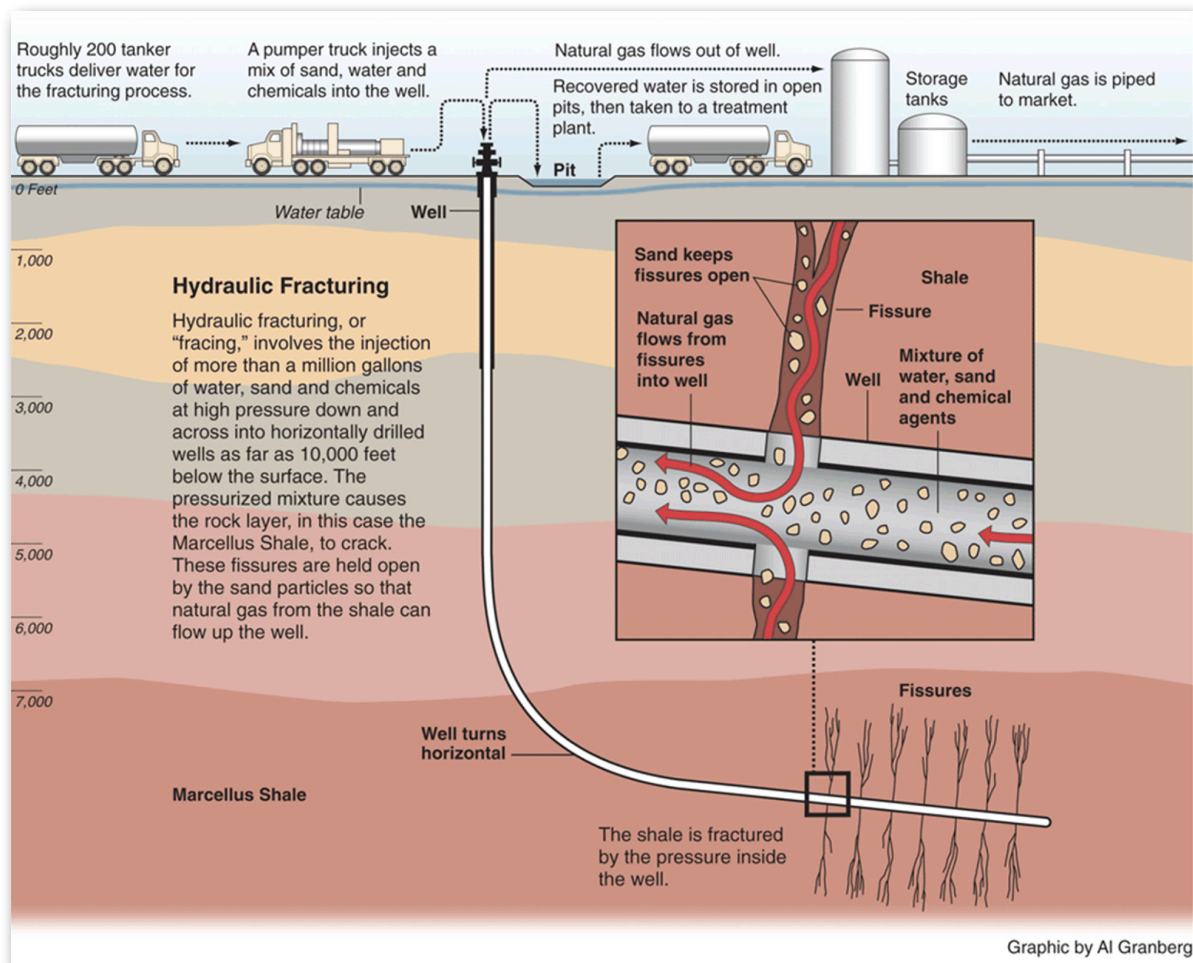
Peak Oil Water

We don't know definitively where oil and gas come from, but one major theory is that the process starts with ancient algae placed under great pressure. If true, that makes the OriginOil pivot to fossil fuels ironically appropriate.

In 2011, the company hired Bill Charneski, a Dow Chemical veteran whom I spoke with along with Riggs Eckelberry while researching OriginOil. Charneski was initially brought into the company to oversee product engineering, but he currently heads the oil and gas division. He turned to the contract engineering firm PACE (headquartered in Fountain Valley, California) for assistance in the design and production of testable prototypes of OriginOil's wastewater treatment technologies.

PACE and its contract manufacturer, Clean Water Technology, were already familiar with the major challenge facing the oil and gas industry. In a word, that challenge is "water."

Oil and gas extraction requires huge amounts of water. Hydrofracturing relies on the injection of pressurized water into oil- and gas-rich zones along with sand or a similar substance to keep flow channels open. Typically, eight barrels of water are needed for every barrel of oil that is extracted. This intensive use of water is the source of two problems.



One is simple availability. With increasing competition for water, its cost has risen. If water needs to be shipped to a well site, transportation costs can add even more expense. The second problem is disposal of the water after it's used, which has obvious environmental implications.

Water acquisition and disposal are not just financial issues. They are increasingly politicized, with prominent anti-fossil fuel activists claiming that drilling presents grave risks to groundwater quality. Though the evidence for this claim is lacking, the anti-fracking lobby attempts to sway political decisions that determine which competing industries get access to limited water resources.

Recycling the water that comes out of wells for further oil and gas extraction therefore makes good sense. Removing pollutants and reusing water reduces the cost of water acquisition as well as disposal. In most cases, OriginOil's water treatment technologies can significantly reduce the cost of oil and gas extraction.

Obviously, the benefits of water treatment vary by region, based on factors that include water availability, access to disposal wells, and water-quality regulations. In Texas, where water disposal wells are widely available, the cost savings on the disposal side are relatively low. In regions where disposal wells are nonexistent and the water used in mining must be purified to human drinking standards, the economic incentives to recycle are very high.

In 2012, Charneski and a PACE engineer, Andy Komor, decided to test OriginOil's algae-processing technologies on fracking flow-back water and produced water. The terms "fracking flow-back water" and "produced water" come up a lot in this field, so I should explain that this is simply water that has gone through the initial separation process to remove oil. It is "produced water" if no fracking has occurred. It's "fracking flow-back water" if the extraction involved hydrofracturing.

The 2012 test was so successful that PACE used the OriginOil technology in their own Frack-Back™ water purification system. A PACE engineer stated that, "The early test results using the OriginOil systems far surpassed the results from standard chemical coagulation, DAF [dissolved air flotation], and filtration." Subsequently, PACE collaborated with OriginOil to improve the efficiency and output of the system. While the system is still in testing and demonstration mode, two more companies have followed PACE in licensing the technology.

This test was the game-changer that transformed OriginOil from a fascinating player in the emerging algae industry to a disruptive innovator in the fully developed oil and gas production industry.

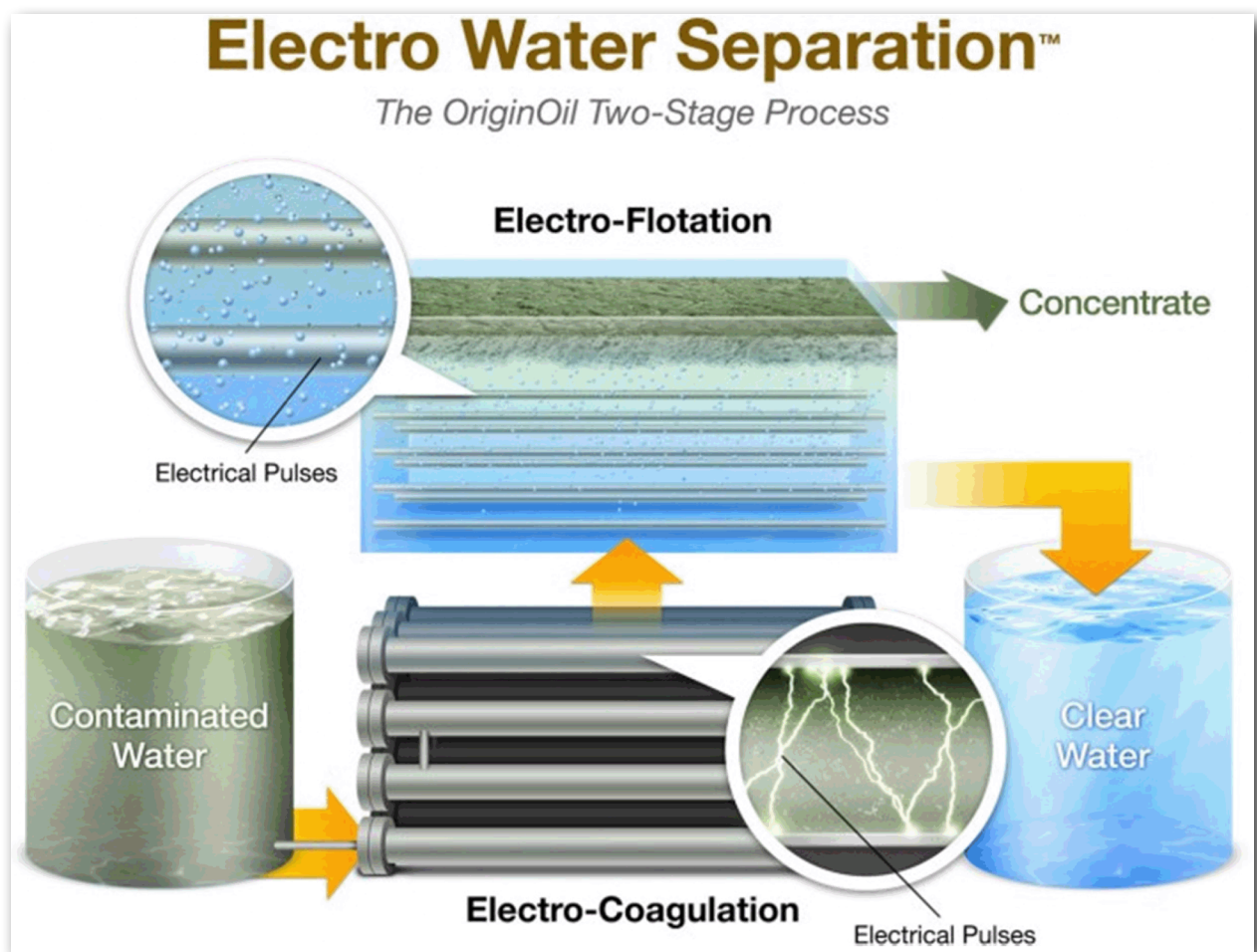
Electro Water Separation™

Today, OriginOil is focused on oil and gas extraction water treatment. After the first separation of water from oil, the minimally treated water with significant pollutants passes through OriginOil's reactor tubes. There, pulses of electricity pass between specially designed anodes and cathodes. This process breaks down the oil-water emulsion.

The pulses neutralize the native charges that oil droplets and suspended solids naturally have. Then, instead of repelling each other, the suspended solids actually coalesce. The electrocoagulated oil droplets become larger and larger, until they can be extracted and sold. The EWS process turns a costly potential pollutant into revenue.

The electro water pulsing also kills the bacteria found in frack flow-back and produced water. This is important, because bacteria in recycled water that is reused in wells can multiply and plug the wells.

The OriginOil unit also breaks down dissolved organic molecular chains in a process known as electro-oxidation. Angstrom- to micron-sized bubbles of gas attach themselves to the agglomerated particles of oils and suspended solids. The organics are thereby mineralized and, as suspended solids, can be lifted to the surface and removed.



At the end of the process, there are three effluents: the oily mat at the top, very clean water in the middle, and heavies like sand on the bottom of the separator. All of that occurs in one piece of equipment. The process is chemical-free, very low-energy, and has a relatively small footprint compared to other techniques.

To clarify, this Electro Water Separation system is employed in the first stage after the initial separation of oil from water. Depending on the beneficial use that is planned, more treatment steps may take place. However, the system can remove well over 99 percent of the oil and suspended solids while also stripping most of the bacteria from the water.

According to Bill Charneski’s calculation, the payback for using the OriginOil technology is about \$200,000 per month for an average fracking well. This, he believes, will drive the industry to abandon more expensive and less environmentally attractive chemical water treatments and to adopt the company’s EWS process instead.

The Competition

At this point in its history, the fracking industry is actively looking for a better way to treat produced and frack flow-back water. It is widely understood that expensive and environmentally unattractive chemical treatments must be replaced by electrocoagulation.

About half a dozen companies have electrocoagulation technologies, including Halliburton, which I consider OriginOil’s most important competition. There are several reasons, however, why I believe OriginOil will win a significant share of this growing market.

	Kaselco	Water Vision	Quantum-Ionics	Ecolotron	Bosque ECR	Halliburton WaterTectonics Clean-Wave	OriginOil CLEAN-FRAC
Pretreatment	Prefilter	Prefilter	Prefilter	Prefilter	Prefilter & Chemical Flocculants	Prefilter	Prefilter
Anode Cathode Configuration	Parallel Flat Plates	Thin Cells	Parallel Flat Plates	Parallel Flat Plates	Parallel Flat Plates	Parallel Flat Plates	Proprietary Tube & Plates
Electrode Fouling	None	Less than 1 Month	1-2 Months	1-2 Months	1-2 Months	1-2 Months	None
Electrode Life	Medium	Low	Medium	Medium	Low	Medium	2-5 Years
System Configuration	Fixed No Integration	Fixed No Integration	Fixed No Integration	Fixed No Integration	Fixed No Integration	Fixed No Integration	Modular Immersion in Frac Tank
OPEX	High	Medium	High	High	High	High	Low
Oil/Water Separation	Gravity Clarifier	Dissolved Air Flotation	Vacuum Clarifier	Gravity Clarifier	Gravity Clarifier	Skimmer	Integrated Concentrator

Source: OriginOil

OriginOil’s design, which is protected by a variety of patents, differs from other systems in several ways. The innovative design of the OriginOil reactor tubes produces less resistance and requires less power than the products of most of the company’s competitors, which use flat metal plates to impart electrical charge to water.

OriginOil has also finessed the corrosion problem that requires Halliburton and others to use sacrificial anodes. Sacrificial or galvanic anodes have more negative electrochemical potential than other parts, meaning they give up molecules and corrode first. As a result, they must be replaced periodically.

Both of these design advantages result in lower operating costs. Additionally, OriginOil's newly developed electronic control technology is a significant differentiator. This technology uses patented algorithms to test the quality of both input and outflow water (influent and effluent) and to adjust the electrical pulses for optimal results and maximum energy savings.

The entire OriginOil system is also more convenient and easier to use in the field than competitors' systems. It's contained in a single unit that houses both the electrocoagulation and micro-bubble technologies.

In contrast, Halliburton's system requires three distinct steps. Charneski points out that the Halliburton water treatment system starts with large steel plates and sacrificial anodes that require a large electrical charge due to their design. Then, a second piece of equipment acts as a skimmer or decanting device, and a third piece of equipment subjects the water to ultraviolet treatment. This more complex system has a bigger footprint, uses more power, and relies on sacrificial anodes that must be periodically serviced.

Co-opting Potential Competition

Another advantage that OriginOil has over much of its competition, in addition to superior technologies, is an extremely smart business model. Rather than raising dilutive capital to manufacture equipment and build a work and sales force, the company is co-opting the strengths of existing players by licensing its technologies.

"Our strategy is not to be a manufacturer but to be a licensor of our strategy," Riggs Eckelberry explains. "I'm in the process of establishing a worldwide network of equipment manufacturers that want to use our technology as a complement to their processes or just want to be in the water treatment business. They realize that we have the best technology, but licensing with equipment manufacturers creates barriers to entry that reinforce our position in the market."

"We license our technology to companies that already have very good market position and very good relationships. They have the channels of distribution and financing needed to make us successful. These licenses become therefore a barrier to entry, because we've got the market position that our OEMs have."

Eckelberry points out another advantage of OriginOil's approach compared to those of Halliburton and other large competitors. "Large competitors like Halliburton are a problem for many operators and service companies, because you kind of have to buy into more than just the Halliburton water treatment system. You have to buy into the larger relationship. So we're sort of the Android versus iOS solution."

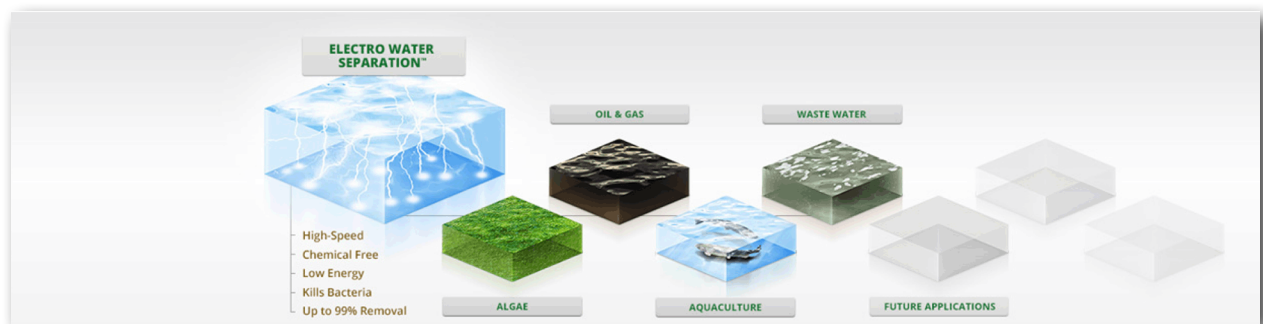
“You can freely license us and integrate our technology into your system—basically, it’s ‘powered by OriginOil.’ You don’t have to drink the Kool-Aid with a bunch of guys in red overalls on your site. I think that’s a very powerful motivation for a lot of people looking for electrocoagulation.”

This approach is already bearing fruit. In September last year, PACE started building its first commercial-scale Frack-Back system incorporating OriginOil’s EWS technology. In October 2013, OriginOil won its first customer for its pay-by-the-gallon business model, which is similar to an equipment-leasing model that spares operators capital costs.

The oil and gas industry is already turning to recycling as a way to reduce the costs of new water acquisition and wastewater disposal. Oil service companies and operators are examining the complex costs and benefits of the various technologies coming online. In some cases, water will have to be taken all the way from frack flow-back water to drinking water. In other cases, after initial treatment, it will be trucked to a disposal well. In all cases, however, OriginOil provides what I believe is the most economical means of dealing with complicated water issues.

In Conclusion

OriginOil is a very impressive company with an enormous pipeline that starts with the exploding oil and gas industry and stretches out to algae production and aquaculture. Many of the technologies developed for algae translate easily into traditional fish farming.



Meanwhile, the company’s original algae harvesting application continues to garner both kudos and customers; and a spin-off called Algae Screen™, which helps algae grow by protecting it from its microscopic predators, was announced late last year. Currently, the company is rolling out a process that reduces ammonia during algae production, killing bacteria and other pathogens. This process may actually provide major cost savings by producing, as a by-product, algae pellets that are nutritionally superior to typical fish foods.

There was never any doubt, by the way, that green efforts to criminalize fossil fuels would fail. While I personally don't believe that CO₂ is driving climate change, it doesn't really matter. The rest of the world is increasingly rejecting political efforts to punish or ban oil and gas usage. Australia, Canada, Japan, India, China, and Russia are either ignoring or repudiating impoverishing anti-CO₂ policies. The US, therefore, cannot resist the benefits of fracking, because a complete ban on fossil fuel usage in the US would have no meaningful impact on global CO₂ levels. Additionally, the use of oil and gas as a tool of Russian expansionism has added an additional incentive for the West to expand fossil fuel extraction.

Gold in Organic Sewage

The first question I asked Riggs Eckelberry was about sewage. EWS would seem to be a logical and cost-saving solution to urban wastewater management issues. His answer was embarrassingly obvious. Municipal governments are incredibly bureaucratic and risk-averse. Betting that city governments will act in a fiscally rational manner is a good way to go broke.

On the other hand, there are many agricultural operations that could save money by adopting the OriginOil technology to treat livestock runoff. There is also a possibility that European efforts to deal with organic sewage on the local level could kick-start the company's technology.

OriginOil has a joint venture with the French company Ennesys in Paris. Anticipating mandated energy self-sufficiency for buildings, Ennesys has installed a system, in collaboration with OriginOil, that processes liquid sewage into nitrates that are fed to algae grown on the roof of the building. Circulating algae helps cool the building and can fuel electrical power generation when harvested. French President François Hollande visited the site and praised both Ennesys and OriginOil for the innovative project in October 2013.

While algae and waste management are important in the long run, I wouldn't be recommending OriginOil today were it not for the short-term potential of the company's involvement in oil and gas extraction. Algae will, I believe, become a major industrial sector at some point in the future, but it's a fledgling sector today. Algae, even if it never competes with other fuel sources, will likely be a fertilizer and major food source for agricultural animals in the future.

The OriginOil Website

I've never seen a better corporate website than OriginOil's. I seriously recommend going to www.originoil.com and spending some time there. In particular, watch some of the videos. Here's a short list of my favorites.

1. [Local NBC Affiliate Reports on OriginOil Launch](#)
2. [The Origins of OriginOil's Technology](#)
3. [OriginOil on Voice of America: Fracking Could Lead to Big Profits](#)
4. [EWS Algae A60: High-Speed Chemical-Free Algae Harvesting](#)
5. [The President of France Visits OriginOil Joint Venture](#)
6. [OriginOil Demonstrates Its EWS Petro™ Process in Texas to Industry & Media](#)

Because of its enormous and disruptive pipeline, I think this is a long-run buy-and-hold company. I suspect there are going to be many events and opportunities in the coming years that will allow you to trade the channel to increase holdings. For those of you who want advice on doing this, I turn you over to the capable hands of the Mauldin Economics analysts.

For transformational profits,

Patrick Cox

Patrick Cox



From the Analysts

With OriginOil's novel Electro Water Separation™ technology, which gives the company exposure to the US oil and gas boom along with the biofuels market (which is still in its infancy), OOIL has some powerful trends in its favor. And with the experienced Eckelberry brothers at the helm, the company will have every opportunity to succeed.

The company's cash pile will allow it to operate for approximately six months without another cash injection, and we expect another one to happen within that time period. Whether it will come in the form of outside investment, a debt offering, or the selling of additional equity (which, in our view, will probably be the route they choose), the company's experienced management team will find a way to keep the doors open.

Since we believe the company will likely issue equity to raise funds, we don't want to allocate too much of our capital off the bat. But shares are sitting in a very attractive range at the moment, so we don't want to miss any of the potential upside, either.

With that in mind, we'd like you to allocate **one-third of your planned capital to OTCPK:OOIL at \$0.21 or better**. Target price of \$0.50 in 12-18 months.



Use of this content, the Mauldin Economics website, and related sites and applications is provided under the [Mauldin Economics Terms & Conditions of Use](#).

Unauthorized Disclosure Prohibited

The information provided in this publication is private, privileged, and confidential information, licensed for your sole individual use as a subscriber. Mauldin Economics reserves all rights to the content of this publication and related materials. Forwarding, copying, disseminating, or distributing this report in whole or in part, including substantial quotation of any portion of the publication or any release of specific investment recommendations, is strictly prohibited.

Participation in such activity is grounds for immediate termination of all subscriptions of registered subscribers deemed to be involved at Mauldin Economics' sole discretion, may violate the copyright laws of the United States, and may subject the violator to legal prosecution. Mauldin Economics reserves the right to monitor the use of this publication without disclosure by any electronic means it deems necessary and may change those means without notice at any time. If you have received this publication and are not the intended subscriber, please contact service@MauldinEconomics.com.

Disclaimers

The Mauldin Economics website, YieldShark, Thoughts from the Frontline, Thoughts from the Frontline Audio, Patrick Cox's TechDigest, Outside the Box, Over My Shoulder, WorldMoney Analyst, Bull's Eye Investor, Things That Make You Go Hmmm..., Just One Trade, Transformational Technology Alert, and Conversations are published by Mauldin Economics, LLC. Information contained in such publications is obtained from sources believed to be reliable, but its accuracy cannot be guaranteed. The information contained in such publications is not intended to constitute individual investment advice and is not designed to meet your personal financial situation. The opinions expressed in such publications are those of the publisher and are subject to change without notice. The information in such publications may become outdated and there is no obligation to update any such information. You are advised to discuss with your financial advisers your investment options and whether any investment is suitable for your specific needs prior to making any investments.

John Mauldin, Mauldin Economics, LLC and other entities in which he has an interest, employees, officers, family, and associates may from time to time have positions in the securities or commodities covered in these publications or web site. Corporate policies are in effect that attempt to avoid potential conflicts of interest and resolve conflicts of interest that do arise in a timely fashion.

Mauldin Economics, LLC reserves the right to cancel any subscription at any time, and if it does so it will promptly refund to the subscriber the amount of the subscription payment previously received relating to the remaining subscription period. Cancellation of a subscription may result from any unauthorized use or reproduction or rebroadcast of any Mauldin Economics publication or website, any infringement or misappropriation of Mauldin Economics, LLC's proprietary rights, or any other reason determined in the sole discretion of Mauldin Economics, LLC.

Affiliate Notice

Mauldin Economics has affiliate agreements in place that may include fee sharing. If you have a website or newsletter and would like to be considered for inclusion in the Mauldin Economics affiliate program, please go to <http://affiliates.pubrm.net/signup/> me Likewise, from time to time Mauldin Economics may engage in affiliate programs offered by other companies, though corporate policy firmly dictates that such agreements will have no influence on any product or service recommendations, nor alter the pricing that would otherwise be available in absence of such an agreement. As always, it is important that you do your own due diligence before transacting any business with any firm, for any product or service.