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FEATURES

The new biomassers and their assault on livelihoods

Jim Thomas

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Watch out for the new biomass economy driven by large biotech, chemical, forestry and agribusiness companies, says Jim Thomas. The new biomassers are on a global looting spree of the world's natural resources to feed the consumption and capital accumulation of the industrialised North.

Around the world, corporate and government strategies concerning climate change, energy, agriculture, technology and materials production are increasingly converging around one telling term: biomass.

Biomass encompasses over 230 billion tonnes of living things [1] that the earth produces every year such as trees, bushes, grasses, algae, crops and microbes. This annual bounty, known as the earth's 'primary production', is most abundantly found in the global South - in tropical oceans, forests and fast growing grasslands. It sustains the livelihoods, cultures and basic needs of most of the world's inhabitants. So far, human beings use only one quarter of land-based biomass for basic needs and industrial production, and hardly any oceanic biomass, leaving over 90 per cent of the planet's full biomass production still yet to be commoditised by industrial society.

But now, thanks to technological changes, particularly in the fields of nanotechnology and synthetic biology, this stock of annual biomass is being targeted by industry as a source of living 'green' carbon to replace or supplement the supplies of 'black' fossil carbons of oil, coal and gas that currently underpin northern industrial economies. From generating electricity to producing fuels, fertilisers and chemicals, shifts are already underway to purportedly elevate the importance of biomass as a critical component in the global industrial economy.

However, what is usually presented as a benign and beneficial switch from black carbon to green carbon is in fact a red hot resource grab (from South to North) in an attempt to capture biomass as a new source of wealth. Plundering the biomass of the South to cheaply run the industrial economies of the North is a deeply unjust aspect of 21st century imperialism that will almost certainly deepen inequality, and exacerbate poverty, hunger, disease and other social problems. Liquidating fragile ecosystems for their carbon and sugar stocks is also a suicidal move on an already overstressed planet. Far from embracing the false promises of a new clean and green bio-economy, we should be extremely wary of the new biomassers and their inflated claims as they launch their latest assault on land, livelihoods and our living world.

Here comes the bio-economy.

It is now over two years since a sharp escalation in food prices created a crisis that broke into front-page headlines around the world. Suddenly, 'bio-fuels' was a topic of intense controversy and opposition among rural communities, particularly in the global South. The headlines at the time that focused on industry's enthusiasm for palm oil and corn ethanol were actually only the visible tip of a much deeper transition and trajectory in industrial policy that is still gaining momentum. That new trajectory, variously called the 'new bio-economy' or the bio-based economy, is gathering speed, political clout and many billions of dollars in public subsidies and private investment. Whether it delivers on its promises, the payload of the bio-economy carries even more threat to people, livelihoods and life on the planet than that portended by the ethanol rush.

Bio-economy describes the idea of an industrial order that relies on biological materials, processes and services. Since many existing parts of the global economy are already biologically based (agriculture, fishing, forestry), proponents often talk of a 'new bio-economy' to describe their particular re-invention of the global economy - one that more closely enmeshes neoliberal economies and financing mechanisms with new biological technologies and modes of production.

The rhetoric of the 'new' bio-economy, however imprecise, is woven throughout current agendas and headlines, wrapped in the post-millennial buzzwords of the 'green economy', 'clean tech' and 'clean development' that permeate environmental, industrial and development policies. When described in these contexts the new bio-economy appears positively: 'clean', 'green', 'fair', 'profitable', 'modern' and 'renewable'.

But an assault on older 'bio-based' economies is hiding in the rhetoric. Standing in the way of a new bio-economy are the billions of people who have preexisting claims on the land and coastal waters where biomass grows. Their knowledge systems are interdependent with a complex array of organisms that sustain us all: the biomass that has nurtured and been nurtured through millennia. Such communities co-exist in a traditional bio-economy, using seeds for food production, firewood and animals for energy, and harnessing local biodiversity for material and medicinal needs.


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Indeed, those diverse biological organisms that are now recast as 'biomass' are not merely an inert resource for livelihoods and survival, but are interdependent with the communities that nurture them. To those who have found themselves on the receiving end of new industrial waves before, the story of a new bio-economy is all too familiar. It is yet another heist on the commons that will displace them and destroy their homes and livelihoods. Despite promises of 'development', human progress, and environmental rescue, the 'new' bio-economy is in fact another strategy to advance the corporate interests of the North.

The new bio-economy as currently planned by forestry, agribusiness biotech, and energy and chemical firms furthers the ongoing transformation and enclosure of the natural world by appropriating plant matter for transformation into industrial commodities so they perform as industrial factories, and redefining and refitting ecosystems as if they were just another set of industrial support 'services'.

The same transnational companies who fostered dependence on the petroleum economy during the 20th century are now establishing themselves as the new biomassers. If that coup is completed, many familiar corporate players will still be sitting at the head of the global economic order. But whether their cars run on biofuel, their computers run on bioelectricity and their credit cards are made of bioplastic, they will still have achieved a controlling clutch on the natural systems upon which we all depend.

What is being switched?

'Many think of biomass mainly as a source for liquid fuel products such as ethanol and biodiesel. But biomass can also be converted to a multitude of products we use every day. In fact, there are very few products that are made today from a petroleum base, including paints, inks, adhesives, plastics and other value-added products, that cannot be produced from biomass.' - David K. Graman, US acting under-secretary to energy, science and environment for George W. Bush. [2]

A simple way to understand the ambition of the new biomass economy is to glance at a list of products and services currently being produced with fossil fuels. Then, imagine each sector switching its feedstock from fossilised to living plant matter.

Transport fuels: Currently an estimated 70 per cent of petroleum ends up as liquid fuels for cars, trucks, airplanes and heating. Biofuels such as ethanol and biodiesel mark just the beginning of converting the liquid fuel market to biomass. A next generation of hydrocarbon biofuels directly mimics gasoline and jet fuel.

Electricity: Coal, natural gas and petroleum are currently responsible for 67 per cent of global electricity production (International Energy Agency, Key World Energy Statistics, 2008). However, co-firing of coal with biomass is on the increase and there is a growing move in many industrial cities to burn woodchips, vegetable oils and municipal waste as the fuel for electricity production. Meanwhile, corporate interests are investigating ways to use nano cellulose and synthetic bacteria to make electric current from living cells, turning biomass to electricity without the need for turbines.

Chemicals and plastics: Currently around 10 per cent of global petroleum reserves are converted into plastics and petrochemicals. However, to hedge against rising petroleum prices, large chemical companies such as Du Pont are setting ambitious targets to switch to supposedly 'renewable' biomass feedstocks such as sugar for the production of bioplastics, textiles, fine and bulk chemicals.

Fertiliser: Global fertiliser production via the Haber Bosch process is an intensive user of natural gas. Proponents of biochar (carbonised biomass) claim that they have a bio-based replacement for improving soil fertility that could be produced on an industrial scale.

What is biomass?

Strictly speaking, biomass is a measure of weight used in the science of ecology. It refers to the total mass of all living things (organic matter) found in a particular location.[3] Fish, trees, animals, bacteria and even humans are all biomass. However, more recently, the term is shorthand for non-fossilised biological material, particularly plant material that can be used as a feedstock for fuel or for industrial chemical production.[4]

According to the US National Renewable Energy Laboratory, 'Biomass includes organic matter available on a renewable basis. Biomass includes forest and mill residues, agricultural crops, and wastes, wood and wood wastes, vegetable oils, animal wastes, livestock operation residues, aquatic plants, fast growing trees and plants, and municipal and industrial waste.'

On closer examination, the latter includes tires, sewage sludge, plastics, treated lumber, painted construction materials and demolition debris. Even industrial animal manures, offal from slaughterhouse operations, incinerated cows and landfill gases all seem to fit the bill for biomass.

Plants have been a source of fuel and material production for millennia but the new use of the term 'biomass' marks a specific industrial shift in humanity's relationship with plants. Unlike the term 'plants', which opens to a diverse taxonomic world of various species and multiple varieties, the term biomass treats all organic matter as though it were the same undifferentiated 'plant-stuff', a particularly industrial view of life. Recast as biomass, plants are semantically reduced to their common denominators so that, for example, grasslands and forests are redefined commercially as sources of cellulose and carbon. In this way, biomass operates as a profoundly reductionist and anti-ecological term, treating plant matter as though it were a homogenous bulk commodity. The use of the term biomass to describe living stuff is often a red flag that industrial interests are at play.

Cellulose - the wonder sugar

If you were to scrape off the thin layer of living material on earth and boil it down to its basic chemicals, most of what you would get is one green sugar called cellulose. It is found in all plants as well as some microbes as long chains of

victim/heroine to present their experiences of resistance in full complexity: they are at the forward edge of the tide of women's empowerment that, at the start of the 21st century, is moving across the African continent.

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glucose in a fibrous or occasionally crystalline structure.[4] This common molecular component is rapidly becoming the darling of industrial attention for four reasons.

Abundance: The earth makes about 180 billion tonnes of cellulose every year.

Energy: Cellulose is the principle source of energy for animal nutrition and for heat when plant materials are burned.

Flexibility: Many of the early plastics were based on plant cellulose, which has the chemical advantage that it can be modified and used in many different ways to produce new polymers, coatings, oils and combustibles.[5] Recent work has also shown that cellulose nano fibres can be modified to exhibit previously unknown properties.[6]

Cellulose is not (necessarily) food: Vegetables and grains have a large cellulose component. And so do the non-food components of plants. Biofuel proponents argue that the cellulose found in plant stalks and leaves can be appropriated for industrial use while leaving the fruit or grains in the food supply.

But while cellulose is theoretically abundant, one significant obstacle to its industrial exploitation has been the difficulty of separating it from other plant components. In most instances cellulose is bound into a matrix of compounds known as lignocellulose, which in turn is composed of lignin (a hard, carbon-rich substance) and hemicellulose (a mixture of other sugars).

Breaking cellulose away from lignin and reducing it to simpler sugars requires either an intense heat process or the application of strong chemicals or enzymes, such as are found in the guts of cows and termites. The task of industrially separating cellulose has now become one of the most active areas of research in energy and materials science. [7]

Getting elemental: 'It's the carbon, stupid.'

In an era of increasingly constrained oil supply, commercial excitement about biomass components such as cellulose can be explained by the industrial hunt for new 'unconventional' sources of carbon. Accounting of global carbon reserves by energy companies such as BP reveals that the billions of tonnes of carbon locked up in global biomass stocks far outstrips known oil and natural gas reserves and rivals coal deposits. Global stocks of carbon in all fossil fuels are 818 billion tonnes while global biomass holds about 560 billion tonnes.

Getting geopolitical: It's all in the South

'If you look at a picture of the globe... it's pretty easy to see where the green parts are, and those are the places where one would perhaps optimally grow feedstocks.'
- Steve Koonin, US department of energy under-secretary for science and former head of research for BP. [8]

While from space the planet may look green and rich with biomass, the dirty little secret of the coming biomass economy is that, just like the fossil carbon reserves of oil and gas, the living carbon reserves of global biomass aren't equally distributed. Worldwide, land-based vegetation stores an estimated 500 billion tonnes of carbon. However 86 per cent of that (430 billion tonnes) is stored in the tropics and sub-tropics, while boreal and temperate eco-regions store only 34 billion tonnes and 33 billion tonnes, respectively. Correspondingly it is in the tropics where biomass also replenishes the most quickly, and where marine biomass, principally phytoplankton, is most productive. Exercising control over this global biomass therefore requires gaining ownership or political control over land and seas in the tropics.

From cracking oil to hacking plants

When advocates of the biomass economy talk of a switch from a (fossil based) hydrocarbon economy to a (plant based) carbohydrate economy they like to point out that we have been there before. Chemically speaking, the difference between a hydrocarbon and a carbohydrate comes down to a few oxygen atoms. Carbohydrates are sugars of carbon, hydrogen and oxygen. A hydrocarbon by contrast is any molecule composed of only hydrogen and carbon and is classified as a mineral.

Historically, and still in local and indigenous communities today, it is plant carbohydrates that hold the upper hand in meeting human needs. As recently as 1820, Americans used two tonnes of vegetables for every ton of minerals as the raw material for dyes, chemicals, paints, inks, solvents and even energy. By 1920 that ratio had reversed, and by the mid 1970s Americans were consuming eight tonnes of minerals for every ton of plant carbohydrate.[9] Enabling that last switch were two factors:

* The higher energy density of fossil fuels. Half a tonne of coal contains the same amount of energy as two tonnes of green wood, and so coal, and later petroleum, took over as the preferred fuel for the industrial revolution.[10]

* The success of petro-chemistry. The first synthetic chemists learned to transform coal tar into profitable dyes and, eventually, to 'crack' petroleum into many molecules which could be refined into fuels, waxes, explosives, pesticides, plastics, paint, pharmaceuticals, cosmetics, textiles, rubber, gasoline, asphalt and much more.[11]

Today, however, worries over peak oil and volatile markets, interest in the money-making potential of carbon markets and the development of new technologies are all helping to drive a switch back. In particular, just as 19th century developments in synthetic chemistry made possible the hydrocarbon economy, so innovation in synthetic biology today is allowing companies to retrofit that economy for carbohydrate feedstocks.

Selling the Switch

ETC Group's analysis suggests that what is really driving investment in the new bioeconomy is good old capitalist opportunism. Nonetheless, advocates of the

biomass economy have plenty of new clothes with which to dress up their old-style imperialist leanings. Below are just a few of the agendas commonly used to justify the new grab on biomass.

1. Sugar dreams: the carbohydrate economy

The term 'carbohydrate economy' was originally coined by activists from the Institute for Local Self Reliance (ILSR) in the US and describes a vision of making chemicals and industrial materials from plant materials instead of petroleum.[12] Their interest in bio-based (that is, plant based) materials is driven by the hope that such materials can be designed to more easily biodegrade in the environment, unlike petroleum-based plastics.

2. Green dreams: renewable resources and the hydrogen economy

Biomass has consistently been included in descriptions and definitions of what constitutes a renewable resource as plants and trees can theoretically grow back after harvest. Biomass is also occasionally included as a form of solar energy since plants harvest energy from the sun. Biomass is also regarded as a key resource for developing another 'green' vision, the notion of a 'hydrogen economy', as hydrogen can also be extracted from plants.

3. Cool dreams: the carbon neutral economy

The contemporary urgency to address the problem of human-induced climate change has put biomass at the centre. Because plants sequester carbon dioxide from the atmosphere, policymakers have regarded plant matter as a 'carbon neutral' feedstock for energy production, arguing that any emissions released in bio-energy production are re-sequestered when replanting. In 2005, The International Energy Authority (IEA) reckoned that biomass-derived energy represented 78 per cent of global 'renewable' energy production.

4. Patriot dreams: energy independence

In America at least, the idea of a home-grown bioeconomy as a patriotic bulwark against terrorism and oil wars has enormous power. By reducing dependence on foreign oil, biofuels and bioplastics are thought to strengthen national sovereignty while withdrawing funds from extremist petro-states. This notion cuts across political lines, tapping into anti-war sentiment on the left and jingoism and security fears on the right.

5. Leapfrog dreams: clean development and the 'green jobs' movement

How can you help poorer economies 'develop' while avoiding dirty industrial development? That's the supposed paradox that advocates of 'environmental leapfrogging' set out to square by using new technologies to create cleaner, greener development. Meanwhile, a recent 'green jobs' movement in the industrial North argues that the green technologies of the bioeconomy are perfect fodder for rescuing their stagnating industrial workforce.

6. Geek dreams: converging technologies and 'cleantech'

'Converging technologies' refers to the way in which seemingly distinct technological fields such as nanotechnology, biotechnology and robotics combine to create a powerful hybrid technology platform. In European science policy circles it is proposed that converging technologies could be directed to 'sustainability' applications such as bioenergy and 'climate technologies' to drive economic growth.[13] Senior scientists and venture capitalists in the US have dubbed this next profitable wave of environmental technologies 'clean tech' - a multi-billion dollar investment category that covers biofuels, bioenergy, bioplastics, and most bio-based materials in general, as well as the underlying enabling technologies such as synthetic biology and nanotechnology.

A grab not a switch

Attributing the recent rise of the bioeconomy and burgeoning interest in biomass to simply green-minded or patriotic consciousness is to wrongly assume that the captains of large corporations and OECD economies are driven by humanitarian or environmental concerns. As with any previous industrial transition, what is behind the dash to biomass is not high ideals but the calculated interest of the corporate bottom line. Hidden in the woolly promises of 'carbon neutrality' and 'energy independence' is the lucrative promise of a vast new resource grab, as hundreds of billions of tonnes of undifferentiated plant matter become a new commodity. Far from transforming to a new economy, the biomass transition is simply a retooling of the same old economy of production, consumption, capital accumulation, and exploitation - with a new source of carbon that is being plundered to keep the industrial machines going.

In economic terms, the effect of turning cellulose and other sugars into a viable feedstock for fuels, chemicals and electricity is to imbue previously worthless grasses, seaweed and branches with a new commercial value. More significantly, any land or water body that can sustain plants acquires an enhanced value as a potential source of biomass, a fact that is already accelerating the global land grab that was originally undertaken to secure food supplies. If the biomass coup is successful, then the technologies of biomass transformation (particularly nanotech, biotech and synthetic biology) become valuable keys to extracting that new source of value, elevating the industries that control them.

With biomass touted as the new feedstock of a global post-petroleum economy, it is essential to ask the question: Does sufficient biomass even exist on the planet to achieve such an historic transition? At the historical point when global society last relied on plant matter as the primary source for its energy needs (in the late 1890's) world consumption of energy is estimated to have been 600 GigaWatts.[14] Today's estimates of world energy consumption range between 12 and 16 terrawatts - at least a twenty fold increase in demand over the previous biomass economy. Today that energy output is met almost entirely from fossil fuels, with a sliver of nuclear and hydro and biomass power in the mix (around 1.5 terrawatts).[15] According to MIT energy economist Daniel Nocera, global energy use is further projected to grow an extra 19 terrawatts by 2050.[16]

A review of 16 global assessments of biomass availability notes: 'In the most optimistic scenarios, bioenergy could provide more than two times the current global energy demand, without competing with food production, forest protection efforts and biodiversity. In the least favorable scenarios, however, bioenergy could supply only a fraction of current energy use, perhaps even less than it provides today.'

Why such a huge range of estimates? The short answer is that some energy economists have simply failed to see the forest for the trees. Living biomass stocks cannot be counted in the same manner as fossilised oil and coal reserves. The economic value of harvested plants as industrial raw materials for food, feed, fibre, chemicals and fuel must be weighed against the vital ecological value of living plants as the foundation of all (rapidly deteriorating) ecosystems upon which our existence depends.

Indeed, when taking into consideration the absolutely critical need to preserve and even restore and enhance (plant-based) ecosystems, the job of budgeting all global biomass takes on a whole different character and the notion that there is any spare biomass whatsoever quickly falls apart.

Earth systems studies that attempt to measure the current health and resiliency of ecosystems and biodiversity offer stark warnings. The 2005 Millenium Ecosystem Assessment concluded that 60 per cent of the world's ecosystems are already in decline. The 'Living Planet Index', a measure of trends in biodiversity based on tracking 1,313 terrestrial, marine and freshwater species, reports that between 1970 and 2003, the index dropped 30 per cent, meaning ecosystems are generally in steep decline. The World Conservation Union has reported that overall, nearly 40 per cent of species evaluated are threatened with extinction. Current extinction rates are now over 1,000 times higher than background rates typical over the earth's history. Land use change, including deforestation and agricultural expansion, is regarded as the leading cause. Meanwhile it is estimated that at least a further 10 to 20 per cent of remaining forest and grassland will be converted to human uses by 2050. In addition, the UN estimates that two thirds of the countries in the world are affected by soil desertification, affecting more than four billion hectares of agricultural land, which supports over a billion people.

Especially telling are the metrics from another measure, called the Ecological Footprint, developed by the Global Footprint Network.[17] This measures human (over)use of the earth's biocapacity. The term 'biocapacity' measures the amount of cropland, pasture, forest and fisheries that is sustainably available for human use after accounting for what nature requires for ecological resilience. Overuse of biocapacity damages ecosystems and drives them into decline. It turns out that since the late 1980's, we have been in 'earth overshoot' with an industrial footprint larger than biocapacity. In fact since around 2003 we have reached a shocking 25 per cent overshoot, 'turning resources into waste faster than nature can turn waste back into resources'. If we keep it up, on current trajectory, we will be using twice the earth's biocapacity by 2050 - an untenable proposition.

As industrial policies associated with the biomass economy press on, conservationists are fearing disastrous outcomes. For example in the Amazon Basin, expansion of sugar cane and soya (in part for biofuels), is driving deforestation to the point where a massive dieback is considered likely. [18] The potential impact of such an Amazon dieback would be a global catastrophe since this forest regulates rainfall and weather patterns over much of South America up through the US Midwest and even as far as South Africa.[19]

What such possibly rapid dramatic impacts tell us is that measurement of ecosystem 'services' and biocapacity, while useful warnings, give us an incomplete picture of the real limits to biomass extraction, providing an unrealistically linear view of how ecosystems function and how they can collapse. Just as the threat of an Amazon dieback can not be measured from a global 'biocapacity' index so there are likely many ecological 'tipping points' which once crossed could push ecosystem resilience into collapse with devastating non-linear effects. We may never see some of these tipping points coming until it is too late.

It is no coincidence that the most dogged proponents of the biomass economy in the past decade have not been environmental NGOs, but large biotech, chemical, forestry and agribusiness companies who hope to expand and consolidate their economic power. These new 'biomassters' are executing a large scale grab on plants, land and livelihoods, making the biomass economy only the latest version of resource extraction from the global South to feed the consumption and capital accumulation of the industrialised North - at the expense of the lives and livelihoods of the majority of the Earth's people, and the future of life itself on the planet.

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[Biobased Chemicals Forum](http://www.gtcbio.com/Biobased) www.gtcbio.com/Biobased

Cutting Edge Research&Development Network and Learn from Peers

[Energy Saving Solutions](http://www.lontech.dk) www.lontech.dk

Automate and Track your Company's Energy Consumption to Save Money