Investing in industrial biotechnology: where is the value? US and global business clusters and investments trends

Paolo Barbanti
Pharma & Biotech Advisors srl

A global economy requires biotech companies to move even faster in relation to the changing environment in which they operate. To achieve a full development potential, companies must be market savvy, make the optimal strategic alliance and maximise every market opportunity.

Today, industrial biotechnology is a very dynamic field and reflects the convergence of several fields of science, technology and engineering. While some components are very old (fermentation), the thinking around and application of the bioeconomy needs are new and still developing. Hence there are many possible interpretations on how industrial biotechnologies (for instance bioprocessing, bioenergy and environmental applications) could have significant impacts on the global economy, international relationships among different countries and individual lives.

Industrial biotechnology is expected to be a fundamental driver of changes in agriculture and health technologies. A number of benefits are expected to arise from these changes, for instance through creating new opportunities for industrial uses of plants and providing technologies to manufacture “lab on a chip” diagnostic tools for personalised medicine. From the bench to the market: industrial biotechnology is the application of modern molecular biology techniques for the improvement of industrial processes for manufacturing commodities such as chemicals, pharmaceuticals and biofuels.

Developments and advancements in genetic engineering to modify or transfer specific genes from one organism to another have enabled biotechnology to become more efficient and applicable to a broad array of commercial markets. Industrial biotechnology, also known as White Biotechnology, in fact is the use of bio-products in industrial products which are usually made from petroleum-based products such as fuel, polymers and petrochemicals, bulk chemicals and specialty chemicals. It can also be defined as the application of biotechnology for the processing and production of chemicals, materials and fuels. The development of a whole new mindset based on green chemistry, the utilisation of bio - based chemical processes, makes up the fundamental aspect and drive for industrial biotechnology. It takes into account the natural diversity of organisms available in soils, forests and oceans, and the discovery of new genes, metabolic pathways, and enzymes that can directly substitute non-biological chemical compounds. As you know, industrial biotechnology will play a critical role in efforts to address global warming and climate change. Actually rising oil and natural gas prices have created tension globally, creating concern that their continued increase may disrupt economies and create political vulnerability. Furthermore, supply

fluctuation, consumer activism, gas emission and greenhouse gas taxes have also resulted in many countries no longer wanting to be dependent on oil - based and chemical - based raw materials and are now looking positively at industrial biotechnology as an alternative and important avenue for solving their problems. Not as established as the healthcare (the first wave) and agricolture (the second wave) sectors in the biotechnology industry, industrial biotechnology is often referred to as the third wave of biotechnology.

Energy security remains the main aspect in the global pursuit of Industrial Biotechnology advancements and the amount of money spent on `clean' energy is set to quadruple in the next decade. The spending boom is caused by many factors, including broader recognition of global warming, worldwide government directives, growing interest in energy among corporations and politicians, and an influx of venture capital. These developments have pushed biofuel to be among the most important sub-sectors in Industrial Biotechnology. There are a lot of new scientific and business opportunities: for example, by converting renewable feedstocks instead of fossil fuels into energy fuels, the emission of green house gases that effect climate change may be reduced. In order to make biofuels more economically viable, higher yields of crops used for biofuels will be required, regardless of whether the source is corn, cellulosic or lignin biomass. Leveraging innovative technologies developed by the agricultural industry will be crucial for the advancement of biofuels as the issue of net greenhouse gas emissions continues to be debated. Furthermore, opportunities for efficient and economically feasible bioconversion of bio-based materials into sugars and subsequent fermentation into biofuels are and will become more available as federal and state legislations are adopted and implemented. Environmental biotechnology is the utilization of biological systems for the remediation of contaminated areas and for environmentally-friendly processes, such as the use of microbes for waste treatment or the efficient clean-up of petroleum spills. Also commonly referred to as bioremediation, the utility of microbes to break down or digests waste chemicals into harmless byproducts has distinct advantages over traditional methods of decontamination.

Bioremediation can also be employed for degradation of other hydrocarbons, polymers and plastics, pharmaceuticals, radionuclides and other toxic metals. Certain plants and microbes have been identified that absorbs mercury, lead, and arsenic and could be used to treat industrial waste. Environmental biotechnology offers an opportunity to provide better treatments for solid waste and wastewater. Biotechnology-based treatment systems, from backyard septic tanks to large animal farms, can now be optimized for maximum results while reducing environmental concerns.

Industrial biotechnologies are afterwards also expected to have a critical role in political and economic stability in the 21st century, both in developing and developed countries, and to provide some of the more smart ways to combat man’s impact on the planet. By 2030 industrial biotechnologies and products associated with them will have impacted on most people’s lives and will not be contentious.

Industrial biotechnologies will be associated with increased wealth in developing nations and have driven the emergence of new multinational entities that reflect the merging of manufacturing options.

Today three main areas (North America, Europe and Asia Pacific) are characterized by different players and scientific and business opportunities. Given the spiralling R&D cost globally and new market opportunities, there is a tremendous potential for exploring new dimensions in new geographies.

Roughly 5 percent of chemical sales depend on industrial biotechnology today and that number is estimated to grow to 20 percent by 2011. This rapid growth is recognized by investors. Actually new partnerships, such as combinations of plant biotech, petroleum discovery, chemical, waste management, carbon credit investors, green venture capitalists, will have consolidated. While many of the new start up companies initiated in the first decade or so of the 21st century will have failed or merged, some will have become the new Nokia, Google or Microsoft of industrial biotechnology. In 2007 North American venture capitalists invested a record $4 billion in cleantech - biochemicals were an important driver. However, the field is not without its investment challenges. While many new businesses rely on start up capital before they begin generating revenue, this is especially true for industrial biotech companies that require extensive research and production scale-up before launching commercial production. Due to several factors, the financial system in the U.S. has undergone a serious crisis throughout the late summer and fall of 2008, although some of the fundamental problems took several years to develop. This has impacted and will continue to impact the bioeconomy. Commodity prices have already declined from their unsustainable highs of the spring and summer of 2008. Firms may find credit more difficult to obtain. Another impact of the global economic slowdown is the decline in the price of oil and oil based products such as gasoline. This in turn has affected the ethanol market which as also adversely impacted the price of corn, and other biobased substitutes for oil. The US administration is moving fast in this field and has adopted the stimulation of white/industrial biotechnology as part of its governmental programme and allocated a substantial budget to draft a “road map” to facilitate the development and implementation of the use of this form of biotechnology.

We should simply copy the US policy, instead, Europe and Italy don’t use the rich potential that this continent offers in terms of knowledge, industrial activities and academic research institutes.

Japan takes biotechnology very seriously considering that the old biotechnologies such as fermentation, enzyme production, food additives and fermented foods have played a critical role in Japanese industry over the last century. Japan also has very strong markets for taking up the fruits of the new biotechnologies such as the pharmaceutical industry which is the second largest in the world, a large healthcare sector under strong pressure to reduce costs, a strong food processing industry hungry for new products and growing bioremediation and environmental sectors.

India, instead, is one of the first few countries, among the developing countries, to have recognized the importance of biotechnology as a tool to advance growth of agricultural and health sectors as early as in 1980s. Programmes in the area of biotechnology included, tissue culture application for medicinal and economic plants, fermentation technology and enzyme engineering for chemicals, antibiotics and other medical product development; agricultural and forest residues and wastes utilization. The achievements in biotechnology in India could become possible only because the government took early initiatives for setting up institutional infrastructure for human resource development. As of now more than 62 universities and institutions are engaged in biotechnology training and education related programmes. Efforts are being made to link up human resource development programmes according to industry requirements, and in fact, academic institutions are also being encouraged to work in close tandem with industry.

And what about China? The increasing use of industrial biotechnology by the Chinese liquid biofuels and chemical industries is expected to help offset energy security and environmental concerns generated by China’s robust economic growth. The expanding

use of bioprocesses to produce products such as fuel ethanol and bioplastics is also likely to contribute to continued innovation, productivity gains, and cost savings. This, combined with strong government promotion of the country's bio-based economy, coincides with the two industries' growing global prominence. China is currently the world's third largest producer of ethanol and second largest producer of chemicals. This growth has encouraged expanded domestic and foreign investment, including in bio-based projects, and generated related gains in exports, particularly in the chemical industry. Market conditions facing many ongoing and prospective ventures, however, are changing as a result of a combination of factors, including the strength of the Chinese currency, new labor regulations, tax changes, and volatile energy prices.

The rapid economic development in many developing countries, especially in South East Asian countries, has demonstrated that national technological capability remains a key factor in competitiveness. As you know, in the future, wealth creation could be closely tied to life sciences, much as it is currently tied to digits. If you think this sounds exaggerated, ask someone who lived in the early 1970s whether people thought India, China, South Korea, Singapore, Taiwan and Malaysia would be centers of technology and new wealth. A few bold digital geeks argued computers would revolutionize not just how information is gathered and disseminated, but almost every business on the planet and more than a few countries. Over the past few decades, most new jobs, wealth, and growth were created in the knowledge and digital realm, therefore today "*the playground is changed*". There are many competitors in this new global race. What started out as an obscure subspecialty primarily of interest to the pharmaceuticals industry, has now spread to agriculture, chemicals and energy. Life sciences are a key component of many national development plans, for instance Singapore considers life sciences a vital part of its development strategy and invests hundreds of thousands of US dollars in each of its graduate students and Malaysia continues investing in training, manufacturing and R & D thanks to a national program and a commitment shared and supported by national authorities, entrepreneurs and public stakeholders.

Singapore and Malaysia are becoming a source of interesting intellectual property business opportunities as well as a place for establishing subsidiaries of European companies and doing world class research on the frontline of innovation. To boost their growing biotech industry strengths, local governments and companies have concentrated on specific areas because with an increasing global competion public authorities are well aware that their cost advantage could have a limited window. To survive in the long term they have moved upstream to higher-value added activities, where there are not longer competition on cost, developing an homegrown biotech sector with a domestic pipeline of products, technologies and services.

Singapore's vision is to be the Biopolis of Asia, an international biomedical hub for life sciences and actually continues to strenghten its position as a manufacturing and research & development base for global biopharmaceuticals companies. Besides Singapore launched a lot of initiatives (for instance A*Star) in order to assist local scientists and clinicians in commercializing their research by providing funding, infrastructure support and linking with potential commercial partners. This taps the significant commercialization potential of universities, hospitals and research institutes attracting scientists and talents. To fostering these efforts, scholarships are available for Singaporeans to pursue Ph.D. studies in top research universities overseas. Today Singapore is already building world-class capabilities across the entire value chain from drug discovery and clinical research to manufacturing and delivery.

The Malaysian government has made biotechnology a high priority as an engine of economic growth with the launch of a 15 year National Biotechnology Policy (NBP) in

2005. In fact, while Malaysia face a strong competition from other Asian countries, it is trying to leverage strengths as its biodiversity and its ICT industry. The National Biotechnology Policy (NBP) details a framework that envisions biotechnology to become a new economic engine for Malaysia by ultimately enhancing the nation's prosperity and well-being. A main part of this strategy is the establishment of the Malaysian Biotechnology Corporation (BiotechCorp) as a dedicated and professional one-stop agency with the main objective of developing the country's biotechnology industry. Another equally important aspect of the NBP is the identification of three key biotechnology thrust areas as healthcare, agriculture and industrial biotechnology. Like in most other developing countries, industrial biotechnology is in its infancy stage. As outlined in the NBP, BiotechCorp has various strategies to promote the overall development of Industrial Biotechnology. It has identified biofuel, enzyme, biopolymer, fine & specialty chemicals, and bioremediation as the sub-sectors that the country should be focusing on. With its well-established commodity market, Malaysia's current focus revolves around the production of palm oil and palm kernel oil products, as well as downstream processing of fine chemicals and enzymes. Currently, Malaysia's biofuel efforts are concentrated on biodiesel, where it is used in most transport and non-transport applications. Malaysia is the second largest producer and the largest exporter of palm oil in the world, accounting for 30% of the world's traded edible oils & fats supply.The NBP has an ambitious target of developing a world class industry and has several core initiatives including: developing human capital through education and training overseas, providing funding and support through the entire R&D cycle, acquiring technology to help local industry and providing significant incentives to attract foreign and domestic investment to the industry with tax exemptions and deduction for qualifying R&D expenditures. Today, although Malaysia is still in the early stages of its 15-year biotech plan, the country is investing in the industry finding an important role and making progress for her economy.

As we can see, with the anticipated rise of emerging countries in this century come the changing “bio-isolation” of Asia from the Europe and United States and the growth of the Asian biotech sector in the recent years has been therefore fueled by increased public and private sector focus.

As this third wave in biotechnology continues to gain prominence, every national government is actively looking at it as a main contributor for the country to build a sustainable bio-based economy that combines eco-efficient bioprocesses with renewable bioresources.

As we can see, the dynamics of the industry and public and private initiative play a capital role of the recent development. States and regions around the globe are actively identifying and implementing strategies for an economic growth and focusing their efforts on life sciences. With prices for oil and gas remaining high, fermentation technologies improving, and the ability to isolate and manipulate genes increases, the future continues to be an exciting one for Industrial Biotechnology.

After due considerations, venture capitalists, entrepreneurs and investment bankers are involved in this competitive arena that can offer many challenges and opportunities for investors and customers.

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