**Algae: the secret weapon to combat climate change?**

**The word Algae can mean different things to different people. And if you prefer to pronounce it ‘al-jee’ then, you know, there’s example number one. If you live somewhere in the world that happens to be next to the sea, then you may well consider the green slime that carpets the rocks, and the smelly seaweed that washes up on the beach to be nothing more than slightly annoying aspects of life by the seaside. And if you’re somewhere like coastal Florida, then you’ll no doubt be only too well aware of the surge of the red tides, otherwise known as harmful algal blooms or HABs, which are nasty toxic outbreaks that can destroy marine habitats and kill fish and birds, and even cause respiratory problems and eye irritation in human beings that are unfortunate enough to swim through them.**

**But that ability to proliferate so rapidly is precisely what made algae one of the most successful organisms ever to exist in nature. It played an absolutely fundamental role in creating a breathable atmosphere by absorbing enormous quantities of atmospheric carbon dioxide and replacing it with oxygen. Without that process happening on a global scale hundreds of millions of years ago, life on land would never have got going in the first place. In fact, algae contain all the right stuff for organic life, including proteins, carbohydrates, nucleic acid and lipids, which are non-water-soluble fatty acids that produce algae oil. And when those early primordial algal blooms died, they sank to the bottom of the oceans, locking all the carbon away beneath the seabed which, over eons of geological time, became the vast deposits of oil that we humans have been busy plundering for the last hundred and fifty years or so.**

**So, you could say it’s quite ironic that an organism resulting in a substance that enabled human beings to cause catastrophic changes to our climate, might just turn out to be one of the key materials to help us fix the problem.**

**Hello and welcome to Just Have a Think**

**Here’s a couple of fascinating facts about algae that you’re welcome to use during your next dinner date…**

**A kilogram of algae absorbs one point eight three kilograms of carbon dioxide every day, essentially to produce more algae. That’s about two point seven tonnes of CO2 per acre.**

**As similar sized forest containing twenty-five-year old maple trees sucks in about two point two kilograms of CO2 per day. That means you’d only need about one point two kilos of algae to equal the carbon capture of an entire acre of forest.**

**Algae grows ten times more quickly than land-based plants too , and it only needs a tenth of the space to produce an equivalent amount of biomass. Plus, it uses ten times less water than land crops.**

**And it can be farmed in non-productive and non-arable regions, which means it doesn’t have to complete with other crops or destroy existing ecosystems.**

**Now, all of that is very interesting and everything, and would definitely impress your dinner partner I reckon, but the question is does any of it mean that algae can actually be made into anything useful?**

**And the answer appears to be a slightly conditional yes…potentially. In fairness, as more and more research is carried out, the scientific and commercial sectors are starting to realise just what an amazingly versatile resource algae could be if the right focus and funding is thrown at it.**

**Back in the oil crisis of the nineteen seventies, the possibility of using algae to capture carbon and convert it into biomass and biofuels attracted a lot of attention, and by about twenty fifteen or so, as climate change was vaguely coming into view for lawmakers around the world, governments were throwing some serious funding into the industry as they realised that deriving biofuel from algae would potentially displace far less agricultural land than other existing fuels crops like corn and sugarcane.**

**Biotech companies partnered up with some of the biggest oil producers, including Shell, Exxon and Chevron and it looked like a genuine net zero carbon alternative to gasoline was on the horizon.**

**It hasn’t worked out quite that triumphantly though, sadly. At least not yet anyway. The trouble is the research and development phase proved to be really very complicated indeed. It’s not just a matter of raking up a bit of seaweed, dissolving it in something nasty and syphoning off the oil content. That would be far too easy. It turns out there are upwards of thirty thousand different types of algae ranging from the tiny microalgae better known as phytoplankton, which by the way produce about twenty percent of the planet’s oxygen, all the way up to huge kelp plants that can grow to tens of metres long in certain parts of the ocean. And some estimates suggest there could be as many as a million different species of Algae on the planet.**

**So, the science bods have been taking different strains of algae into their laboratories where they’ve been genetically modifying them to see if they can come up with a new super strain that can grow quickly enough, and contain sufficient quantities of the all-important oil producing lipids to produce a viable biofuel. It’s a whole sphere of research known as ‘bioprospecting’. And it’s extremely expensive and time consuming.**

**And even when the perfect strain is genetically derived, which researchers reckon may be a few years away yet, then they’ll still need to build facilities to process it in large enough quantity and at low enough cost to make it commercially viable against fossil fuel.**

**Of the big oil giants who originally got involved with algal biofuels, only Exxon has stuck with their research program, which is another irony given their track record of climate denial and obfuscation. Since twenty seventeen they’ve been working with a private firm called Synthetic Genomics in Southern California to develop a process using CRISPR gene-editing technology to produce an optimised algal strain. Exxon haven’t been shy in promoting what they call their miniature science campaign on social media either, which has led some environmentalists to suggest a bit of greenwashing might be going on. Synthetic Genomics do have a pretty impressive facility which looks likely to hit Exxon’s goal of producing ten thousand barrels of algae fuel per day by twenty twenty-five, but you know, when you set that against Exxon’s current daily production of four million barrels of crude oil, it kind of puts the scaling problem into quite stark context.**

**Despite those daunting statistics, Joe Biden’s administration is showing considerable faith in the possibility of using algae fuel to offset at least some of the prodigious fossil fuel consumption over in the States, with a particular leaning towards the aviation industry. In April 2021 the US Department of Energy committed sixty one point four million dollars to new biofuel research, and are on track to meet a commitment to demonstrate significant algae growth on a specified amount of land, and to scaling up production in outdoor ponds by twenty-twenty five, with a twenty fifty goal of producing an algae strain that can be genuinely cost-competitive with fossil fuels on the energy market.**

**But algae offers many more low carbon commercial opportunities than just fuel oil.**

**One of the most encouraging prospects is bioplastics. Some algae contain a substance called Polyhydroxy-butyrate or PHB, which is a polymer that can be used to replace polypropylene.**

**The authors of this paper used what they call metabolic engineering techniques to modify a strain of microalgae to increase the proportion of PHB in its construction from ten percent to eighty percent, creating an almost complete bioplastic just from this one process. And the great thing about this material is that unlike polypropylene, which will be swimming around in our oceans for hundreds of years causing damage wherever it goes, PHB breaks down in a normal household composter, and if it did make its way into the ocean then it’d dissolve within a year or so, taking it’s carbon content down to the seabed just like any other algae. And the really encouraging news is that there’s already a fairly well-established infrastructure in place for producing the material at scale.**

**Algae farms are widely used in many parts of the world to produce things like foods, medicines and nutritional supplements like spirulina. One of the largest operations is run by a company called iWi in the Unites States. They have farms in Texas and New Mexico, each consisting of forty-eight algae ponds the size of football fields.**

**The processes required to obtain a hundred grams of protein from beef create about twenty-five kilograms of CO2 equivalent emissions. But according to another algae farm start up called SuSeWi in the UK, producing a hundred grams of protein from algae actually removes three hundred and twenty grams of carbon dioxide from the atmosphere. And it’s not like you’ll have to make do with green slime for breakfast, lunch and dinner. This isn’t the dystopian nightmare depicted in Charlton Heston’s nineteen seventy three movie Soylent Green! The algae from these farms will be converted into dried protein that will then be used as a constituent of other non-diary alternatives. SuSeWi founder Keith Coleman is planning to build a series of algae ponds in Morocco that will cover a hundred hectares, capable of producing seventeen hundred tonnes of protein a year. And he’s even more ambitious than that. Apparently, the next phase will be what he describes as a full-scale farm, covering six thousand hectares of otherwise unusable land. That level of protein production would compete with the world’s largest chicken factories which churn out two million chickens a week for human consumption, using up about a hundred million tonnes of water and emitting a million tonnes of CO2 equivalent every year.**

**But we do of course need to be realistic about how we humans will respond to these new foodstuffs. For the foreseeable future at least, the reality is that a large proportion of the human species will still insist on eating meat, but even here, algae has come up trumps. Scientists have discovered that a species of red algae called Asparagopsis taxiformis, which is found in tropical and warm temperate waters, can be added to the feed of ruminant animals to reduce their methane output. There are more than one and a half billion cows in the world and, combined with other livestock animals, they currently produce methane at a rate equivalent to more than three billion tonnes of carbon dioxide every year.**

**But adding just two percent of this red seaweed to the diets of those animals has been shown to reduce their methane emissions by as much as ninety percent with nearly ninety nine percent effectiveness. The science bods are still trying to identify precisely how it works but it appears that certain compounds in the algae can somehow stop the production of methane in the animal’s digestive system. The challenge, as with everything we’ve so far looked at, is building enough algae farms and scaling up production to meet demand, which arguably, is where government incentives are so desperately needed, but a start up called Symbrosia is already producing the feed additive at a sustainably run facility in Hawaii. It’s still very early days but the handful of small farms they’re currently working with have already avoided about four tonnes of CO2 equivalent emissions and Symbrosia are on the look out for new partners to expand their operations as fast as possible. So, you know, if you’re a farmer, or a smart investor, then I would suggest you check them out.**

**But perhaps the easiest way to utilise algae for climate mitigation may be to grow very large quantities of seaweed in ocean farms and sink it to the bottom of the deep sea where it will lock away its carbon content for good. That’s essentially just mimicking exactly what nature does but on a turbocharged scale. According to this twenty-nineteen study published in the online journal Science Direct, there are about forty-eight million square kilometres of ocean that are suitable for this kind of seaweed aquaculture. The paper’s authors calculated that if algae aquaculture was ramped up from it’s current two thousand square kilometres to about seven million square kilometres, or about fifteen percent of the total suitable area, then that would be enough to completely offset all the greenhouse gas emissions from current global agriculture. Now, that amount of seaweed would represent double the volume of all existing wild species, so it’s probably not a realistic rate of expansion. Plus, any ocean farming of algae would need extremely careful stewardship to ensure it didn’t get out of control and start killing off existing sea-life and ecosystems. So perhaps we haven’t found the elusive silver bullet to fix the entire climate emergency here, but the paper suggests that targeted industrial-scale expansion of seaweed offset farms in high potential regions like Asia and the Pacific coast of the United States could make a substantial impact on achieving the IPCC goal of keeping global atmospheric warming to less than two degrees Celsius above pre-industrial levels.**

**So, it looks like there are some really very tangible solutions to be had from algae if we can just convince commercial investors to grow some cojunes and speculate some of their billions of hedge fund dollars, and get our lawmakers to …grow some cojunes and put some incentives in place to speed things up a bit.**

**I’m sure you’ve got your own views on this one, so if you have, then why not jump down to the comments section below and leave your thoughts there.**

**That’s it for this week though.**

**Before I go, I just want to let you know about a podcast I took part in recently with the folks at Spark Network. They’re part of an organisation called “iClima Earth” who aim to redefine climate change investments, by focusing on companies that can genuinely enable the avoidance of CO2 emissions. And I’ll leave a link to the podcast in the description section of this video. (**[**https://rss.com/podcasts/climatetalk/378010/**](https://rss.com/podcasts/climatetalk/378010/)**)**

**And as always, a huge thank you to the channels amazing Patreon supporters who help keep these videos completely independent and ad-free. And I must just give a quick shout out to the folks who’ve joined since last time with pledges of ten dollars or more a month.**

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**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.
See you next week**