**Algal Ethanol**

Third generation biofuels use specially engineered crops such as algae as the energy source. These algae are grown and harvested to extract oil within them and leave protein as a by-product. The protein can be used in animal feeds. The oil can then be converted into biodiesel through a similar process as first-generation biofuels, or it can be refined into other fuels as replacements to petroleum-based fuels. Algae yield about 30 times more biodiesel potential per acre per year over soybeans and can grow in diverse environmental conditions.

Third-generation biofuels are more energy dense than first and second-generation biofuels per area of harvest. They are cultured as low-cost, high-energy, and completely renewable sources of energy. Algae are advantageous in that they can grow in areas unsuitable for first and second-generation crops, which would relieve stress on water and arable land used. They actually take 99% less water than other biomass resources. Algae can be grown using sewage, wastewater, and saltwater, such as oceans or salt lakes. Because of this, there wouldn't be a need to use water that would otherwise be used for human consumption. Some strains of algae can even selectively absorb heavy metal ions, which could further improve water quality. However, further research still needs to be done to further the extraction process in order to make it financially competitive to diesel and other petroleum-based fuels.

However, there are some challenges to using algae as a bioenergy source. Theoretical maximum yields have not been achieved in commercial facilities, thus algae harvesting and oil recovery needs innovative solutions. Open ponds for growing algae are susceptible to contamination and lower productivities. Closed bioreactors used in the production process are quite expensive. Overall, the algae production and harvesting process need further development before using algal oil for biofuel is feasible and economically beneficial.





