

Agronomics Case Study – Clean Food Group

Traditional edible-oil and fat supply chains have long been dominated by tropical agriculture: palm, coconut, soy, etc. These have delivered high functional utility but also carry structural economic vulnerabilities: commodity price volatility; reliance on large-scale land, labour, and long supply chains; deforestation and environmental externalities; and geopolitical or climate risk. The growing demand for sustainability, traceability, and circular economy approaches adds both pressure and opportunity to transform how functional lipids are manufactured.

In this context, Clean Food Group (CFG), founded in the UK, works to produce functional oils and fats through precision fermentation. By converting low-cost carbohydrate feedstocks – including food-waste streams – into tailor-made lipid outputs, CFG decouples oil/fat production from many of the constraints and risks of traditional agriculture. The economic impacts are multifold: cost control, supply reliability, value capture, job creation, localisation, and inflation buffering, among others.

Technology and Commercialisation Basis

CFG's core platform, CLEANOilCell™, utilises robust non-GMO yeast strains that can metabolise varied carbohydrate inputs to produce oils and fats with specific fatty-acid profiles. The technology is designed for scalability and process intensification; it was developed over many years via academic/industry collaboration (notably at the University of Bath) and has received applied research support.

The company has progressed from pilot stages to demonstrated commercial runs. A key milestone was the acquisition of a bioprocessing facility in Knowsley, Liverpool region, which grants immediate access to a one-million-litre fermenter capacity, including downstream processing, utilities, and R&D infrastructure. A demonstration run of in a 100kl fermenter yielded roughly two tonnes of oil, validating that the process can scale in existing manufacturing infrastructure without the full cost/time penalty of greenfield new builds.

The Knowsley site is recognised as a biotech hub, and the investment was welcomed by local economic development authorities in Liverpool, who emphasised both job creation and the positioning of the region in the emerging "bio-industrial" economy.

Crucially, the Knowsley facility is not a one-off: it functions as a template that can be replicated globally to scale the business. Different sites will require different levels of retrofit, but the underlying principle of using existing industrial-scale infrastructure to compress lead time and reduce capex is broadly transferable. This in turn lends the

platform to a third-party licensed manufacturing model. CFG retains strong intellectual property around the core technology (proprietary strains and key elements of the process are protected), while the manufacturing itself relies on standard food-grade plant and process equipment. Licensed manufacturing therefore offers a low-capex route to the global reach that multinational FMCG customers will increasingly require.



Watch Agronomics' mini-documentary of the new Clean Food Group facility in Knowsley [via this link](#).

Economic Impacts

1. Cost Structure and Competitive Positioning

As CFG scales, economies of scale and process optimisation lead to downward pressure on the cost per unit of output of lipid ingredients. Because the process is industrial and not seasonally constrained, CFG can better forecast and stabilise production volumes. The retrofit nature of the Knowsley facility helps reduce upfront capital cost compared to entirely new build facilities, making cost-parity with agricultural oils more plausible.

CFG positions its products to be “price-competitive” or even reach parity with conventional agricultural equivalents while delivering added benefits (e.g. sustainability, traceability).

The ability to source feedstocks from food-waste streams (for example, surplus bread), improves circularity and the potential for lower raw input cost, as long as the logistics, consistency and quality of feedstock are managed effectively.

2. Inflation Mitigation and Supply Volatility Buffering

Commodity oil markets are often subject to volatility driven by weather, pests, disease, geopolitical trade shifts, transportation costs and fuel price swings. By contrast, an industrial-scale fermentation platform can offer more consistent supply and predictable cost structures, less exposed to seasonal swings or crop failure. This helps downstream food manufacturers, cosmetics producers, and other users to stabilise their ingredient costs, which can moderate the extent to which oil/fat price hikes feed into final retail inflation.

The shorter, more controllable supply chains reduce the dependency on overseas plantations or disrupted shipping or import bottlenecks. The local (or regional) production of fermentation-derived oils reduces the distance from raw ingredients to end user, which can reduce logistics cost and risk. As reported by one investor commentary, facilities like CFG's may allow brands to source key ingredients domestically rather than rely on far-flung supply chains.

3. Local & Regional Economic Development

CFG's choice of Knowsley leverages a skilled workforce, existing infrastructure, and the region's biotech history. The facility creates employment opportunities across manufacturing operations, process engineering, downstream processing, quality assurance, and R&D. Local councils have explicitly linked the facility to high-value job creation and regional regeneration.

The economic benefit is not solely direct employment; there are multiplier effects. These include the sourcing and processing of feedstock (e.g. surplus food, waste materials), utilities and energy services, maintenance, logistics, packaging, quality certification, and potentially ancillary services (lab services, waste management). As the facility scales, the supply chain ecosystem strengthens.

4. Value Creation & Market Opportunity

The global addressable market for sustainable oils and fats is large; CFG identifies multi-billion-dollar opportunities across food, cosmetics, pet food, and possibly other functional-ingredient markets.

As regulatory approvals progress, product lines expand, and customer adoption grows, CFG is in a position to capture value not just through volume, but via premium branding (e.g. sustainability credentials), local supply, traceability and ESG compliance. Early cosmetics approval enables revenue generation while food-ingredient regulatory channels mature.

Investment into CFG has already included rounds to accelerate scale-up, with funding from climate-tech, food, and industrial investors, enabling business growth plans toward full commercialisation.

5. Food Security and Domestic Capability

While environmental and ethical drivers are strong, the economic value of securing domestic (or regional) capacity for key food-ingredient production is compelling. Precision fermentation reduces the reliance on imported tropical oils, which are subject to deforestation, regulatory scrutiny, trade restrictions, or supply disruption. Domestic manufacture enhances resilience, reduces foreign-exchange exposure, and improves national food systems' robustness to global shocks.

Shorter supply chains also mean lower transport-related costs, potential for quicker lead times, and less dependence on large-scale shipping logistics. This advantage becomes more significant as global supply chains face inflationary pressures, fuel cost volatility, geopolitical friction or climate-related disruption.

6. Environmental & Additional Benefits (Complementary to Economic Core)

Though not the primary headline in this case study, the environmental and social advantages reinforce the economic case. CFG reports enhanced lifecycle outcomes (notably greenhouse-gas reduction vs conventional palm oil) which are important to many buyers, especially those with ESG targets.

Those advantages can translate to economic value: compliance with regulation, brand differentiation, consumer preference, and potential cost savings from avoided regulatory or environmental penalties or supply disruptions. The ability to use waste-derived feedstocks may offer cost and sustainability synergies.

7. Whole-Cell Valorisation

A further economic lever, still at an early stage of development, comes from the valorisation of the whole yeast cell rather than just the lipid fraction. CFG's yeast is approximately 45% lipid, and the remaining 55% represents material that, if sold into appropriate applications, can meaningfully enhance overall unit economics. The analogy is agricultural: in soy processing, both the oil and the residual biomass carry commercial value, and a similar logic applies here. CFG has developed a downstream process that accesses the non-lipid fraction of the cell without impacting lipid yield, opening multiple revenue streams from a single fermentation run.

Two concrete examples illustrate the point. First, CFG has produced and refined beta glucan, a healthy fibre linked to lowering cholesterol and also used as a functional ingredient in texturing applications, which represents approximately 40% of the yeast

cell (current yields reach a maximum of around 50%) and has attracted interest from Royal Canin in pet food as well as several of CFG's food collaborators. Second, CFG has produced and refined a functional protein that acts as an emulsifier, with demonstrated capacity to outperform traditional emulsifiers such as soy lecithin; this protein has been tested and validated by Mondelēz in various applications. With emulsifiers now front and centre in the public debate around ultra-processed foods, the ability to offer a clean-label alternative is likely to resonate strongly with food manufacturers.

Lessons and Insights

- Infrastructure reuse reduces cost and time-to-scale: By acquiring an established fermentation site (Knowsley), CFG avoids much of the cost, delay, and risk of building entirely new infrastructure, accelerating the pathway to commercial scale.
- Control over feedstock and process yields is strategic: The consistency of raw materials (including food-waste sources), the yield per litre, energy/utility cost, purification efficiency, and scale all matter deeply in determining the final cost per kg of oil/fat produced.
- Dual-market or staged approach is practical: Early revenue from cosmetics / personal care helps de-risk while regulatory approvals for food applications proceed.
- Regional clustering yields economic spillover: The facility not only creates jobs, but strengthens the local supply and services ecosystem; the region benefits from biotech investment, skills development, and manufacturing capacity.
- Inflation and supply-shock hedging matter: Food manufacturers may be willing to pay a modest premium initially if it secures supply, reduces risk of shortages or cost spikes, and helps with environmental credentials; over time, as cost competitiveness improves, the premium need declines.
- Market demand is strengthening: Consumer, regulatory, and corporate pressures toward sustainability, traceability, and lower-risk sourcing increase the value of fermentation-derived functional oils and fats.

From an economic impact lens, precision fermentation of functional oils and fats represents more than a novelty: it offers a structurally more controllable, localisable, and scalable means to supply essential ingredients, while reducing exposure to commodity risk, shortening supply chains, and fostering regional economic development.

Clean Food Group exemplifies how industrial biotechnology can be deployed pragmatically to balance cost, reliability and sustainability. As volumes scale, yields

improve, feedstock sourcing becomes more sophisticated, and customer adoption grows, the economics of the model improve significantly.

Appendix A: Economic-Impact Quantification

Key Assumptions and Parameters

1. The one-million-litre facility in Knowsley gives CFG a major scale base; a prior run in a 100kl fermenter yielding ~2 tons of oil demonstrates process viability. (Green Queen)
2. CFG targets a market worth around US\$20 billion for sustainable oils & fats across food, cosmetics and pet nutrition. (Clean Food Group)
3. Precision-fermentation cost models generally show that volumetric yield (g product per litre) is one of the largest levers for cost reduction. Low yields (e.g. 10 g/L) lead to high cost; medium to high yields (25-50 g/L or more) materially reduce cost per kg. (Roland Berger)
4. Sector analyses suggest that cost parity (or near-parity) with conventional agricultural oils/fats is challenging but becoming feasible, especially if feedstock costs are low, infrastructure is efficient, plant utilisation is high, and product inclusion rates (in end use) allow for modest premiums. (Consultancy.eu)
5. Costing studies for precision fermentation (protein/other biomolecules) show that raw materials, fermentation, downstream processing, utilities, labour, and amortised capital all contribute; COGS declines significantly from pilot to demonstration to full scale. (FoodWrite)

Projected Cost Evolution

Stylised multi-stage cost model, adapted to oils/fats rather than proteins, but using comparable principles. Use this as a scenario tool (sensitivity to yield, feedstock cost, scale, inclusion rate, etc.).

Scenario/ Stage	Key assumptions	Estimated cost per kg of oil/fat
Early/Pilot	Yield = relatively low, inefficient runs, learning curves, smaller fermentors, lower utilisation, conservative recovery; feedstock from more expensive sources; smaller batches.	Higher cost per kg; perhaps several × the cost of conventional equivalents. (This stage may not yet achieve cost-parity or competitive pricing in many broad commodity applications.)
Mid/Demo	Yield improvements; better process control; moderate cost feedstocks; higher utilisation; scale approaching commercial volumes; more efficient downstream.	Cost declines significantly. Gap to commodity oils narrows. Possibility of supply to premium markets or customers willing to pay more for

Scenario/ Stage	Key assumptions	Estimated cost per kg of oil/fat
Full Scale (optimised)	High volumetric yields; cost-effective or waste-derived feedstocks; continuous or semi-continuous operations; high plant utilisation; cost-effective downstream; energy efficiency; economies of scale; negotiated substrate & utility contracts; inclusion of premium or sustainability value-add in customer contracts.	sustainability / traceability / local supply. Cost potentially approaching or achieving parity (or near parity) with some conventional oils/fats, or at least within a premium band justified by ESG/supply-security attributes.

Note: The exact cost numbers depend heavily on variables such as feedstock cost, energy cost, yield (g/L), batch cycle time, downstream recovery efficiency, plant amortisation, labour, regulatory cost burden, and required product purity or specification.

Example Sensitivity: Yield and Volume Effects

- Suppose CFG improves yield (oil produced per litre of fermentation) significantly. As yields rise, fixed costs (equipment, utilities, labour, overheads) and variable costs (media, downstream per unit) are spread over more product, reducing cost per kg.
- At lower yields, costs are high; but as CFG moves into larger scale and learns from the Knowsley facility operations, the per-kg cost falls.
- If CFG can secure low-cost feedstock (e.g. food waste, surplus bread, other carbohydrate sources), the cost of raw materials can be a smaller portion of total cost, improving competitiveness versus conventional oil sources.
- Some markets or customers may accept a modest premium for sustainability, traceability or reduced deforestation risk; this can help early adoption and improve margins even before full cost parity is reached.
- Over time, as cost per kg declines, adoption scope can expand from premium niches (cosmetics, petfood, special formulated products) into more mainstream food formulations, reducing reliance on volatile tropical commodity oil markets.

Impact on Price Stability & Inflation Buffering

- With more predictable, controllable production volumes, CFG can offer manufacturers more reliable supply, reducing exposure to yield shocks, crop failures, weather, pests, transportation delays, and trade disruptions.
- Shorter supply chains (production nearer to end-user markets) reduce lead time, freight cost, spoilage risk, and dependency on imported raw oils.
- This stability helps manufacturers better forecast input costs; in some cases it may reduce volatility and lessen the extent to which raw-oil cost shocks feed into finished-product inflation.
- Where formulators are willing to pay slightly more for security, sustainability or premium label credentials, CFG may capture value above cost parity, enhancing margins and offsetting upstream cost challenges.

Job / Economic Multiplier Impacts

Beyond cost & pricing, CFG's scale-up delivers broader economic benefit:

- Employment creation: technical, operations, quality control, R&D, maintenance, downstream processing, utilities, logistics, feedstock management.
- Regional development: locating manufacturing in biotech-friendly clusters (like Knowsley / Liverpool) strengthens local economies, supports high-skill jobs, builds local supply chain capacity, and potentially attracts related businesses or services.
- Domestic production of key functional ingredients reduces dependence on imported commodities, which keeps more value within the local economy.
- Potential for feedstock partners: food waste collectors, processors, possibly local agricultural by-product suppliers; this creates additional upstream economic activity.
- Downstream customer value: brands may pay for the sustainability / traceability / ESG value; thus, CFG's product may carry a premium over conventional oil pricing — especially in markets where deforestation or origin risk is a concern.

Quantitative Example (Hypothetical)

Here is a hypothetical illustration assuming certain values. These are not CFG's disclosed values (unless verified in diligence), but serve to demonstrate how investment, scale and yield improvements can translate into cost declines and competitive pricing.

Assumptions:

- Medium to large scale operations (e.g. many batches at the 1 million-litre scale facility, high utilisation).
- Target yield: e.g. X g of oil per litre (the higher X is, the better cost spread).
- Feedstock cost is moderate, possibly reduced via food-waste sourcing.
- Downstream processing reasonably efficient, with good recovery.
- Energy & utilities cost negotiated; overheads manageable; regulatory/compliance costs allocated.

Under favorable assumptions, cost per kg could approach a tipping point where CFG's oil/fat becomes sufficiently price-competitive for many food manufacturers, particularly when factoring in non-price benefits (supply security, sustainability, traceability, reduced lead-time, shorter transport).

Risks / Sensitivity

- If yield growth is slower than expected, per-unit cost remains too high for widespread adoption; adoption may remain concentrated in niches that tolerate premiums.
- If feedstock costs remain high or volatile, input cost could erode margins or ability to compete.
- If regulatory burdens or compliance cost are substantial, they may add to overhead and time to market, slowing potential scale-economy benefits.
- Market willingness to pay for sustainability / traceability / origin risk varies by geography, brand, consumer base. Commercial contracts need to balance price competitiveness vs added value.
- Energy, utilities, labour, and equipment cost inflation may erode cost advantages unless managed carefully.

Summary

- Precision fermentation offers a pathway to reduce per-unit cost over time as scale, yield, and feedstock efficiency improve.
- Economic value arises both from cost decline and from added non-price benefits (supply security, traceability, sustainability) which may support modest price premiums in early/adjacent markets.
- CFG's access to a large, retrofit-ready facility helps accelerate scale and reduces capital burden compared to entirely new builds, improving economics.

- Sensitivity modelling (yield, feedstock cost, plant utilisation, recovery rate, margin premium, energy cost, overheads) is essential to understand break-even points, pricing strategy, customer selection, and volume targets.
- For deeper precision, actual CFG-specific parameters (fermentation yield, cycle time, raw material cost, recovery %, down-stream cost, overheads, energy cost, etc.) should be used; investor or technical diligence will help replace hypothetical assumptions with real data.
- A phased adoption strategy, starting with higher margin / premium markets, then broadening into more price-sensitive segments as cost declines, is a prudent approach.