

**OECD  
INTERNATIONAL FUTURES  
PROGRAMME**

***THE BIOECONOMY  
TO 2030:***

***DESIGNING A POLICY AGENDA***

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# **THE BIOECONOMY TO 2030: DESIGNING A POLICY AGENDA**

In 2005, the International Futures Programme (IFP) of the Organisation for Economic Co-operation and Development (OECD) embarked on a two-year project to design a bioeconomy policy agenda for governments. The bioeconomy is a new concept that encompasses many economic activities – each of which benefits from new discoveries – and related products and services arising out of the biosciences. The OECD project team, along with partners in government, industry and academia, will assess how pervasive biotechnological applications are likely to become given our rapidly increasing biological knowledge. The project will also examine the prospects for further development over the next two to three decades, the potential impact on economies and societies, and most importantly, the policies needed to promote and exploit this new wave of innovations to promote high-level social and economic goals.

## ***Background and Rationale***

The term “bioeconomy” is interpreted in different ways by different actors. The OECD Project supposes the bioeconomy to be the aggregate set of economic operations in a society that use the latent value incumbent in biological products and processes to capture new growth and welfare benefits for citizens and nations. These benefits are manifest in product markets through productivity gains (agriculture, health), enhancement effects (health, nutrition) and substitution effects (environmental and industrial uses as well as energy); additional benefits derive from more eco-efficient and sustainable use of natural resources to provide goods and services to an ever growing global population. The bioeconomy is made possible by the recent and continuing surge in the scientific knowledge and technical competences that can be directed to harness biological processes for practical applications.

Looking to the future, new techniques in biotechnology, genomics, genetics, and proteomics will continue to converge with other technologies resulting in potentially large scale changes to global economies in the next thirty years. Unsurprisingly therefore, strategic interest is growing in the biosciences in both OECD and non-OECD countries. Indeed, the bioeconomy is growing faster in

China, India and Singapore than in many OECD countries and the lead position occupied by OECD countries in most fields is being challenged.

However there are considerable uncertainties facing both public and private actors, in terms of technology development as well as commercialisation, intellectual property and business models. In addition, the bioeconomy will have implications for society and economy (e.g. – pension sustainability, long-term healthcare, changing insurance markets, and ethical questions) which will have to be addressed. At the same time, technological and commercial progress in the biosciences is outpacing the policy and regulatory frameworks that govern them. Hence, policymakers will have challenging decisions to make and will need to understand the tradeoffs and possible consequences of their actions. There is an increasing need for a long-term international policy agenda that clearly explains the issues that will have to be faced in the coming 20 to 30 years.

### ***Sectoral and Geographical Coverage***

The Project will cover biotechnology applications in the following sectors: agro-food, health, industry and environment, energy and security. In terms of geographic coverage, the scope will be global. The Project will focus essentially on OECD countries, but Brazil, China, India, Russia & Singapore will be included along with some mention of other LDCs according to their strength in specific markets.

### ***Main Purpose***

The main purpose of this Project is to bring together experts from the public and private sectors to seek to identify the necessary steps to realize the potential gains of what is called the bioeconomy.

If that potential is to be achieved, a number of scientific, technical, economic, industrial, social and governance issues will have to be addressed. Government policy can play a decisive role in this, by encouraging or blocking developments. Long-term human capital formation, judicious investment in research and development, continual adjustment of regulatory oversight, new infrastructure investment for the medium and long term are but a few examples of challenges facing governments in capturing the benefits of the bio-revolution.

The aim of the OECD Bioeconomy Project is to evaluate the potential impact of biotechnologies and biosciences on the economy and identify those areas where public policy can be effective in removing barriers, encouraging innovation, and improving understanding and co-operation among the various stakeholders. Although it is often convenient to divide the bioeconomy along fairly traditional sectoral lines such as health, agro-food, energy, and so on, such an approach fails to integrate the increasing convergence of a number of technologies, research domains, economic infrastructures, and government practices. As the bioeconomy's impacts will be society-wide, the emphasis will be on cross-cutting issues where a horizontal, multidisciplinary approach and the notion of sectors "involved in" biotechnology are better suited. Of course, specific bioscience applications will be studied as required to inform the debate, but this will not be an end in itself.

The specific objectives of the Project can be summarised as follows:

1. Assess the long-term prospects of the bioeconomy over the next thirty years, and the key factors (trends, drivers) that are likely to shape its evolution. This entails *inter alia* a discussion of possible paradigm shifts and the social implications of the rapid pace of knowledge in the biosciences and new biobased applications.
2. Building on existing work, improve the indicators and metrics that are needed to monitor the development of the bioeconomy.
3. Identify the most critical issues that may affect the medium and longer-term prospects for the bioeconomy and sub-sector applications.
4. Explore the value chain and emerging new business models to identify the most promising approaches and highlight the conditions required for successful future models, including mapping interlinkages between applications and emerging roadmaps. Identify areas for public-private co-operation and for promoting co-operation among the various stakeholders more generally.
5. Identify where policies and regulations are increasingly out of step with biotechnology development. From this, draw implications regarding best practices and the supportive measures that could be put in place to encourage

innovation and promising biobased applications. More broadly, propose options for a more dynamic policy framework – legal, regulatory and institutional – which would be more conducive to the development of the bioeconomy and its contribution to economy and society more generally.

6. Raise awareness of and shed light on the concept of the bioeconomy and its potential in the coming decades, and seek ways to make the concept more robust and concrete. Explore options for communicating successes in the biosciences. Promote recommendations of the Project inside and outside of OECD countries.

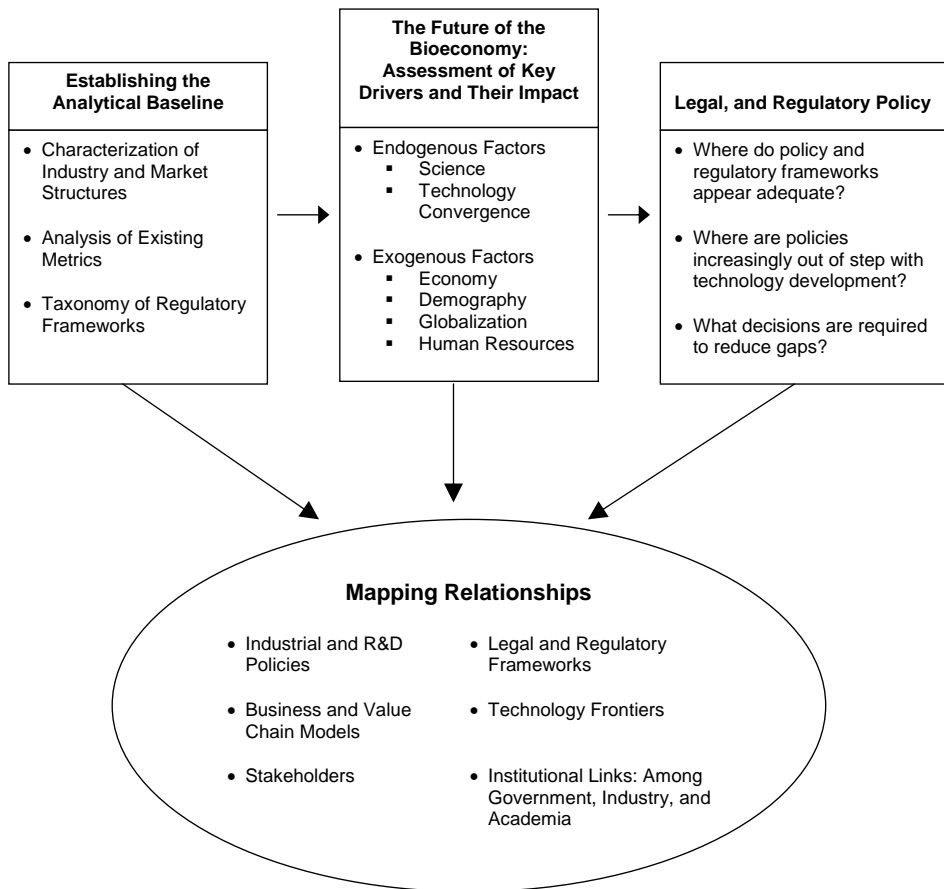
In addition, it is envisaged that the Project will provide a longer-term perspective for the development of the Organisation's work programme on biotechnology.

## ***Project Structure***

The Project will be carried out in four main parts. In Part 1, the current state of the bioeconomy will be considered and the current industry and market structures, metrics, and regulatory frameworks will be examined. In Part 2, trends, key drivers and uncertainties of the bioeconomy will be assessed and the gaps, challenges and critical issues identified. In Part 3, value chains, emerging business models and co-operation among stakeholders will be analyzed, relationships will be mapped and the implications for institutional, legal, and regulatory policy examined. The general conclusions and recommendations for improving institutional and regulatory framework conditions resulting from this work will be drafted in Part 4. In addition, once the baseline has been established in Part 1, work on improving existing metrics and indicators will run for the duration of the Project.

## ***Project Approach***

The project components are presented in the chart below as phases but could, to some extent, run concurrently.



## ***Expected Output***

The physical output of the Project will take the form of a series of technical reports and working papers, leading to the preparation of a final synthesis report that will be issued under the responsibility of the Secretary-General of the OECD. The main intellectual contributions of the Project will be to:

- (a) Provide an original forward-looking and policy-oriented assessment of the prospects and issues facing the development of biobased applications worldwide and the development of the bioeconomy;
- (b) Achieve a better understanding of the approaches that could be adopted for the development of promising business models, including innovative tools and roadmaps;
- (c) Contribute to the formulation of possible solutions that governments may find useful in addressing some of the main problems facing the bioeconomy;
- (d) Foster international co-operation between the governments of OECD countries and other nations across the world in matters pertaining to biobased economic and business developments.

## ***Why the OECD?***

The OECD is well placed to contribute to a forward-looking policy analysis of these issues. First, OECD member countries devote significant public and private resources to the biosciences. Indeed, most of the field's key players are within the OECD. Member countries account for more than 90% of global R&D and command 80% of global economic resources. Secondly, bioeconomic development extends to a broad range of activities and policy domains that are the subjects of current OECD work: science and technology more generally, regulation, economic development, health, energy, industrial and environmental biotechnology, agriculture, industry, R&D and the broader agenda of sustainable development. Thirdly, within the OECD, the International Futures Programme has considerable experience in conducting long-term policy analysis of complex emerging issues, and – closely collaborating with other specialised Directorates – in establishing a fruitful dialogue among stakeholders in the public sector, private sector and research community.



## How is the bioeconomy different from other innovation cycles?

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- **Affordability** – The cost of biotechnologies has decreased markedly in the past decade. For example, diagnostic and treatment devices, once only available to large corporations and well-financed R&D efforts, are now available on the general market for use by doctors and consumers.
- **Convergence and linkages** – The bioeconomy is possible because of our rapidly expanding knowledge of how living organisms develop, react, and interact at fundamental levels that range from nano molecular structure to genes. This discovery process in turn drives innovation in a wide range of economic domains. The ability to understand and exploit this potential depends on the convergence of a number of disciplines, each of which benefits from progress in its own as well as related fields. This convergence cycle is blurring the traditional boundaries that separate chemistry, biology, mathematics, etc. The development of certain biotechnologies will indeed depend on advances in other technologies such as nanotechnology and informatics.
- **Impact** – Technology applications flowing from developments in the life sciences will have far-reaching impacts on other economic sectors. For example, the agriculture and chemical sectors were once linked through the use of pesticides in crop production, but emerging technologies will create biobased chemicals with decreased toxicity and increased effectiveness. Nano bio tools will be used for a large variety of applications, from medicine to security and environmental monitoring.
- **Rapid, discontinuous change** – The biological sciences are among the most dynamic sectors of modern science. Discoveries in genetics, metabolics, systems biology and proteomics are leading to novel and eco-efficient products at ever faster rates. Meanwhile, the pace of discovery is accelerated by the growing – and global – human capital and financial investment in bioscience. What had been an expensive, frontier scientific effort in 1990 is often now a routine, increasingly automated procedure. “Knowledge Churn” has become the motor for advances in the biosciences.
- **The human factor** – Unlike many other technologies, most biotechnologies involve a human element in development, production, and consumption. Products have to be developed in secure laboratories, tested with animal and human subjects, and in many cases consumed directly by humans. Individual and societal values will play an important role in decisions as to which technologies are explored and exploited. Public opinion will be a key determinant in this innovation wave (security, safety, privacy, ethics).
- **Safety** – Biotechnology can affect human health dramatically. The same technologies that improve human welfare can be used for harm. It is imperative that safety issues be addressed in order to fully realise the potential of the bioeconomy.
- **Increased knowledge intensity** A good example of this interplay is the linkage between innovations in the life sciences and informatics. Data can now be collected, stored, retrieved and analysed more and more quickly. This rapid increase in knowledge will lead to greatly shortened discovery paths.
- **Information** – Information in the biological sciences is more readily available today than ever before, but the complexity of that information and the problem of its reliability pose challenges for researchers and industrialists.
- **High opportunity costs** – Innovation in the biosciences requires active support from government and industry. Those countries able to muster resources to invest in R&D and human capital formation – and equipped with policies to meet the challenges posed by new products and processes – will move ahead, creating wealth within their societies and becoming leaders in innovation globally. Those who fail to keep pace with these changes risk losing new global markets and compromising growth at the national level.
- **All of the above** - The biosciences offer a combination of factors that make this innovation wave different from past ones (i.e. the IT revolution). Governments need to map these possible future directions, match them to social and economic needs, and adjust policy agendas to reap the benefits of the bioeconomy.

Lastly, there is a strong political imperative. When OECD science and technology ministers met in Paris in 2004, they urged the OECD to strengthen its contribution to work on biotechnology as a driver for sustainable growth and development. In particular, they encouraged the Organisation to complete its work on the policy challenges for a biobased economy, and to identify the barriers to and opportunities for its further development.

## ***Organisation of the Project***

The Project is being conducted over a two-year period. A *Project Team* will be set up within the OECD Advisory Unit. It will collaborate closely with the OECD's Biotechnology Division and other and other specialised parts of the OECD. The *Project Team* will be directly responsible for preparing the report, including its main conclusions and recommendations. Team members will also prepare background papers, supervise work commissioned to outside consultants and seek input from other OECD Directorates and Agencies who have responsibilities in policy areas that may have an important bearing on the future development of the bioeconomy.

In parallel, a *Steering Group* will be set up to advise the *Project Team*. It will be composed of twenty to thirty high-ranking experts and decision-makers from the public sector, private entities, and research institutions from OECD Member countries. The *Steering Group*, in addition to financing the Project, will advise the *Project Team* on the formulation of a more detailed Project development strategy, and comment on interim drafts as well as on the final report and its recommendations. It is envisaged that four meetings of the *Steering Group* will be convened during the course of the Project.

The results of the project will be discussed at a final conference of partners and stakeholders in late 2007. Conclusions will be used to further biotechnology work at the OECD.

## ***Financing***

The OECD's International Futures Programme designs projects with partners from government, industry and foundations. Projects are scoped and budgeted, and then funded by voluntary contributions to the IFP.



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