



FAST FORWARD TO THE BIO-ECONOMY



Technological innovations have driven unprecedented social and economic progress, enabled industries, improved health and empowered communities. A part of this progress has undisputably been possible because of fossil fuels. They paved the way for the Industrial Revolution 300 years ago and, since then, fossil fuels have been the world's number one energy currency. But where to next? Patrick van Leeuwen reports.



If you thought fossil fuels only powered your car and home, you're in for a surprise. Fertilisers, chemicals and medicine all contain fossil fuels. But because of growing concerns around the impacts of climate change scenarios like Peak Oil – an assertion that we're almost out of it – coupled with a projected explosion in world population and growing food and energy demand, fossil fuels are no longer seen as part of the long-term solution.

Biotechnology (industrial, agricultural, and pharmaceutical) is possibly the 'fossil fuel' of the 21st century, one that could trigger progress on the same scale as that of the Industrial Revolution. The major economies – Brazil, Europe, US, and China – are already competing for market dominance. Brazil's ambition is to cash in on its status as the renewable energy pioneer and take front stage as the first real bio-economy. Meanwhile Europe, the US and China are competing to reach what the sector refers to as the commercialisation stage of advanced bio-refineries – basically, moving bio-economy products out of labs and into consumers' hands. These refineries are at the heart of any bio-economy and certainly at the heart of a post-fossil fuel society.

The environmental case for the bio-economy is straightforward. If you take fossil fuels out of the current energy equation you solve everyone's carbon emission problem. The good news is that this is not an activist's utopia. It is already taking place, albeit at a relatively small scale across the world. Fossil fuels can be substituted by bio-based products or raw materials such as agriculture and forestry residues – things like straw and wood chips – or even household waste which can then be 'magically' converted by advanced bio-refineries into ethanol, a fuel. This bio-ethanol can then be used for multiple purposes such as for transport fuels, the making of materials and chemicals such as diapers, plastics, shoes, tyres and medicine. And one thing that fossil fuel refineries cannot do and that bio-refineries can, is to make feed and food for livestock from side-products resulting from the bio-refining process. Basically you make something useful out of something that otherwise would have been waste. Our ecosystem is a closed loop so we might as well make it profitable and sustainable. The encouraging bit is that businesses and governments are making investments in these types of green innovations as you're reading this piece.

But for whose benefit? The industry's or the planet's? Arguably, given the current economic situation, this and any other lucrative notion is a good idea. If it can generate jobs, drive growth and ease impacts of what's

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unequivocally both no one's and everyone's fault, why not? A recent Bloomberg *New Energy Finance Report* estimates that \$4.4 trillion and 7.1 million jobs are up for grabs for the first movers in this industry. The European Union (EU) bioeconomy strategy 'Innovating for Sustainable Growth' is the way Europe says it's interested; the Obama administration describes its National Bioeconomy Blueprint as 'a major engine for American innovation and economic growth'; and the Chinese Government's \$308.5b investment for the 2011-2015 period on bio-pharmacy, bio-engineering, bio-agriculture and bio-manufacturing should 'combine economic development with improving people's livelihood'.

This is where it starts to sound really good – these investments are not simply made for short-term gains. They can genuinely make a difference in the long run, for the benefit of all of us. If we go down this route we may be putting in place the building blocks of a truly sustainable economy that is healthy for both people and the environment. And, throwing in some money in the mix, it will make governments happy too.

If you take a closer look at what the bio-economy could do for certain countries, it's fairly compelling. The Bloomberg report has estimated that if countries use 17.5% (a conservative number) of their available agricultural residues to make advanced (or cellulosic) bio-ethanol they could do the following:

- India could displace up to 100% of its gasoline consumption in 2030, achieve a growth potential of \$329b, create close to 1m jobs (man years) and cut CO₂ emissions by 80% in 2030.
- China could displace 37% of its gasoline consumption

in 2030, achieve a growth potential of \$779b, create close to 3m jobs (man years) and cut CO₂ emissions by 29% in 2030.

€ Europe could displace 68% of its gasoline consumption in 2030, achieve a growth potential of \$532b, create over 1m jobs (man years) and cut CO₂ emissions by 54% in 2030.

€ The US could displace up to 16% of its gasoline consumption in 2030, achieve a growth potential of \$663b, create close to 1.5m jobs (man years) and cut CO₂ emissions by 11% in 2030; and

€ Brazil could displace 83% of gasoline consumption in 2030, achieve a growth potential of \$622b, create over 1m jobs (man years) and cut CO₂ emissions by 67% in 2030.

As with all smart ideas, the frontrunners in the race are usually the large economies. The how is no longer the issue, it's when. The stage between research/demonstration to full-scale commercialisation of bio-refineries is critical if this is ever to take off in a meaningful way. According to Novozymes, one of the world's largest industrial bio-technology companies, Europe and China will see their first commercial operations in 2012; the US in early 2013 and Brazil in 2013-2014. Once they go commercial, these bio-refineries will need to produce the volume needed to substitute for fossil fuels. In 2014, Novozymes estimates that the production capacity of cellulosic ethanol is close to 1bℓ. The Bloomberg report claims there is enough bio-based material available to produce more than 350bℓ in 2030.

We may live in difficult times now but there are very exciting days ahead of us. **SG**

The CleanStar Mozambique project

Every day, hundreds of millions of people in the developing world rely on charcoal-burning cookstoves to prepare meals for their families. Most of their homes are poorly ventilated which means that the combination of carcinogens and pollutants in cooking smoke lingers on. This has been found to contribute to underweight births, cancer, respiratory diseases, and increased rates of infant mortality. Research shows that indoor air pollution causes an estimated two million deaths per year and sickens millions more – mostly infants and small children¹. Nearly a third of Africa's 7million km² of forest has already been burned for charcoal², stripping the continent of its vital biodiversity. This greatly contributes to the projected 6.7b tons of greenhouse gasses that household energy use in Africa is expected to emit into the atmosphere by 2050³.

CleanStar Mozambique (CSM) is pioneering a new, sustainable business model that will drastically improve both the environment and livelihoods. Thousands of smallholder farmers in Sofala province will transition from charcoal production and slash-and-burn agriculture to cultivating a diverse range of crops and trees. This will significantly improve their income and nutrition levels, replenish degraded soils and restore biodiversity.

Any surplus food that the farming families do not eat or sell on the local market, they can sell to CSM. The company will operate a local food and ethanol cooking fuel production facility and produce a range of food products as well as an ethanol-based cooking fuel made from locally-grown cassava. These products, as well as clean-burning ethanol cookstoves, will be sold into urban markets.

CSM's goal is to create long-term economic, social and enviro-value at every point along its value chain. It will focus on helping improve nutrition and increase incomes by at least 300% for rural smallholders, while planting millions of trees and enhancing biodiversity in Sofala province. This

is also expected to greatly contribute to cleaner air in Maputo, and lower energy costs. By transitioning from charcoal to ethanol, CSM expects to see a reverse in deforestation. By 2014 it is expected that the venture will involve 2000 smallholders over 10000 acres (4000ha), supply 20% of Maputo households with a clean and cheaper alternative to charcoal, and so, protect 9000 acres of indigenous forests per year. The company will also employ approximately 1000 people in Mozambique. From a commercial standpoint, CSM is replicable and scalable across large parts of the developing world. Projects like this can help create new, sustainable, bio-based markets.

The partners

Novozymes and CleanStar Ventures have jointly founded CSM. Novozymes provides enzymatic and microbial solutions to many industries, including food, agriculture and biofuel. CleanStar Ventures is an environmental venture development group with particular expertise in agroforestry and biofuels. Novozymes and CleanStar Ventures have also joined forces with ICM (US-based world leader in ethanol production plants), Dometic (Sweden-based business that produces the world's leading ethanol cookstove), and Bank of America Merrill Lynch (world leader in carbon finance). The day-to-day management team leading CSM has decades of experience in agriculture, bio-processing and business development, including many previous projects in Sub-Saharan Africa.

www.cleanstarmozambique.com

¹ *Biomass Fuels and Respiratory Diseases: A Review of the Evidence* (<http://pats.atsjournals.org/cgi/content/full/5/5/577>)

² Africa's burning charcoal problem (<http://news.bbc.co.uk/2/hi/africa/8272603.stm>)

³ Impacts of Biomass and Petroleum Energy Futures in Africa (www.caei.com.ar/es/programas/africa/05.pdf)