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euglena (2931): a One-Trick Organism Without Fuel for Growth

Company: euglena Co., Ltd
Listing: Tokyo Stock Exchange, 1st Tier,
Stock Code: 2931
Industry: Food materials, bio-fuel
Price (As of Jan. 17 close): ¥1,240
Market Cap: ¥102.9 billion
Recommendation: SELL
Well Investments Fair Price: ¥500-580

The Crux:

Crude prices plunged in the last 2 years and are not expected to return to peak levels for many years, making algae-based biofuel – the premise for the co.'s future growth – uncompetitive at least until 2020. The co.'s plan to set up commercial-scale biofuel production has already hit a delay while its only profitable unit is running out of market to expand into. Recent stock falls of U.S. peers indicate co.'s equity will come under intense pressure in the near term. Meanwhile, major domestic manufacturers have come in to challenge co. in algae farming.

[1] Please see last page for full disclaimer

Executive Summary

Euglena is a single-cell micro-organism that has the properties of a plant and an animal and lives in fresh and salt water. It uses photosynthesis to generate oxygen. Oil stored in the euglena body produces a fuel that's similar to diesel. Euglena is used for algae (seaweed) based products.

- euglena's business is based on cultivating the eponymous single-cell organism for use 1) as an ingredient in health foods and 2) as feedstock for making algae-based biofuel.
- Co. has two operating segments: Healthcare and Energy & the Environment (E&E). The former brings in 99.9% of the total profits but, we believe, faces a near-term slowdown as company is now a large player in its niche and Japan's market for health foods & supplements has sub-2% annual growth. The co's big selling point, the novelty of its product, has faded.
- Major domestic manufacturer, Kobelco, has entered algae-based food market and says it's already lining up clients. Growing risk that more players with larger resources will enter the market, which will increase competition and crimp margins.
- Co. declared it has not filed a patent for its technology to cultivate large volumes of micro-algae. We believe this opens up the co. to losing any technological advantage it used to have and note that U.S. rivals are already in front and commercializing their product.
- Manufacturing costs of algae-sourced biofuel are $300 to $1,000 per barrel of crude oil equivalent. The industry could hardly compete with crude at its peak of $147 per bbl in 2008. It certainly can't compete now, which puts the future of co.'s E&E segment in grave doubt.
- In Dec. 2015 co. unveiled a 5-year target to begin manufacture of biofuel for jets in 2020. Just eight months later it announced that construction of a test facility, needed to confirm the technology's viability, is running a year behind schedule and won't be ready until the first half of 2019. This renders the 2020 target unattainable.
- U.S algae market leader TerraVia Holdings Inc. has announced a shift away from biofuel to value-added healthcare & food products because of the inability to compete with crude oil. TerraVia saw its stock fall 90% on crude price declines – a sign of what euglena equity faces.
- Even if co. manages to operate at its best-ever profit margin of 15% and hits the FY2017[2] target of ¥15 billion in annual revenue, we estimate its operating income at ¥2.25 billion and net income around ¥1.6 billion. Ignoring the drag on co.'s value that should be ascribed to the E&E segment, we value euglena relative to similar Japanese health food and supplements companies. Based on a premium PE multiple to that peer group (30x), the co.'s share price comes out at ¥580.
- Even if we fully incorporate the co.'s achievement of latest mid-term targets into the current

[2] See the presentation "Explanation of Earnings report as of Sep. 2016 and the policy for Sep. 2017" dated Nov. 9th, 2016 published by euglena

share price, we should expect profitability to remain the same as the current target for FY2017 (4.6% = NP ¥0.69 billion / Revenue ¥15 billion). This conservative assumption gives a fair price estimate of ¥500 per share (Based on: Market cap of ¥41.4 billion = Revenue ¥30 billion x Profitability 4.6% x PER30). These estimates imply a 55% to 60% downside risk.

Full Discussion

1. euglena's Growth Strategy

According to a Nov. 18, 2013 board meeting, the co. business strategy is based on the development of two directions. In the Healthcare segment, it is focused on using euglena as an ingredient in health foods. The Energy & the Environment (E&E) segment aims to cultivate algae for use in biofuel, particularly for aircraft jet engines. On this basis, in 2012 the company raised ¥7.6 billion in a public offering of new stock[3].

As of October 2016, the same two were listed as co.'s main businesses on its website with no sign of a change in strategy. Thus, we believe it is appropriate to analyze and value the co. based on these two segments: Healthcare and E&E.

2. Healthcare Segment

A) Where the Co. Says It's Heading

As of October 2016, the Healthcare segment accounted for 99.97% of total revenue and E&E for the other 0.03%[4]. From that it's fair to say that valuing the Healthcare segment is akin to valuing the whole company.

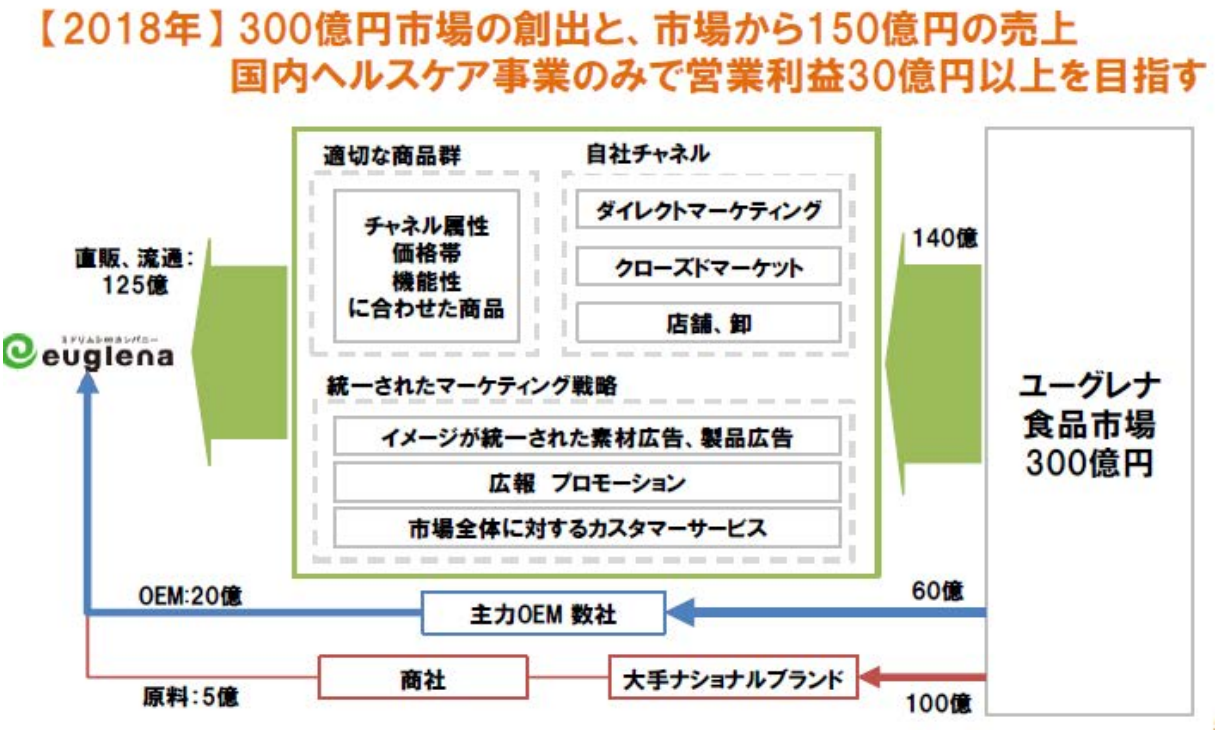
According to the co. results presentation for FY2014 (See Figure 1 below), the co. plans to expand the market for euglena food products to ¥30 billion, its annual revenue to ¥15 billion, and annual operating income to more than ¥3 billion by 2018.

[3] From company statement on the decision to issue shares for third-party allocation http://v4.eir-parts.net/v4Contents/View.aspx?cat=tdnet&sid=1114921

[4] From the company's 3Q16 financial report, p. 14 http://v4.eir-parts.net/v4Contents/View.aspx?cat=yuho_pdf&sid=2416619

Figure 1: Co. Draws Targets and Food Market Schema

We aim to create a ¥30bn market, annual revenue of ¥15bn and Operating Profit of ¥3bn from just the domestic Healthcare business by 2018

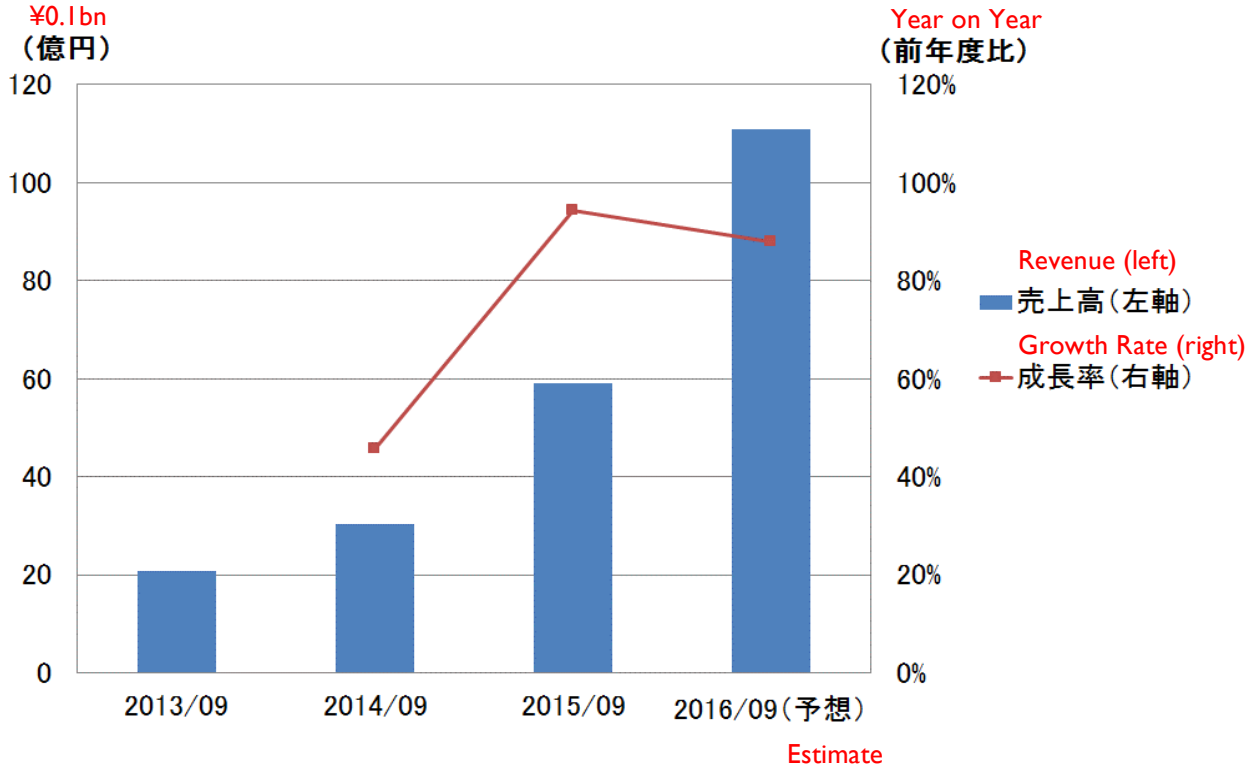


(Source：euglena presentation)[5]

Figure 2 below shows the sales and growth rates of the Healthcare business. From it we can see that the co. grew quickly in the last 4 years. If we take the view that this segment posted ¥11.1 billion in revenue for the fiscal year ended Sept. 2016 (FY2016) the co.'s ¥15 billion target for fiscal year ended Sept. 2017 (FY2017) seems reasonable. However, can we really expect this pace of growth to continue? As we'll explain later, new players with more resources are entering the market which we expect to lead to greater competition for market share. We are likely then to see the co.'s profit margins decrease as it seeks to fend off new entrants from taking over its positions.

[5] From the section on Future Strategy in euglena's financial statement for period ended Sept 2014, p. 56, published in Nov. 2014 http://v4.eir-parts.net/v4Contents/View.aspx?cat=tdnet&sid=1198200

Figure 2: Healthcare Segment Sales and Growth Rate



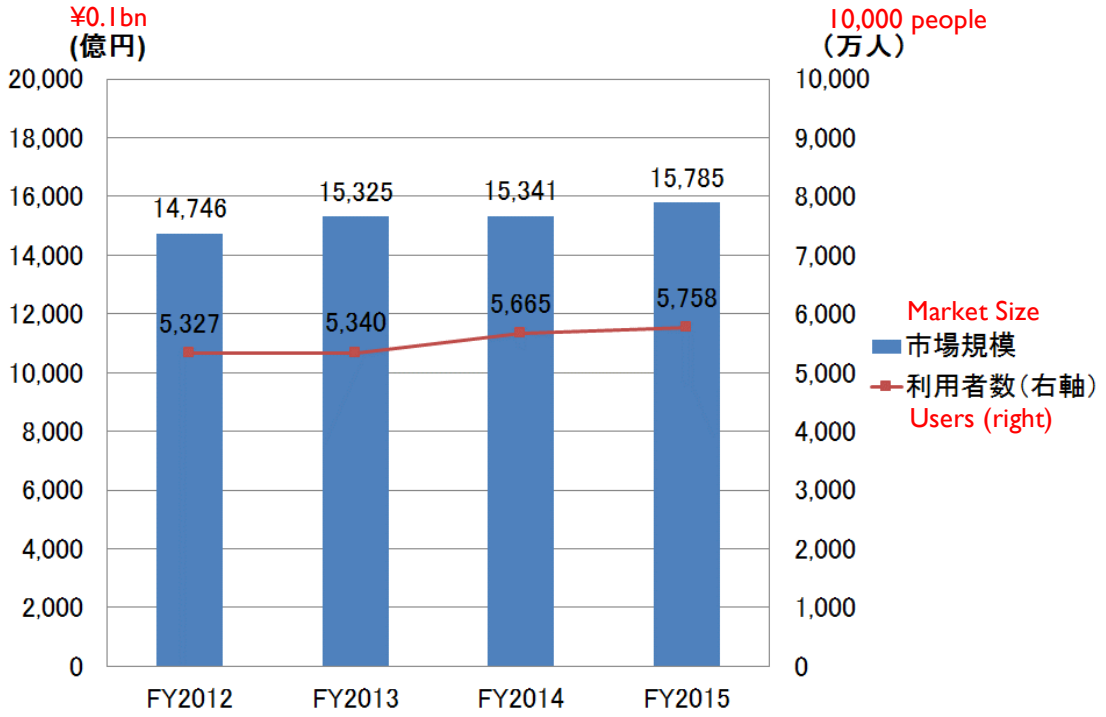
(Source: euglena)

B) Losing Luster Amid Saturation in the Market

According to a survey by Intage Inc., Japan's market for healthcare foods and supplements is estimated at about ¥1.6 trillion[6]. In recent years, the annual growth rate of this market has averaged less than 2% (See Figure 3). That shouldn't be surprising. The number of health food and supplement consumers is already estimated at some 57 million people, or one in every two Japanese.

[6] *President Online*, http://president.jp/articles/-/17722, published on March 14, 2016

Figure 3: Size of Japanese market for health foods and supplements



(Source: Intage Inc.)

So, it's fair to say that the Japanese market has entered maturity[7]. Then, how did euglena attain quick growth in such a market?

We think the main reasons were as follows:

- **Novelty factor:** euglena-based food products drew interest because they were completely new
- **Feel-good PR message:** euglena rode the wave of publicity that touted its main ingredient as a product that could solve humanity's energy and food issues

However, with consumer trends changing quickly, since the emergence of euglena a host of other superfoods and super-fruits have hit the Japanese market, retailing both via high-end cafés and juice bars and mass-consumer products in supermarkets and convenience stores. Having been around for a few years, euglena can no longer count on its novelty value. The health and eco-conscious consumers that supported the brand now have more options.

Let's consider the size of the niche that the co.'s health foods and drinks occupy and their position in this market. A co. investor relations official said[8] in a 2013 interview that the

[7] In fairness, at the same time Intage Inc. estimates that the current size of Japan's health foods and supplements market will eventually expand by 2.2 times to ¥3.5 trillion. However, at current pace of growth this level won't be reached for more than 30 years. For the sake of this analysis, we believe this has no impact on current share price and can be overlooked.

[8] *Equity Story*: http://equitystory.jp/interview/euglena_interview.html

Japanese market for the very popular aojiru[9] health drink was in the region of ¥50 billion, while the market for products from chlorella, another member of the algae family, was worth about ¥30 billion. Since a representative of the co. named these as the nearest competitors for euglena products, we can use the figures to construct a rough outline of the size of this niche.

Using the general market growth rate for health foods and supplements in Japan, we estimate that the size of the market in which the co.'s products compete is in the region of ¥90 billion to ¥100 billion. In which case, euglena's ¥11.1 billion annual sales for the fiscal year ended Sept 2016 account for over 10% of the niche. That makes the co. one of the biggest players in its field. It's unavoidable that as a major player, the co. will not only struggle to grow at the same rates as before (In fact, euglena itself admits the slowdown of the growth as it sets its revenue target for FY Sep. 2017 at ¥15 billion, which means only 35% growth while euglena achieved 87% growth on its revenue as of FY Sep. 2016) but will also need to fight off competition from new market entrants. We see co. margins in the Healthcare segment shrinking as a result and overall growth slowing as a result of product saturation in this field.

C) New Players With Larger Budgets Enter Market

Even if the market for algae and other plant-based juices and snacks matures, we could see the co. generating steady cash flow from current offerings as long as there isn't a big increase in the number of competitors. However, that scenario does not seem likely as companies who have no relation to health foods or food of any kind are turning their attention to this market. The maker of environmental equipment, Kobe Eco-Solutions Co. Ltd. (short-name: Kobelco), a unit of Kobe Steel Ltd. and a major manufacturer in its own right, in November 2015 announced plans to enter the food business specifically through the manufacture and sale of euglena as a food raw material[10]. The company, which has developed its own technology to produce algae that does not rely on photosynthesis and is therefore not constrained by weather conditions, submitted a notification of its intentions to the Public Health Center in Kobe. The authorities issued a certificate to Kobelco acknowledging receipt of the notice, which means the company can go ahead with plans to build a facility for euglena cultivation. Kobelco, which claims that its system is 250 times more efficient than photosynthesis-based euglena farming, also said at the time of announcement that it has already earmarked customers for its product[11].

New rules passed by Japan in the last two years lower the bar for companies to be able to claim that their products have health benefits. As of a year ago (Oct. 2015), 120 applications for new so-called "functional" foods had been filed with the Consumer Affairs Agency of which 43 came from companies that had never made food before. Among those are Nippon Paper

[9] a Japanese juice made from leafy vegetables such as kale
[10] http://www.kobelco-eco.co.jp/english/news/2015/20151130.html
[11] According to a Sept. 8, 2014 article in the Nikkei financial daily, Kobelco aimed to begin sales of the product in FY2016

Industries Co., the country's No.2 paper maker, which is marketing seedlings for a new tea variety the company says helps control cholesterol, and textile firm Omikenshi Co., which is mixing pulp with the yam-like *konnyaku* plant to offer fiber-rich flour that supposedly contains no gluten, fat and little carbohydrates[12].

This shows us that the co. is facing domestic competition from better-capitalized players with more well-known brands and broader sales networks as companies seek to jump on consumer interest in healthier foods. We expect more rivals to emerge in the next few years. As the co. can no longer benefit from being promoted in the media as a new fad, we believe its battle will be largely to retain, as opposed to grow, market share.

D) No Patent Protection

Normally, in order to defend itself against competition from well-established firms that have much larger resources a startup will take out a patent to protect its technology. This is what euglena[13] has to say about applying for patents:

Q 大量培養技術は特許化されていますか？

A 大量培養技術は特許化していません。
特許にするためには、どのように培養するか、ということを細かく記載する必要があり、それが公開されることとなってしまいます。もし、誰かがそれを真似てミドリムシを培養し始めたとしても、我々はそれが我々の技術で培養したのかどうかについて確認することができません。よって、特許化せずに秘匿情報化する手法をとっています。コカ・コーラの原液などの類似した技術に関して同様の手法がとられています。

TRANSLATION:

Q: Are you seeking to patent the technology for mass cultivation (of algae)

A: We are not seeking to patent it. In order to apply for a patent, you need to write down in detail exactly how the cultivation process works, which will lead to it becoming public. Even if someone started to cultivate similar algae to us, we would not be able to confirm that it was being produced with the help of our cultivation technology. In that sense, we are adopting a strategy of concealing our information and not pursing patents. It's similar to the way Coca Cola acted in regards to safeguarding its ingredients and manufacturing secrets.

As such, euglena happens to be the claimant or rights holder to just 11 patents (in Japan), not one of which is related to the mass cultivation of algae. In such a situation, the co. has no legal protection should it be judged to be a monopolist because its technology.

[12] http://www.bloomberg.com/news/articles/2015-11-17/tree-noodles-a-low-cal-fat-free-way-to-beat-chinese-competition
[13] company website, Frequent Q&A section, https://www.euglena.jp/ir/faq.html

Meanwhile, if you look at the philosophy outlined in the co.'s Q&A, you have to wonder: Is the concealment strategy actually working? Is it protecting the co. from the competition? Clearly not, as Kobelco's case shows. A number of U.S. firms, which we'll discuss in detail later, have even gone further and succeeded in commercializing their process.

Today, the co.'s technological superiority in the field can be said to be under serious doubt. It might be true that in 2005 the co. was the world's first to develop technology that could cultivate algae outside of the lab in mass quantities. Yet in the 10 years since evidence confirming euglena's technological superiority has been thin on the ground[14]. All of which suggests that, like Kobelco, large manufacturers can enter the algae food materials market with relative ease. While it may be true that the co. was the one who created the market for euglena-based products, more powerful players seem to be able to come in and exploit it.

Therefore, even if the co. achieves its revenue target of ¥15 billion, it faces two major threats: the slowdown in growth rate due to market size limitation and an intensification of competition due to new market entrants with large capital, which will cause a drag on profit.

3. Energy & the Environment (E&E) Segment

While the co.'s Healthcare segment has grown earnings rapidly in recent years, there is a death knell ringing for the core E&E segment. This makes it impossible to justify or even vaguely fathom how the co. trades at more than 150x PE multiples. In the past, the co. stressed that the E&E segment – through the manufacture and sales of biofuel for use in jet engines – will drive and accelerate future growth. But, is that still a realistic prospect?

A) Crude Oil Price Tanks; Algae Costs Do Not

Let's be honest here, as unfortunate as this may be for the environment the co.'s E&E strategy has no chance of taking off without the drying up of global crude oil reserves.

First, let's look at the current cost of algae-sourced biofuel production. Industry participants and independent analysts give a pretty wide range of figures, yet they all sit within $300 to $1,000 per barrel of crude oil equivalent[15]. In fact, when Bloomberg News featured the co. and its founder Mitsuru Izumo on TV and in print last year, analyst Clair Curry from Bloomberg's in-house New Energy Finance research bureau pointed out that as of 2015 the industry's

[14] For example, in the April 17, 2015 press release euglena announced the start of a research facility in the U.S. There have been no further updates on this venture or its results.

[15] Consider the following reference materials: *BioFuels Digest* magazine, Oct. 2014 issue (referenced in bibliography on p. 2 of the Japan Petroleum Energy Center report published March 15, 2016
https://en.wikipedia.org/wiki/Algae_fuel#cite_note-Steiner-134
"GreenFuel Technologies: A Case Study for Industrial Photosynthetic Energy Capture", 2007, Krassen Dimitrov, Ph. D.

manufacturing costs are at least three to four times higher than they should be for algae-mixed fuel to be competitive. To challenge or even approach crude oil and alternative fuels, algae biofuel needs to drop to $2 per gallon[16] from a current industry average of $7 to $15 per gallon, Curry told Bloomberg TV[17].

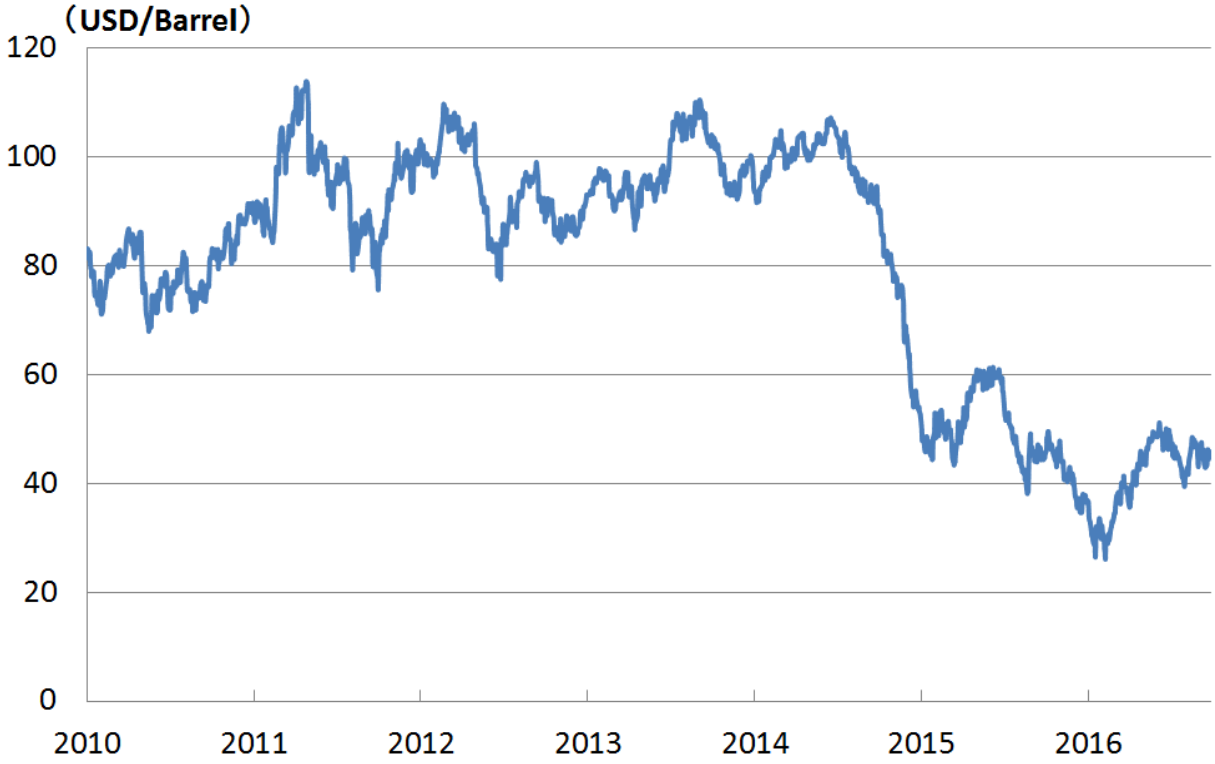
The U.S. Department of Energy is slightly more lenient. In a March 2015 policy paper produced by its Bioenergy Technologies Office, the goal for algae-based fuel is set at $3 per gallon of gasoline equivalent. At that level, the DoE agency believes algae-based fuel can compete with gasoline derived oil that costs $75 to $90 per barrel. So, when does the DoE believe this will be achieved? The report lists a 2022 deadline for validating *demonstration* technology for algae feedstock that can operate at the desired $3 per gallon level[18].

Exxon Mobile Corp. is a little more critical of algae's prospects. This is despite, or maybe because of, a major $600 million initiative the oil major embarked on in 2009 to make algae-based biofuel a commercial reality within a decade. When the oil major "downscaled" the program in 2013, then CEO Rex Tillerson said algae-sourced fuels may still be 25 years away from mainstream success.

The cultivation process of most algae farmers is sensitive to weather conditions and open tanks deployed to grow the organisms are prone to contamination. As a result, algae production suffers from high capital costs with the price of equipment, fertilizer, electricity, and labor all increasing in recent years. Meanwhile, the price of crude oil has fallen since 2010.

[16] There are 42 U.S. gallons in an oil barrel
[17] https://www.bloomberg.com/news/articles/2015-07-07/this-pond-scum-already-in-your-smoothie-may-fuel-your-airplane
[18] p. 29 of report; source: http://energy.gov/sites/prod/files/2015/03/f20/section1_mypp_march2015.pdf

Figure 4: WTI Crude Price Graph

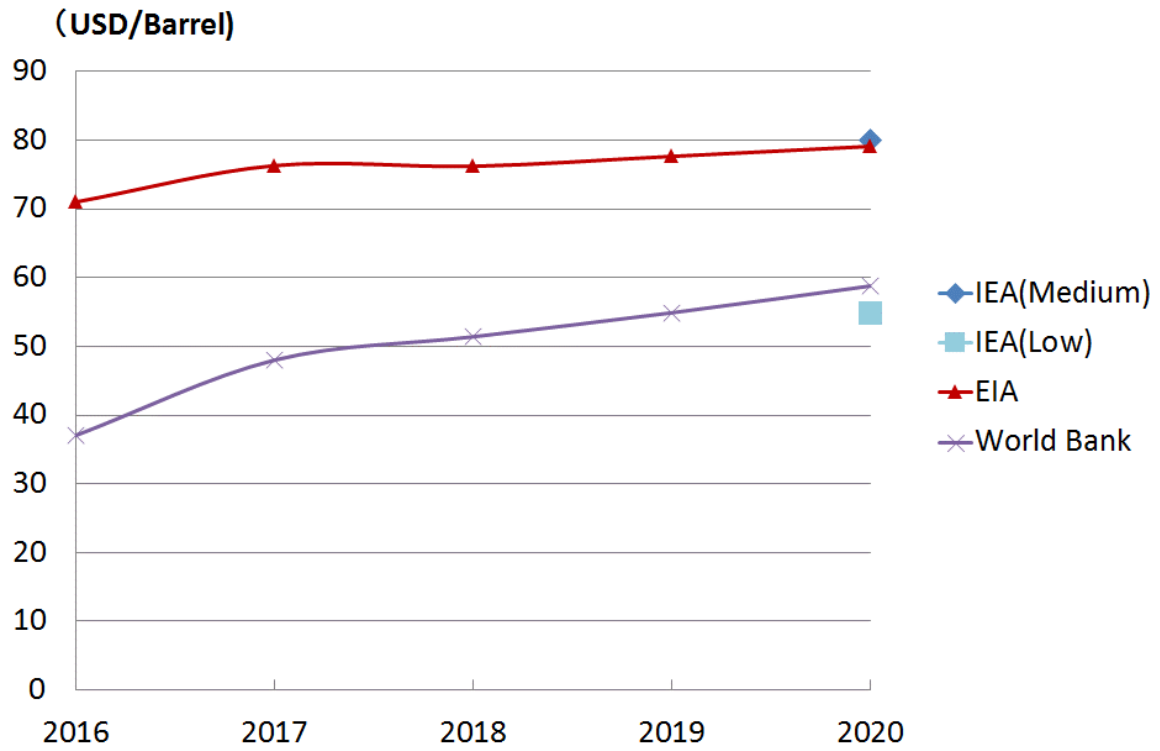


(Source：Bloomberg)

As of January 2017, WTI traded in a range of $40 to $60 per bbl. As a result, not only biofuels but other alternative sources such as shale oil and natural gas have struggled to compete. The outlook for crude oil through 2020 from sources such as the International Energy Agency, the U.S. Energy Information Administration, the World Bank and numerous think tanks and institutes points to a continuation of this price trend. Crude is seen as unlikely to break out of the $60 to $80 per bbl range[19]. The idea that a fuel that has production costs of $300 to $1,000 per bbl can somehow compete with crude in the next 5-8 years is hard to fathom.

[19] "The Energy Annual Report for 2015", printed also as the "Energy White Paper 2016", online edition. Published by the Agency for Natural Resources and Energy, part of METI. http://www.enecho.meti.go.jp/about/whitepaper/2016html/1-1-1.html

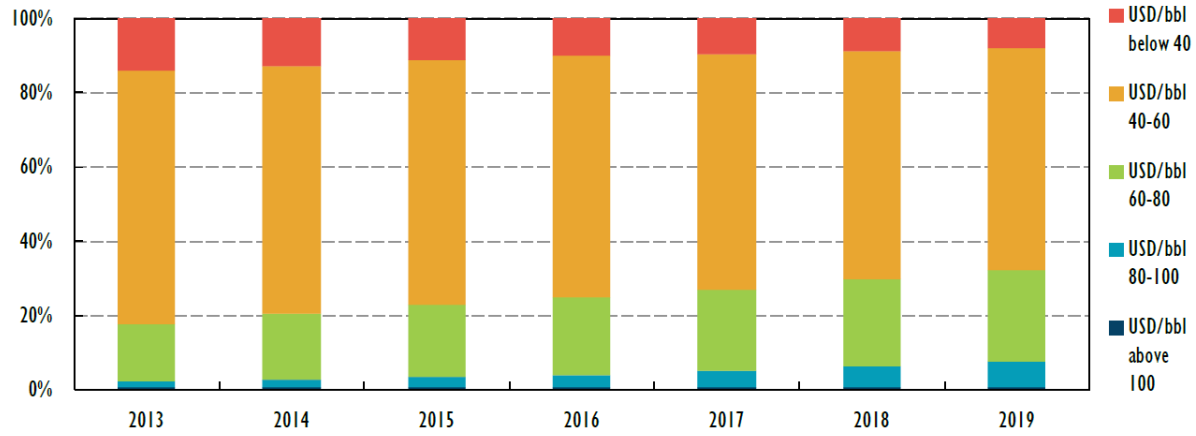
Figure 5: Crude Oil Price Outlook for 2016-2020



(Source：Japan's Ministry of Economy, Trade and Industry)

Algae-sourced biofuel is not the only fuel hoping to take over from conventional oil. While it is true that profitability of shale oil depends on its mining area, Figure 6 shows us that more than half of U.S. shale assets sit in the $40 to $60 per bbl range. What's more, we're seeing more shale properties move down the cost curve, evidenced by the fact that output from this sector is rising even with crude oil trading at $40 per bbl. If shale deposits can deliver crude oil for similar prices to conventional wells we're going to see a depression in crude prices continuing. And all the while, the costs of natural gas, solar energy and other alternatives keeps declining. We believe the dim prospects for algae biofuels should be reflected in the co.'s stock price. Currently, the outlook for the E&E unit seems to assign it a massive premium compared with other Japanese health food providers that don't have ambitions in biofuel. We believe this makes no sense given the outlook for and current economics of the E&E business.

Figure 6: U.S. Shale Oil Cost Curve



(Source: Japan Oil, Gas and Metals National Corp, IEA mid-term oil market report 2014[20])

B) Technical (and Confidence) Issues

The question we have is whether even the co. believes it can achieve commercialization of algae-based biofuel. Recent co. statements suggest there is growing internal doubt.

Take as example the co.'s press release from Dec. 1, 2015[21]. In it the co. makes a spectacular announcement that it will commercialize algae-based jet fuel by 2020. The plan is predicated on the construction of a small demonstration facility that will come online by early 2018. Less than a year later, on Aug. 12, 2016, the co. announces a delay to the plan. Now, euglena says that the ¥3 billion demonstration facility, which can produce just 125 kiloliters of certified jet fuel a year, will not become operational until the first half of 2019. That makes the original goal of achieving commercial-scale production by 2020 completely laughable.

To put the scale of the demonstration plant in context: Its entire output, based on a standard 90% kerosene / 10% algae-based biofuel mix, would be enough for a single airplane to make one return flight between Tokyo and Osaka once a week, according to the estimates from ANA Holdings, Japan's biggest airline firm, and a potential buyer of euglena's product[22].

In recent press releases, the co. often touts the achievements of its RealTech Fund, a venture that has nothing to do with biofuels. On its website, the co. also added the following statement: "The future of this business is not only dependent on whether it can realize the biofuel project." (See paragraph 2 below). Could it be that the co. is preparing the ground to exclude biofuel development from its long-term business strategy?

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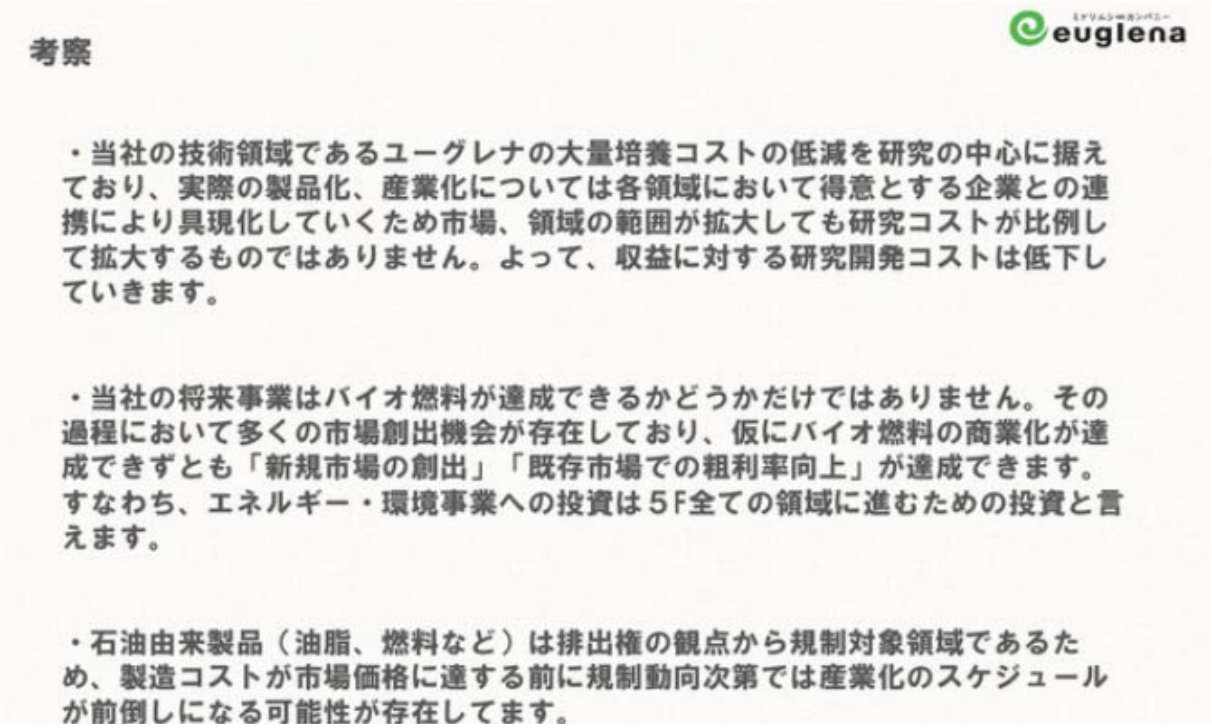
20 From p. 12 of "Thoughts on Oil Price Drop and Shale Oil", by Masaru Ihara. Published Jan. 22, 2015 by Jogmec Corp.
21 Dec. 1, 2015, company press release
22 http://asia.nikkei.com/Tech-Science/Tech/Euglena-plans-Japanese-refinery-for-algae-derived-jet-fuel



(Source：euglena IR materials[23])

TRANSLATION:

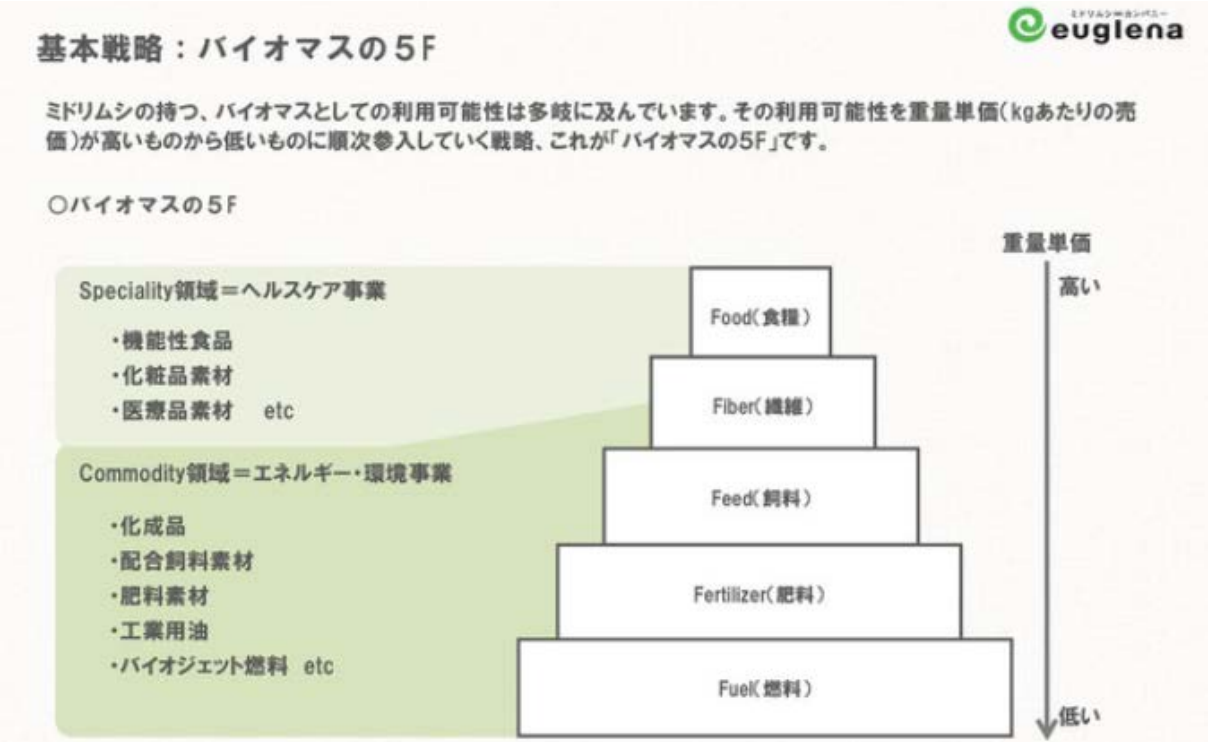
Outlook

- *This company's focus area is on research of ways to bring down the cost of cultivating large quantities of euglena. Even though we tie up with companies that specialize in each specific area in order to realize our plans of manufacturing different products, we're not actually increasing our research costs proportionately with every new area and market that we enter. Accordingly, from a profit standpoint, we're actually bringing down research & development costs.*
- *The future of this business is not only dependent on whether it can realize the biofuel project. To that end, we're creating several markets so that even if for the time being we're unable to commercialize biofuel we can "Create new markets" and "Improve margins in markets we currently operate in". In other words, it cannot be said that all our investments in the Energy & the Environment segment are driven by our need to make progress in the 5Fs of our strategy.*
- *Since crude-oil based products, such as fats and fuels, are subject to regulations on their emissions, before reducing production costs to compete with market prices we could bring forward the production schedule based on changes or moves in those regulations.*

What should be most worrying for investors is the fact that E&E was not only billed as a core contributor to future earnings, but also as the co.'s most profitable area. See the 5**F** product pyramid that euglena has on its website. The co. explains that its strategy has five blocks, which

[23] http://www.euglena.jp/ir/strategy.html

are ranked by unit price. **F**uel has the lowest price relative to weight, while **F**ood (the only current bread-winner) has the highest. Based on this explanation by the co. itself, it seems that the co.'s earning expectations for the foreseeable future rest on its highest-cost business. And, as discussed earlier, that means there's little hope of profit growth.



(Source：euglena)

TRANSLATION

Basic Strategy: The 5 Levels of F in Biomass (Food, Fiber, Feed, Fertilizer, Fuel)

There are a multitude of applications to which you can put algae/seaweed, which is a biomass. The ability for them to be implemented depends on the unit price of sales. We rank the applications based on price of unit, from the higher-price at the top to the lower-price at the bottom. This strategy we call the 5 levels of F.

Specialty Area: Healthcare :
Functional food
Cosmetics materials
Materials for medical goods, etc.

Commodity Area: Energy & the Environment
Chemicals
Materials for combination feed

Materials for fertilizer

Oil for construction materials

Biofuel for jets, etc.

Interestingly, the strategy presentation is also misleading in terms of what the co. says it is relying on to expand profit. First, investors are told, using jet fuel and animal feed sectors as examples, that "products which become commoditized take on the form of goods that can be generally traded at market prices. So, the requirement for a new player to enter the market and be able to compete is to create a lower cost base." Two pages later, the presentation shows the rapid growth of "revenue" (not profit) in some uncertain future while profitability is designated in the lowest category (see table above for "*The 5 Levels of F in Biomass (Food, Fiber, Feed, Fertilizer, Fuel)*").

In addition, the co. says that: "Since crude-oil based products, such as fats and fuels, are subject to regulations on their emissions, before reducing production costs to compete with market prices we could bring forward the production schedule based on changes or moves in those regulations." As you saw in the "Outlook" translation above, the meaning here is that even if the production schedule were brought forward due to changes in regulation – which would imply that profitability remains low since production costs were not lowered enough to compete with market prices – the effect would be a rapid expansion of revenue but not necessarily of profit. The company admits that it is still unknown whether profit would grow to match the revenue expansion (whenever in the distant future that happens to happen).

The above reads as a tacit admission that the co. does not see algae-derived biofuel challenging traditional fuels on market terms. So, should investors hope that changes in regulation will make euglena's E&E business implementable[24] instead of waiting for the co. to deliver a competitive product? If so, why would euglena benefit more than peers? And, how much equity value does one assign to *potential* changes to legislation?

One thing that we can say looking at such statements is that the co. is not projecting confidence in its ability to compete in the market.

3) Powerful Rivals at Home, Stock Crash Examples Abroad

Let's for a minute indulge in the co.'s dreams of algae-based biofuel being a viable competitor to traditional fuels. Would this leave the co. as the only beneficiary, picking up steady profit?

In Japan alone, those seeking to commercialize the manufacture of algae-based biofuel include

[24] Even though E&E's profitability would remain much lower than that of the Food segment

heavy industry giant IHI Corp., electricity wholesaler and utility Electric Power Development Co. Ltd (also known as J-Power), the Toyota Motors-backed components maker Denso Corp., and pigments and resins major DIC Corp. All four target production of jet fuel, as shown in the table below that was put together by Japan's semi-governmental New Energy & Industrial Technology Development Organization (NEDO). Of the four, at least Denso and IHI have stated similar aims to euglena of reaching commercial output around the start of the next decade.

主要事業者	IHI	J-POWER	DENSO	DIC
共同実施者	ちとせ研究所・神戸大	東京農工大・日揮	中央大・クボタ・出光興産	神戸大・基礎生物学研究所
微細藻株	ボトリオコッカス 油分（炭化水素）を体外分泌し、保持する特徴を有する藻。増殖能力の高い株を獲得済みであり、更なる改良も実施。 	珪藻 海洋珪藻 オイル成分の分布がシンプル。細胞の付着性がない。自己凝集性がある。 	シュードココミクサ 日本国内の温泉から発見された藻類。酸性条件下で生育可能であり、野外培養に有利 	クラミドモナス 海産性 モデル緑藻の*Chlamydomonas reinhardtii*の近縁種 
目的代替油	ジェット燃料	ジェット燃料	ジェット燃料・ディーゼル	ジェット燃料
開発段階	応用研究 ～ 商用実証へ 鹿児島市に国内最大級（1500㎡）屋外培養設備を構築し、プレ実証試験を展開中 	基礎～応用研究（中期） 大型培養槽（円型10㎥、20基：福岡県）により、藻類の連続培養試験を実施中 	基礎～応用研究（中期） 60㎡培養槽（レースウエイ型：愛知県）における、藻類の試験培養を実施中 	基礎～応用研究（中期） 25 m²屋外レースウエイ培養槽を設置し（米国）、屋外培養を実施中 
研究開発の概要	屋外大規模培養実証を実施中 商用スケールに向けた課題抽出 海外での培養適性評価試験の実施 発電所等の排CO2の有効利用検討 等	屋外培養条件の確立、育種 屋外における半連続培養等の最適化 遺伝子組換えによる育種技術の確立 耐冷性株併用による通年培養の検討	屋外培養条件の確立、育種 屋外における培養条件の最適化 遺伝子組換え株の商用利用手法確立 藻の省エネ、低コスト回収技術開発	屋外培養条件の確立、育種 屋外における培養条件の最適化 遺伝子組換えによる育種技術確立 代謝解析による油分向上技術検討
研究開発支援状況	24年度からNEDO事業（戦略的次世代バイオマスエネルギー利用技術開発事業）にて実施。	25年度からNEDO事業（戦略的次世代バイオマスエネルギー利用技術開発事業）にて実施。	23年度からNEDO事業（戦略的次世代バイオマスエネルギー利用技術開発事業）にて実施（中央大と）。 25年度から別のNEDO事業実施（中央大、クボタ、出光興産と）	24年度からNEDO事業（戦略的次世代バイオマスエネルギー利用技術開発事業）にて実施。

(Source: NEDO[25])

Denso in 2010 set up a plant to cultivate algae known as *pseudochoricystis* at its Zenmyo Plant in Aichi Prefecture. The aim is to mix algae extracted liquid with gas oil petroleum. The capacity of the Zenmyo pond is 33,000 liters. The company is preparing a bigger cultivating site in Kyushu and seeks to be technically ready for a commercial-scale facility by fiscal year ending March 2019 (Source: Nikkei)

IHI registered its *botryococcus* algae-based oil, Mobura, as a trademark in 2013. The company began in March 2015 large-scale algae growing at a cultivation pool in Kagoshima Prefecture. By May, it reached its harvest target. The pool, the largest in the country with a surface area of 1,500 sq. meters, is about 15 times the size of IHI's previous facility. IHI is also experimenting at other sites, including in Southeast Asia. It aims to establish the technology for large-scale production by fiscal year ending March 2021. (Source: Nikkei)

State-backed Algae Biofuel Project

Another key Japanese project in creating commercial-scale production of algae biofuel by 2020 is being led by the University of Tsukuba. Established in 2010, the partnership of Tsukuba, Tohoku University and the Ibaraki Prefectural government has started to produce *botryococcus* algae, which grows at the same rate as euglena but produces a hydrocarbon similar to heavy fuel oil B, the kind normally handled by Japanese refineries. Tsukuba expects to move from an output of 14 metric tons of oil in 2015 to 14,000 tons in 2020. (Source: Tsukuba University and Nikkei; http://www.tsukuba-sogotokku.jp/project/project3_measure/)

[25] A select list of Japanese businesses involved in the development of technology to manufacture biofuel prepared by NEDO in its August 2015 report, p. 6.

Overseas, the U.S. alone has a history of algae-based biofuel research spanning more than 30 years. Despite the many twists and turns of the U.S. algae sector a number of ventures have now emerged and are showing good results, including in commercial-scale facilities.

Figure 7: Select List of U.S. Biofuel Ventures

Name	Founded	Partner	Technology	Results
TerraVia (formerly Solazyme)	2003	Chevron Unilever	Cultivation of high oil content algae without use of photosynthesis via special microalgae	Civilian plane loaded with a fuel that had 40% algae-sourced oil content completed a 1,500km flight
Sapphire Energy	2007	DOE Monsanto	Manufacture of algae-based oil using special algae and photosynthesis	After raising $300 million in financing built the world's first algae-derived biofuel commercial-scale test facility, which has been in operation since August 2012
Algenol BioTech	2006	Dow Chemical Reliance Industries	Manufacture of ethanol from microalgae that are cultivated in tanks filled with seawater	Built a demonstration plant next to Reliance Industry's Jamnagar Refinery in India (now in operation). Has a Florida test facility.
Cellana	2004	Royal Dutch Shell	Manufacture of algae-based oil through micro algae and photosynthesis	Demonstration plant in Hawaii State operating since 2009
Synthetic Genomics	2005	ExxonMobil	Manufacture of biofuel from algae grown using photosynthesis	Initial $600M plan to be on a commercial scale put on pause

(Source：Japan Petroleum Energy Center, Mitsui Global Strategic Studies Institute[26])

26 "The Latest Situation in Manufacture of Biofuel from Algae", published March 15, 2016 by Japan Petroleum Energy Center (JPEC)

The list above is nowhere near exhaustive. It is simply to illustrate that U.S. companies have worked in this field for dozens of years before euglena was founded. Many of these companies have faced massive technological and financial challenges, yet some have progressed as far as mass-scale cultivation of algae, expansion of operations abroad, and the ability to demonstrate their product effectiveness in target markets.

Despite all of that, with the big drop in crude oil prices, they have seen interest in their product diminish. Exxon Mobile scaled down on its initial plans for algae-based fuel production less than 12 months before crude oil prices started falling and has not come back to the sector with anything like the enthusiasm it showed in 2008-2009. Coincidentally, that was around the time when crude oil peaked at $147 per bbl.

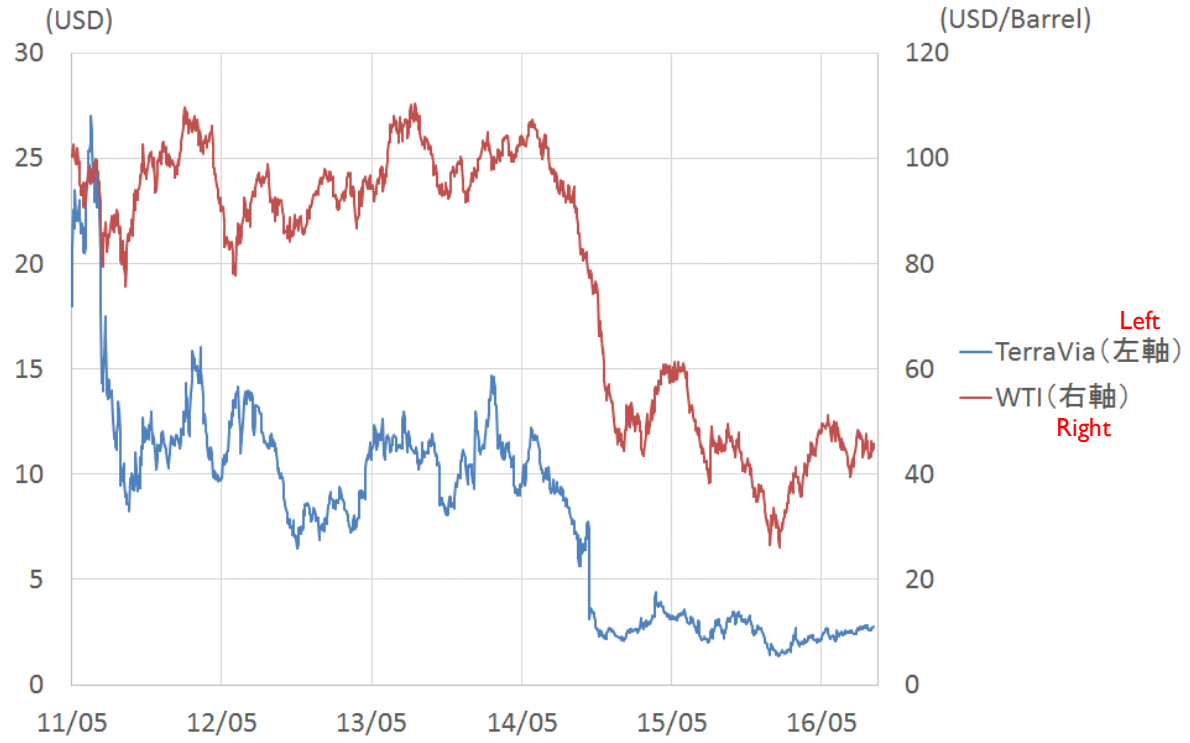
This may be history repeating itself as with the oil crisis of the 1970s. No matter what results TerraVia and Sapphire Energy delivered, they simply could not offer a competitive product once crude oil prices started heading south again. Sapphire Energy, in February 2015, said that its cost of production was $26 per gallon[27], which is $1,000 per crude oil barrel equivalent. This is why these companies, which have a strong history and research background in biofuels, nevertheless are shifting to value-added goods in the food and healthcare industry – the same space that euglena sees as its jumping-off point.

What happens to algae farming companies that focus on biofuels? Let's look at the stock price of TerraVia, one of the few larger listed entities in the sector. In Figure 12 you can see the moves in equity versus the price of WTI crude. At the time of listing TerraVia traded at $27, but since August 2014, when crude started to tumble, so did its stock. TerraVia now trades around $2 per share – a 90% drop.

"The microalgae as a biomass resource" by Hiroshi Uno, p. 6; published Dec. 5, 2011 by the Mitsui Institute

[27] Referenced on p. 4 of JPEC's "The Latest Situation in Manufacture of Biofuel from Algae" that was published on March 15, 2016

Figure 8: TerraVia Stock Plotted Against WTI Crude Price



(Source：Bloomberg)

TerraVia's stock move is evidence that investors don't see the development of algae-based biofuel production as realistic and directly hints at what can happen to the equity of a company counting on this sector as a core business.

In summary, the future of euglena's E&E segment looks highly troubled. High manufacturing costs versus energy alternatives, delays in project implementation, and a lack of patent protection, as well as a seemingly fading conviction in its own ability to deliver, cloud the chances that euglena can commercialize a biofuel product that is competitive and that can deliver an earnings boost. When you see rivals in the U.S. already ahead of the co. in terms of commercialization, and you note that some major biofuel players are shifting away from the industry, it's impossible to assign any positive value to euglena's E&E segment. In fact, we believe once the market fairly assesses the conditions of the business it will downgrade the E&E segment to reflect its negative value to euglena shareholders.

We point to TerraVia's equity story as a harbinger of things to come.

4. Valuation

1) Massive Gap in PE Multiples With Similar Firms

As of Jan. 17, euglena traded at a price to earnings (PE) ratio of about 150, which is way beyond the PE ratio (of 10x to 27x) that companies with a similar business profile enjoy (See Figure 9). We believe the premium valuation reflects not only decent results in the Healthcare segment but also future expectations for the co.'s algae-based biofuel business.

As outlined earlier, we believe the Healthcare segment has likely peaked as Japan's market for health foods and supplements is already mature and sales growth rates are declining. What's more, the entry of major industrials with larger resources, sales networks and brand awareness into the same market threatens the co.'s growth and profit margins.

Rather than being a catalyst for future growth, we believe the co.'s E&E segment brings down the net equity value. The business is not competitive and cannot be expected to provide any significant earnings in the next 5-8 years due to the current crude oil price environment and outlook, as well as the cost basis for producing biofuel with algae. Given how far out *potential* profit from the E&E segment lies, we believe euglena should at best be valued solely on the basis of its Healthcare division, which accounts for 99.97% of earnings.

Figure 9: Peer Group Valuation Comparison

Company Name	PER	ROE	ROA	MCAP (in bn yen)
euglena Co., Ltd	151.4	5.2	4.5	102.9
Morishita Jintan Co., Ltd	27.01	4.7	3.1	11.5
AMS Life Science Co., Ltd	26.66	5.2	2.3	10.1
Nippi. Inc.	5.84	7.8	3.0	11.6

(Source：Bloomberg)

Under the most bullish scenario we can imagine as of today, euglena maintains the highest profit margin of the last four quarters – 15%, recorded in 2Q16 – and achieves its annual revenue target of ¥15 billion. If that is the case (which is a big "if") we estimate the co. will post a yearly operating profit of ¥2.25 billion[28], and assuming non-operating profit, costs and corporate tax rate don't change dramatically, an annual net profit of ¥1.6 billion or ¥19.36 per share. (In this calculation, we don't take into account subsidy income that accounts for most of

[28] In the co.'s earnings target for FY2017, the revenue target is 15 billion, OP target is 0.82 billion, Ordinary Profit target is 1.1 billion and the NP is 0.69 billion.

the current non-operating revenues. Our assumption assumes a NP that is more than double the co. target of ¥0.69 billion for FY2017. See Figure 10 for a summary of co. financials.)

As we believe only the co.'s Healthcare business has positive value, we look to Japanese makers of similar health food and supplements to provide the PE multiples for a peer comparison. Figure 9 shows that domestic peers trade at PE ratio in the range of 8 to 27. We take a peer group premium 30x multiple and apply it to the estimated best-case scenario ¥1.6 billion net income. That gives us a market value of ¥48 billion or ¥580 per share.

Secondly, according to the co.'s latest mid-term business targets, the co. claims it will achieve ¥30 billion revenue by 2020. However, based on the stock options (SO) plan linked to the target, the strike terms for this 6th SO plan have Ordinary Profit target at ¥1 billion from revenue of ¥30 billion, which is surprising given that the strike terms for the 5th SO plan saw Ordinary Profit at ¥1 billion from revenue of ¥15 billion. Clearly, this shows management themselves are not confident in the profit growth through 2020.

In addition, the co. admits in the latest plan that the profitability of its new business segments outside food business will be lower. Therefore, we can conservatively assume the NP ratio for target revenue of ¥30 billion would be the same as that of the ¥15 billion revenue target. Hence, NP ¥0.69 billion / Revenue ¥15 billion = 4.6%. Under this assumption, even if we fully incorporate the achievement of the mid-term business targets by 2020 into the current stock price, we believe that a ¥41.4 billion market cap (approx. ¥500 per share) should be reasonable price for this company. This is calculated as follows: Revenue ¥30 billion x 4.6% profitability x PER 30.

Even though our calculation is based on the most bullish scenario imaginable and revenue numbers that euglena does not expect to hit for another four years, the numbers still come out with a market capitalization that is approximately 55% to 60% lower than the current one.

2) Potential for Stock Plunge

If, as we expect, the market takes cue from TerraVia, and turns skeptical on the viability of euglena's plans for biofuel in the short- to mid-term future, resources deployed by the co. on E&E will be seen as value destructive. Then, we expect the stock to drop lower than ¥500-580.

Whichever way you look at euglena's business, it is grossly overvalued. We believe the market will in the near future revisit its assumptions on the co.'s business and future potential, which will put considerable downward pressure on the stock.

Figure 9: Extract From euglena Financial Statements

	FY ended Sept 2015	FY ended Sept 2016				
		FY16	1Q	2Q	3Q	4Q
(P/L)						
Revenue	5, 924, 356	11, 103, 230	2, 339, 780	2, 890, 228	2, 951, 940	2, 921, 282
Cost of Goods Sold	1, 905, 041	2, 966, 454	653, 092	743, 264	793, 800	776, 298
Gross Margin	4, 019, 315	8, 136, 775	1, 686, 688	2, 146, 963	2, 158, 141	2, 144, 983
Operating Expenses	3, 542, 979	7, 442, 820	1, 655, 784	1, 723, 581	1, 806, 576	2, 256, 879
Operating Profit (OP)	476, 335	693, 955	30, 904	423, 381	351, 566	−111, 896
OP/Revenue Rate	8. 0%	6. 3%	1. 3%	14. 6%	11. 9%	−3. 8%
Non-Operating Profit	253, 996	256, 525	44, 976	45, 370	127, 484	38, 695
Non-Op. Expenses	3, 949	5, 974	570	834	2, 601. 00	1, 969
Current Profit	726, 382	944, 506	75, 309	467, 918	476, 448	−75, 169
Net Profit for Period	469, 639	665, 427	110, 608	317, 871	323, 325	−86, 377
(B/S)						
Current Assets	8, 605, 186	11, 354, 902	8, 919, 854	10, 958, 560	11, 585, 609	11, 354, 902
Fixed Assets	5, 918, 204	4, 171, 103	6, 024, 601	4, 185, 449	3, 975, 469	4, 171, 103
Investment and Other Assets	3, 118, 983	461, 152	3, 132, 139	937, 434	653, 907	461, 152
Total Assets	14, 523, 390	15, 526, 005	14, 944, 456	15, 144, 009	15, 561, 079	15, 526, 005
Liabilities	1, 821, 991	2, 103, 276	2, 121, 679	1, 975, 294	2, 068, 610	2, 103, 276
Current Liabilities	1, 393, 290	1, 611, 645	1, 746, 594	1, 467, 644	1, 565, 438	1, 611, 645
Non-current Liabilities	428, 700	491, 630	375, 085	507, 650	503, 172	491, 630
Net Assets	12, 701, 399	13, 422, 729	12, 822, 777	13, 168, 715	13, 492, 468	13, 422, 729

(Source：euglena financial reports)

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