ECONOMICALGAE

From green to clean

ALGAE BIOFUELS

Do not require clean water or arable land

Grow quickly: can double in size in **24 hours**

Yield high amount of oil per cultivated area: **2,000-5,000 gallons** of fuel per acre per year.

Can hold up to **80%** of its mass as oil

Yield of various plant oils

(Gallons per acre)

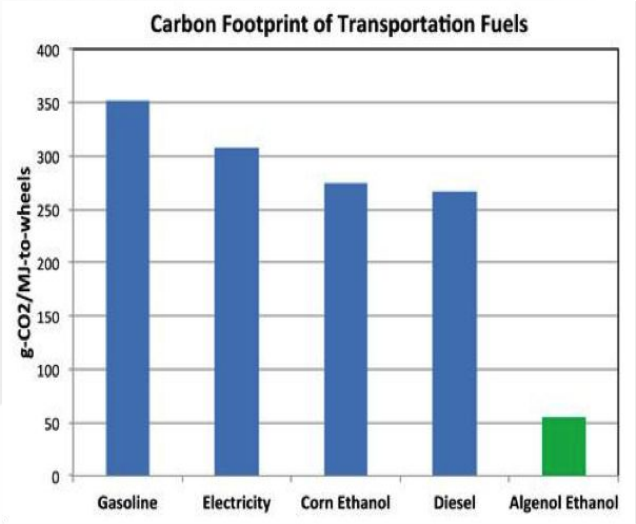
Soy	47
Safflower	83
Sunflower	101
Castor	150
Coconut	244
Palm	635
Algae	10,672

About algae

- Among the fastest growing plants, about 50 percent of their weight is oil.
- Contains no sulfur; is nontoxic and highly biodegradable.
- Algae fuel is also known as algal fuel or oilgae.

TARGET PROBLEM

- In 2015 fossil fuels released about **35 billion** metric tons of CO2

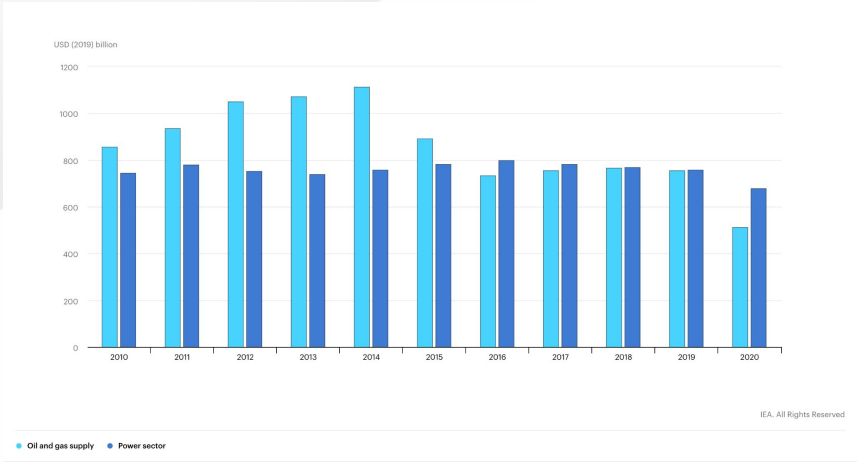


OUR SOLUTION

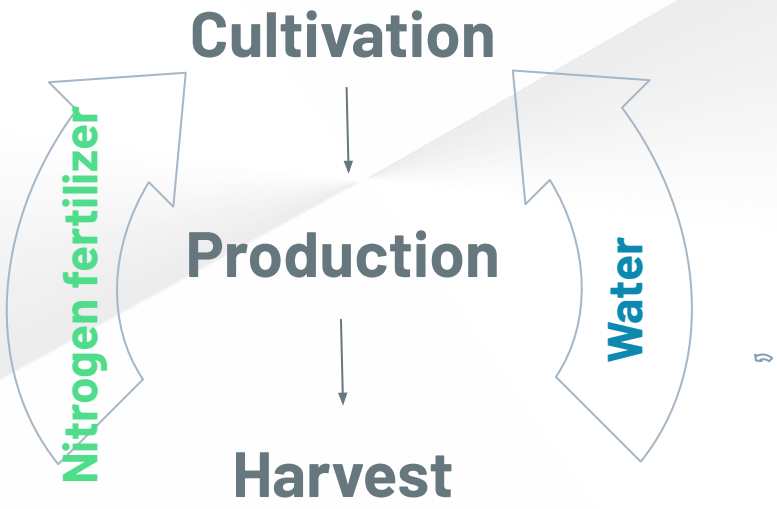
- Algae biofuel could reduce CO2 emissions by **70%**
- Nearly **zero net gain** of CO2 in the environment
- Utilize **multi-output manufacturing** to recycle materials and streamline algae biofuel production

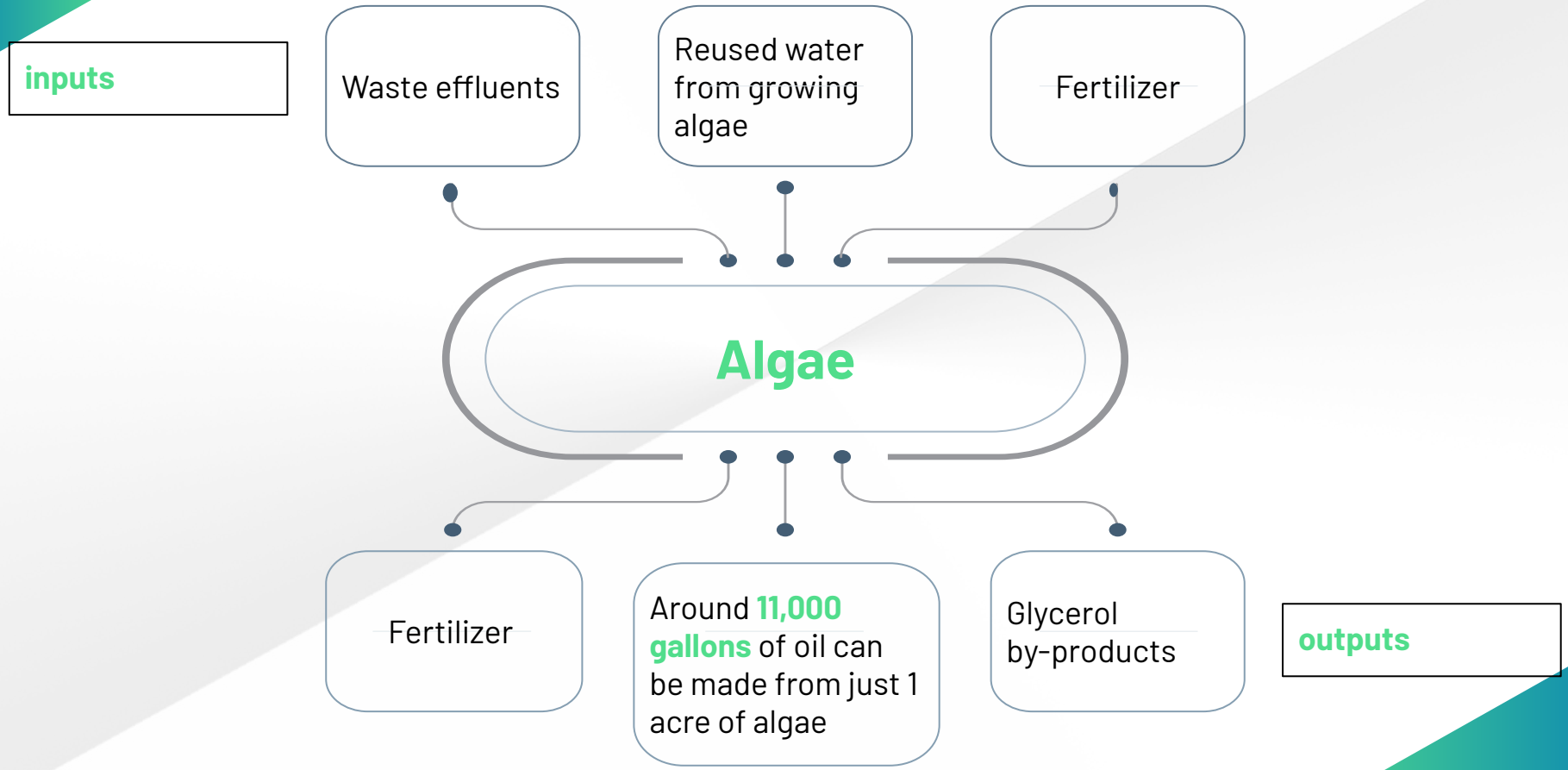
MARKET OPPORTUNITY

- Investments in alternative energy over the last 10 years have remained stable, compared with the rollercoaster ride for oil and gas
- Can offset US dependency on imported oil → self-sustained economy
- Also allows for developing nations to create their own self-sufficient economies since algae can be grown in virtually any environment



OUR SYSTEM


Cultivation
Production
Harvest
Nitrogen fertilizer
Water

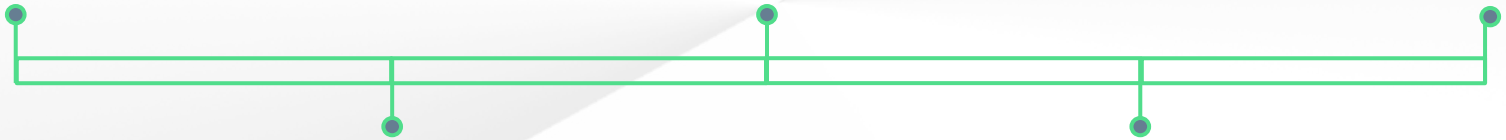

inputs
Waste effluents
Reused water from growing algae
Fertilizer
Algae
Fertilizer
Around 11,000 gallons of oil can be made from just 1 acre of algae
Glycerol by-products
outputs

2 years

Design commercial pilot and partner with waste water treatment plants, farmers

Bench-scale testing and forming key relationships

Establish and implement systems fully at customer site



Plan - grow brand awareness, establish starting site

Develop large-scale prototypes to validate key performance indicators

1 year

WE PLAN TO TARGET THE TRANSPORT FUEL MARKET, AND SCALE UP PROCESSES THAT CAN BE IMPLEMENTED TO DEVELOPING COUNTRIES TO ADDRESS THEIR ENERGY NEEDS

SOURCES

1. Siegel, RP. “Algae-Based Biofuel: Pros And Cons.” *Triple Pundit: People, Planet, Profit*, Triple Pundit: People, Planet, Profit, 4 July 2017, www.triplepundit.com/special/energy-options/algae-based-biofuel-pros-cons/.
2. Harvey, Chelsea. “United Airlines Is Flying on Biofuels. Here's Why That's a Really Big Deal.” *The Washington Post*, WP Company, 11 Mar. 2016, www.washingtonpost.com/news/energy-environment/wp/2016/03/11/united-airlines-is-flying-on-biofuels-heres-why-thats-a-really-big-deal/?noredirect=on&utm_term=.e7c351c243b8.

1. Rapier, Robert. “Algal Biofuels Dead? 'Not So Fast', Says Algal Biofuel Researcher.” *Forbes*, Forbes Magazine, 2 Nov. 2018, www.forbes.com/sites/rrapier/2018/11/02/algal-biofuels-dead-not-so-fast-says-algal-biofuel-researcher/#24e427eb56c4.
2. “Biofuels: The Benefits and Drawbacks.” *National Geographic*, National Geographic, 27 Feb. 2017, www.nationalgeographic.com/environment/global-warming/biofuel/.
3. “How Biomethane Can Help Turn Gas into a Renewable Energy Source.” *Phys.org - News and Articles on Science and Technology*, Phys.org, phys.org/news/2018-10-biomethane-gas-renewable-energy-source.html.
4. “Algae for Biodiesel 101.” *Making-Biodiesel-Books.com*, making-biodiesel-books.com/algae-for-biodiesel-101/.
5. Newman, Stefani. “How Algae Biodiesel Works.” *HowStuffWorks Science*, HowStuffWorks, 28 June 2018, science.howstuffworks.com/environmental/green-science/algae-biodiesel3.htm.
6. “Microalgae Biofuels vs. Other Crop-Based Biofuels.” *Halobacterium Misconceptions*, 1 Sept. 2015, baliga.systemsbiology.net/see-interns/hs2015/projects-2/chlamydomonas-reinhardtii/microalgae-biofuels-vs-other-crop-based-biofuels/.
7. “Algae Basics.” *Algae Basics - History of Algae as Fuel*, allaboutalgae.com/algae-basics/.
8. “Algal Biofuels.” *Department of Energy*, www.energy.gov/eere/bioenergy/algal-biofuels.
9. “Algal Biofuel Production Is Neither Environmentally nor Commercially Sustainable.” *Phys.org - News and Articles on Science and Technology*, Phys.org, phys.org/news/2017-08-algal-biofuel-production-environmentally-commercially.html.
10. Wesoff, Eric. “Hard Lessons From the Great Algae Biofuel Bubble.” *Greentech Media*, Greentech Media, 19 Apr. 2017, www.greentechmedia.com/articles/read/lessons-from-the-great-algae-biofuel-bubble#gs.7KtF2QY.
11. Westervelt, Eric. “Biofuel Push Stalls In 'Car Crazy' Germany.” *NPR*, NPR, 24 May 2011, www.npr.org/2011/05/24/136579791/biofuel-push-stalls-in-car-crazy-germany.
12. Shogren, Elizabeth. “Air Force And Navy Turn To Biofuels.” *NPR*, NPR, 22 Sept. 2011, www.npr.org/2011/09/26/140702387/air-force-and-navy-turn-to-bio-fuels.
13. “Military Goes Green For An Edge On The Battlefield.” *NPR*, NPR, 3 Dec. 2010, www.npr.org/2010/12/03/131785448/Military-Goes-Green-For-An-Edge-On-The-Battlefield.
14. “The Benefits of Biodiesel.” *Green America*, www.greenamerica.org/green-living/benefits-biodiesel.
15. Bullis, Kevin. “Do Biofuels Reduce Greenhouse Gases?” *MIT Technology Review*, MIT Technology Review, 22 Oct. 2012, www.technologyreview.com/s/424050/do-biofuels-reduce-greenhouse-gases/.
16. Hannon, Michael, et al. “Biofuels from Algae: Challenges and Potential.” *US National Library of Medicine National Institutes of Health*, US National Library of Medicine National Institutes of Health, Sept. 2010, Bullis, Kevin. “Do Biofuels Reduce Greenhouse Gases?” MIT Technology Review, MIT Technology Review, 22 Oct. 2012, www.technologyreview.com/s/424050/do-biofuels-reduce-greenhouse-gases/.
17. “Biofuels Fact Sheet.” Biofuels Fact Sheet | Center for Sustainable Systems, css.umich.edu/factsheets/biofuels-factsheet.
18. Tribou, Doug. “Algae in the Gas Tank? U of M Researchers Study Problems Holding Back Algal Biofuel.” RSS, www.michiganradio.org/post/algae-gas-tank-u-m-researchers-study-problems-holding-back-algal-biofuel.
19. “Algae Bioreactors Are the Future for Growing Algae.” Energy, Technology, & Policy, 7 Feb. 2010, webberenergyblog.wordpress.com/2010/02/07/algae-bioreactors-are-the-future-for-growing-algae/.
20. “UC San Diego News Center.” How The Immune System Fights Back Against Anthrax Infections, ucsdnews.ucsd.edu/pressrelease/uc_san_diegos_algae_biofuels_program_ranked_best_in_nation.
21. “Union Membership Drops.” *Ross Runkel Report*, 26 Jan. 2017, www.rossrunkelreport.com/blog/union-membership-drops.
22. Kommers, Nate. “Algae Biofuel Can Cut CO2 Emissions by up to 68 Percent Compared to Petroleum Fuels Finds New Peer Reviewed Study.” *Algae Biomass Organization*, 19 Sept. 2013, algaebiomass.org/algae-biofuel-can-cut-co2-emissions-by-more-than-50-compared-to-petroleum-fuels-finds-new-peer-reviewed-study/.
23. epmusic47. “Help Raise Awareness for Bioenergy by Sharing This Infographic.” *Inhabitat Green Design Innovation Architecture Green Building*, Inhabitat, 13 Apr. 2016, inhabitat.com/help-raise-awareness-for-bioenergy-by-sharing-this-infographic/.
24. “PETROLEUM REFINERIES SECTOR.” *Epa.gov*, 2014, www.epa.gov/sites/production/files/2016-11/documents/refineries_2013_112516.pdf.
25. Doshi, Amar. “Can We Maximize The Economic Benefits Of Microalgae Biofuel Production?” *Science Trends*, Sept. 2017, doi:10.31988/scitrends.4954.
26. Laux, Sara. “How to Prevent Algal Blooms at Your Lake.” *Cottage Life*, 10 May 2018, cottagelife.com/general/how-to-prevent-algal-blooms-at-your-lake/.
27. Paintballshop. “12oz CO2 FILL.” *Paintballshop*, www.paintballshop.co.nz/collections/co2-and-hpa/products/12oz-co2-fill.
28. “Algae Basics.” *Algae Basics - History of Algae as Fuel*, allaboutalgae.com/how-algae-grow/.
29. Algae Research Supply. “Temperature of My Algae Culture.” *Algae Research Supply*, algaeresearchsupply.com/pages/should-i-heat-my-algae-culture.
30. “Melbourne Certified As A Carbon Neutral City.” *Archinect*, archinect.com/news/article/70886409/melbourne-certified-as-a-carbon-neutral-city.
31. “Municipal Wastewater Treatment Systems & Equipment.” *Aeration Industries*, www.aireo2.com/en/markets-2/municipal/.
32. “Top 7 Renewable Energy Sources.” *EnvironmentalScienceDegree.com - List of Accredited Environmental Science Degree Programs*, www.environmentalsciencedegree.com/top-7-renewable-energy-sources/.
33. “Municipal Wastewater Treatment Systems & Equipment.” *Aeration Industries*, www.aireo2.com/en/markets-2/municipal/.
34. Hsu, Jeremy. “In New System, Algae Cleans Water, Then Transforms into Organic Fertilizer.” *Popular Science*, 7 May 2010, www.popsci.com/science/article/2010-05/algae-cleans-manure-runoff-transforming-organic-fertilizer.
35. “2016 Bioenergizeme Infographic Challenge: Algae Biofuels, Exploring the Energy of Tomorrow Today.” *Department of Energy*, www.energy.gov/eere/bioenergy/2016-bioenergizeme-infographic-challenge-algae-biofuels-exploring-energy-tomorrow.
36. “Nitrogen Fertilizers Deplete Soil Organic Carbon.” *ScienceDaily*, ScienceDaily, 30 Oct. 2007, www.sciencedaily.com/releases/2007/10/071029172809.htm.
37. Steger, Cai. “The Promise of Algae Biofuels - a New NRDC Report.” *NRDC*, 15 Dec. 2016, www.nrdc.org/experts/cai-steger/promise-algae-biofuels-new-nrdc-report.
38. Andrwe. “Solar Heat H2O Heater.” *Island Recreational*, www.islandrecreational.com/Solar-Heat-H2O-Heater_p_511.html.
39. “Analysis of Algae Growth Mechanism and Water Bloom Prediction under the Effect of Multi-Affecting Factor.” *NeuroImage*, Academic Press, 24 Jan. 2017, www.sciencedirect.com/science/article/pii/S1319562X17300359.