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Deep Dive
Redefining Coffee



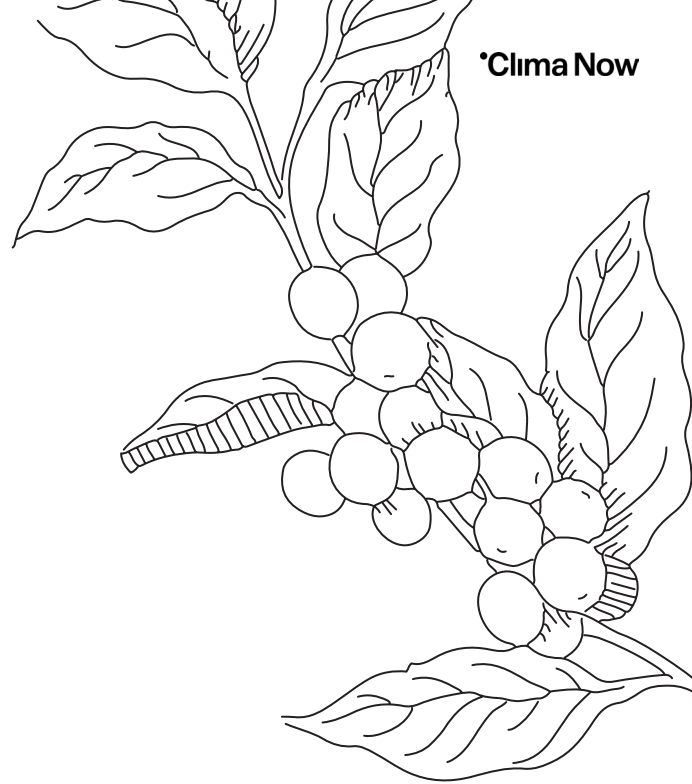
Aroma Engineering Startups and the Future of Sustainable Brews

In the world of coffee, innovation is brewing. The cup of coffee we savor every morning carries a complex tale, from the farmlands where coffee beans are cultivated to the challenges of meeting rising global demands while grappling with the dire implications of climate change. It's within this narrative that aroma engineering startups emerge as catalysts for a new era of coffee production — one that blends sustainability with innovative technology.

The Complexity of Coffee Farming Practices

The journey of a coffee bean begins amidst farmlands, encapsulated within the coffee berry. Over the span of 4 to 7 years, coffee cherries are meticulously nurtured, harvested, and processed before embarking on a global journey, primarily to the US and Europe, but increasingly to Asia as well.

Each coffee cherry contains two beans, and the typical cup of coffee is crafted from 70 roasted beans. Similar to cocoa, coffee cultivation is categorized into shade-grown and sun-grown practices. Although coffee is traditionally intended to thrive in the shade of agroforestry, the pursuit of increased yields has resulted in the adoption of mechanized and monoculture farming, contributing significantly to adverse environmental effects.



Navigating Business Challenges

However, these new farming practices are not able to secure the global long-term demand mainly for the following two reasons:

1. Climate Change Impact

Rising temperatures and persistent droughts are rendering vast expanses of land unsuitable for coffee cultivation. This drastic reduction in viable farming regions not only curtails production but also alters the taste of coffee itself. Climate change is on course to render half of the current coffee farmland unusable in the next 25 years, impacting yields and quality.

2. Rising Global Demand

Simultaneously, the surge in new consumers across Asia and Africa (doubling consumption over the past three decades) amplifies the need for increased production as their growing middle classes have acquired a taste for coffee. This demand will likely result in a coffee price increase of around 5% in the next 12 months, and it is unlikely to cool off thereafter.

This confluence of factors places immense pressure on supply chains and intensifies the need to decarbonize the coffee industry.

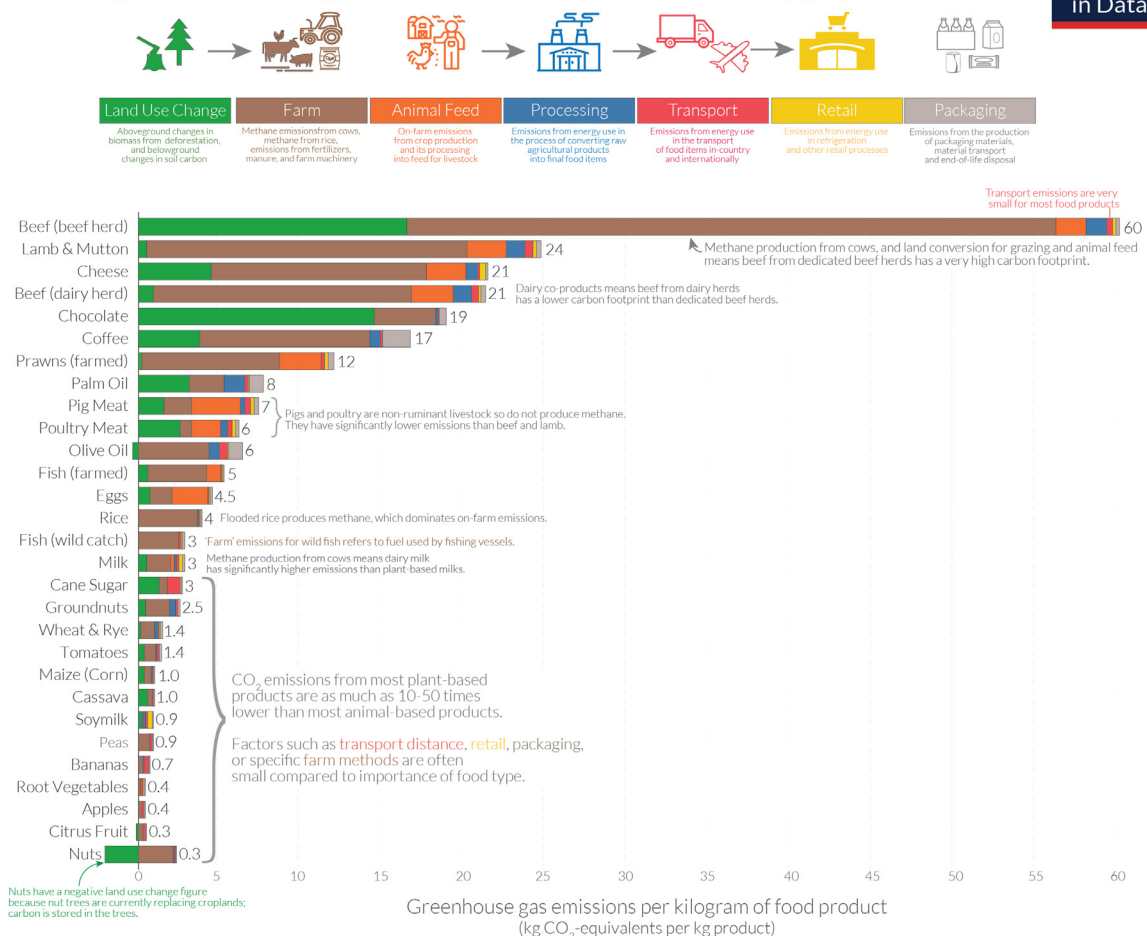
The High CO2 Emission Impact of Traditional Coffee

Traditional coffee production generates a substantial carbon footprint. When measured in CO2 emissions per kilogram, coffee even indicates a higher environmental footprint than conventionally farmed meats like lamb or chicken with **17kg of CO2 emissions per kilo coffee**. Strong emission drivers are mostly the cultivation/harvesting as well as the brewing extraction itself (watering and energy usage). As indicated, expanding the coffee cultivation leads to deforestation and large-scale monoculture farming which enhances soil degradation and biodiversity loss. Modernized farming practices, including sun-exposed fields, intensive irrigation, and the use of nitrous oxide-emitting fertilizers, further contribute

significantly to coffee's carbon footprint. Another practice heavily impacting the footprint of your daily cup is the addition of regular cow milk which doubles the overall footprint. Contrary to common belief, Coffee pods (e.g. aluminum) do not have a larger footprint as they mostly use less amount of coffee beans and packaging only accounts for a fraction of total emissions, but recycling of these materials of course remain a focus.

Food: greenhouse gas emissions across the supply chain

Our World in Data

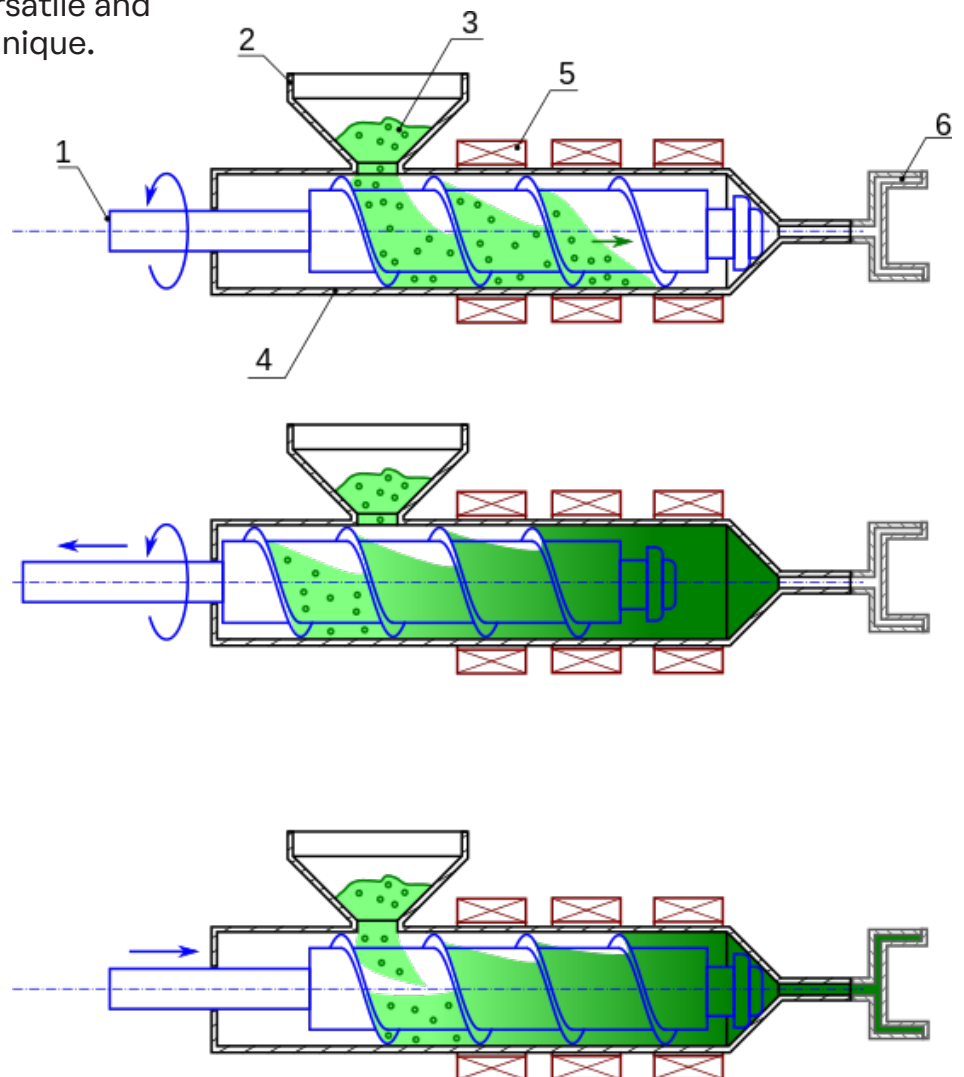


Note: Greenhouse gas emissions are given as global average values based on data across 38,700 commercially viable farms in 119 countries. Data source: Poore and Nemecek (2018). Reducing food's environmental impacts through producers and consumers. Science. Images sourced from the Noun Project. OurWorldinData.org - Research and data to make progress against the world's largest problems. Licensed under CC-BY by the author Hannah Ritchie.

Aroma Engineering Startups: Crafting Coffee with Extrusion Technology

Aroma engineering startups are emerging as transformative solutions in this space. By redefining coffee production through pioneering methods, they aim to offer a coffee experience without the carbon-intensive cultivation and processing methods used in traditional coffee farming, but the same taste. These innovators leverage local non-tropical natural ingredients and established food production processes, such as extrusion technology, to replicate the taste, aroma, and texture of coffee without using coffee beans. Extrusion technology involves forcing a material through a specially designed machine, which shapes it into the desired form before it is cut or cooled to finalize the product. We know this from productions for pasta or cereals. This technology allows for precise control over the shape, texture, and consistency of the final product, making it a versatile and widely used manufacturing technique.

By employing extrusion and the **Maillard reaction** (a chemical reaction between amino acids and reducing sugars that occurs during cooking or heating), novel flavor profiles are created while significantly reducing water usage, land utilization, and CO2 emissions. First startups in this space report numbers such as a CO2 emissions of only **2kg per kilogram coffee** as well as 95% reduced water usage and 66% less land use. This is a significant milestone and has the potential to decarbonize the industry which is currently accounting for at least 1% of global GHG emissions.





A Glimpse into the Future

Aroma Engineering startups are working on optimizing roasting methods and addressing emission sources in their research. They represent a significant step towards a more sustainable and innovative future for coffee. Other coffee alternatives startups aim to revolutionize coffee production through cutting-edge technologies like precision fermentation and cell cultivation. However, while these technologies hold promise, they face hurdles in terms of regulation, costs, and consumer acceptance.

These ventures herald a new era where the rich aroma and taste of coffee can be enjoyed without compromising the planet's well-being. The goal now is to create a product that can compete with traditional coffee flavours and does not diminish the experience.

Sources:

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