

Making the Bioeconomy Measurable: Politics of an Emerging Anticipatory Machinery

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The production and use of anticipatory knowledge, such as predictions, scenarios, forecasts and narratives about possible futures, has become a salient feature of the action at the interface of the life sciences and society, and a topic of increasing interest in science and technology studies.¹ In many biotechnology arenas, actors work to create persuasive claims about future developments. Entrepreneurs attempt to excite investors with business plans. Military planners construct bioterrorism scenarios. Financial analysts estimate biomedical markets. Multidisciplinary panels expound on potential ethical issues. Journalists identify and dramatize emerging trends. And popular culture spreads science fiction imagery to vast audiences. In short, many forms of anticipatory knowledge play a role in the process through which futures of the life sciences are envisioned and monitored, supported and opposed, bought and sold, nurtured and regulated, revised and reimagined. Given the epistemic challenges of foreseeing future developments in both science and society, it is not surprising that anticipatory knowledge about the biosciences is often considered provisional or frankly unreliable. But despite these difficulties, anticipatory knowledge remains an indispensable tool of prediction and control. It is also a powerful tool for promising, and its speculative energy helps mobilize financial and political support for biotechnology.

The Organisation for Economic Co-operation and Development (OECD) project on 'The bioeconomy to

2030' is an example of a new and ambitious anticipatory enterprise. The Bioeconomy Project (BP) aims to play a central role in creating forward-looking policy frameworks for the development of biotechnology over the coming decades. The OECD's International Futures Programme (IFP), which conceived the project, styles itself 'as a pathfinder to explore new issues, provide first initiatives for policy framework development, and propose new rules of the game' (OECD, undated a). A 'Scoping document' (hereafter SD) describes the project (OECD, 2006), presenting an argument that one might tersely summarize as follows:

A nascent entity—the bioeconomy—shows great promise but needs to be nurtured. Policy can help or hinder its growth. To guide policymaking, analysis must map the present state of the bioeconomy, anticipate its evolution through 2030, and pinpoint key issues. The BP will create credible narratives, metrics, and indicators about the bioeconomy, and will identify relevant policy frameworks and business models. In this way, the project will help ensure that OECD countries capture the benefits of the bioeconomy.

Like many future-making projects, the BP must be understood not only as an effort to anticipate the future but simultaneously as one to shape it, and, owing to its high-level governmental connections, it is in a potentially influential position. The project is quite self-consciously an effort to advance 'the bioeconomy'—both as a *concept* and as a set of technological and economic *activities*. Clearly, the BP is predicated on the assumption that translating the concept of 'the bioeconomy' into a matter of ongoing policy concern will contribute to policies that stimulate the use of biotechnology. But why does the IFP consider the bioeconomy to be a promising focus for policy analysis? To precisely what does the term apply? What alternative conceptualizations does it obviate or displace? And how does the BP envision the concept developing? This comment briefly considers these questions as a means to examining the politics of an effort to create a new machinery of anticipation in the contemporary life sciences.

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1 Some examples of STS work on this topic include: Brown and Michael (2003), Brown *et al.* (2000), Fortun (2001), Hedgecoe and Martin (2003) and Van Lente and Rip (1998).

Defining the bioeconomy

The BP's effort to promote and institutionalize the bioeconomy entails defining the *bioeconomy*, which remains a rather new term. (As a crude indicator, a Google search of 'bioeconomy' yielded 161,000 hits in June 2007; 'biotechnology' received 42 million hits.) The IFP calls the bioeconomy a 'novel concept' and the scoping document notes that it is 'interpreted in different ways by different actors' (OECD, undated b, 2006: 3) The BP advances this concept in several intertwined but analytically distinguishable ways. First, it provides a formal definition of the term:

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. (OECD, 2006: 3)

This definition takes 'economic operations' as its distinctive focus. Contrasting this term with some extant alternatives brings its significance into relief. For example, the bioeconomy is not so encompassing as 'the social, ethical, legal, economic, public and policy aspects of current and emerging developments in the life sciences'—the subject matter that this journal addresses under the rubric 'biosocieties'. Nor is the bioeconomy coterminous with 'biotechnology', regardless of whether the latter is understood as a technoscientific domain or an economic sector (Hilgartner, 2001). Indeed, the BP contends that the fact that it does not focus on 'traditional sectoral lines such as health, agro-food, energy and so on' is a key advantage of its approach (OECD, 2006: 3). The bioeconomy, it stresses, is not limited to any single economic sector but is a cross-cutting phenomenon with 'impacts' that 'will be society-wide' (OECD, 2006: 3).

Beyond providing a formal definition, the BP fleshes out the term by linking it to the breathless narratives associated with 'emerging technology' (Hilgartner and Lewenstein, 2004). These narratives are sometimes evoked by making explicit analogies to information technology:

Tomorrow may see a world of biologicals as today we see society driven by digital technologies. (OECD, undated a)

Sometimes by making claims about technological convergence:

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. (OECD, 2006: 3)

And sometimes using revolutionary rhetoric, as in the term 'the bio-revolution' (which appears in the SD) or via talk of major transformations:

... the biosciences could produce the *next wave of innovation* in products and services across a range of economic activities in health, agriculture, industry and energy. This could *transform the way people produce and consume* over the next decades. (OECD, undated a, emphasis added)

Often, these narratives are evoked using the language of speed:

The rapid increase in knowledge will lead to greatly shortened discovery paths. (OECD, 2006: 4)

Discoveries ... 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. (OECD, 2006: 4)

Those who fail to keep pace ... risk losing new global markets and compromising growth at the national level. (OECD, 2006: 4)

The BP also inflects this concept with a strong moral valence: the impact of the bioeconomy on the economy, the environment, human health and sustainable development will be overwhelmingly positive. Innovation in biotechnology is desirable and must be encouraged. Policies must be designed to exploit its potential. Opportunities must be taken. Benefits must be realized. The fact that specific biotechnologies have at times encountered strenuous opposition is not explicitly mentioned in the SD. The document uses the terms *risk* and *safety* at several points (although the words *hazard* and *damage* do not occur). But these references implicitly take a stance that regards risks as manageable rather than intractable problems, and appears to subordinate

Table 1. Risk and ethics in the Scoping Document: Illustrative quotations (emphasis added in all cases). As these examples suggest, references to risks and ethics tended to address biosecurity issues, or were concerned with the influence of safety and ethical concerns and regulations on the use of biotechnologies

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*).

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.

Biotechnologies influence most aspects of health care already. The main drivers here are pursuit of quality (including *safety*), efficacy and efficiency of products.

Those who fail to keep pace with these changes *risk* losing new global markets and compromising growth at the national level.

The security sector has also transformed significantly in the past five years, principally due to global events. The main drivers here are market demand for offensive and defensive technologies and strategies that vary from surveillance and detection systems, to *risk* management protocols around the dual use of materials and knowledge.

One element of this work is to develop a set of biosecurity measures ... that will provide for a proportionate response to the *risk* that potentially *dangerous* biological material could be obtained by unauthorised persons and deployed to cause *harm*, without unduly hindering research or being financially burdensome.

One method of addressing this ‘dual use’ aspect of life sciences research is through the adoption of codes of conduct. The science community voluntarily conforms to codes of conduct on issues such as research *ethics* and professional conduct. Self-regulation has worked well in these and other areas. Initiatives are underway to apply a self-regulatory approach in the context of balancing scientific freedom and biosecurity.

However, the policy and regulatory frameworks that currently govern bio-science based activities are often unsuited to the economic, social, and *ethical issues* now emerging. This is increasingly the case as knowledge about biological and genetic processes is combined with empirical evidence in shorter and shorter timeframes. The gap between opportunity and the existing policy response is widening.

What impact will trends such as population ageing, urbanisation and changing *social values* have on the demand for bio-based products and services?

them to economic concerns. The SD also notes the existence of social values and ethical issues, which it seems to frame as exogenous factors that might influence the development of the bioeconomy (see Table 1).

Clearly, these efforts to define the bioeconomy are not merely descriptive; they also have a performative dimension. Framing the concept in economic terms makes it susceptible to treatment by the machinery of economistic policy analysis. Defining the bioeconomy as trans-sectoral makes it into an entity relevant to actors associated with many diverse segments of the economy. Defining it broadly also widens the scope of its benefits and

highlights the need to nurture its growth. This way of constructing the bioeconomy as an entity thus offers opportunities for drawing together a diversity of actors under a single policy rubric—one that not incidentally treats the economic aspects of biotechnology as central while tending to treat risks and ethical issues as secondary concerns.

Measuring the bioeconomy

This rubric, however, is merely a starting point; for the BP aims to flesh out its abstract definition through extensive analytic and tool-building endeavors. The BP seeks to measure and map the

bioeconomy in some detail, thus providing a 'long term international roadmap for policy dialogue and formulation across the coming decades' (OECD, 2006: 5). Realizing this vision necessarily requires finding ways to connect the formal definition (that is, 'the aggregate set of economic operations in a society that use ... biological products and processes') to the ongoing practices and activities for which that abstraction is intended to stand. This is not simply a matter of one-way reification, in the sense of treating an abstraction as if it had concrete existence; it is a process of iterative alignment that also involves making the abstraction more concrete by constructing techniques and institutional machinery capable of persuasively representing the activities (cf. Callon, 1998). The particulars have yet to be worked out, but the SD states that the methods will include both narrative techniques that look at 'alternative future paths' and the creation of quantitative metrics and indicators (OECD, 2006: 14).

Given the OECD's role in creating economic indicators and metrics suitable for comparative analysis across countries and over time, the goal of creating quantitative means for measuring the bioeconomy has the potential to be especially significant. One can glean a sense of the possibilities by considering its 2002 report: *Measuring the information economy* (OECD, 2002).² I cannot discuss the information technology (IT) report here. Suffice it to say that it presents comparative data across OECD countries on a wide range of phenomena related to IT, including investment levels, internet access, human capital, employment, patents, consumption, exports and so forth. One might speculate that similar comparative data and indicators on 'the bioeconomy' could conceivably become quite significant politically. Indeed, in policy cultures that place 'trust in numbers' (Porter, 1995) it is possible that such data could play a substantial role in making the bioeconomy into a matter of heightened policy concern: for example, by offering new opportunities for anticipatory economic and policy research; by placing countries in a comparative context conducive to highlighting issues of international competitive advantages and disadvantages; by providing a wealth of official statistics for policy operatives to selectively mine for dramatic facts; and, not least, by enhancing societal capacities to measure, monitor, model and *care about* the current and future 'health' of an increasingly tangible entity: the bioeconomy.

Conclusion

In advancing the bioeconomy concept, the BP seeks to create a new policy-oriented machinery suited to the work of ongoing technoeconomic anticipation. The BP frames 'reliable data on the development of the bioeconomy and the impact of biotechnology ... on economic growth, health, and the environment' as 'the foundation of objective policy making' (OECD, 2006: 14). But, as the above discussion suggests, the efforts of the OECD to define the bioeconomy, build it into data-gathering practices and institutionalize it in the machinery of policymaking are far from apolitical. Quantitative metrics and indicators may express particular forms of objectivity, but they cannot escape the deep and often invisible politics of what is counted, how it is counted, why it is counted and how the counts are used. For this reason, the OECD's work in this domain warrants ongoing, reflexive examination.

References

- Brown, N., & Michael, M. (2003). A sociology of expectations: Retrospecting prospects and prospecting retrospects. *Technology Analysis and Strategic Management*, 15, 4–18.
- Brown, N., Rappert, B., & Webster, A. (Eds) (2000). *Contested futures: A sociology of prospective techno-science*. Aldershot: Ashgate.
- Callon, M. (Ed.) (1998). *The laws of the markets*. Malden, MA: Blackwell.
- Fortun, M. (2001). Mediated speculations in the genomics futures markets. *New Genetics and Society*, 20, 139–157.
- Hedgecoe, A., & Martin, P. (2003). The drugs don't work: Expectations and the shaping of pharmacogenetics. *Social Studies of Science*, 33, 327–364.
- Hilgartner, S. (2001). Biotechnology. *International Encyclopedia of the Social & Behavioral Sciences*, 1235–1240. Oxford: Elsevier.
- Hilgartner, S., & Lewenstein, B.V. (2004). The speculative world of emerging technologies. Unpublished working paper.
- OECD (2002). *Measuring the information economy 2002*. URL (accessed June 2007): http://www.oecd.org/document/5/0,2340,en_2649_37441_2765701_1_1_1_37441,00.html
- OECD (2006). Scoping document: The bioeconomy to 2030: Designing a policy agenda, June. URL (accessed June 2007): http://www.oecd.org/findDocument/0,2350,en_2649_36831301_1_119829_1_1_1,00.html

² The SD notes that the OECD has experience developing indicators and metrics in information technology and communications, suggesting that this expertise will serve for the analogous problem of measuring the bioeconomy.

OECD (undated a). Bioeconomy, FAQs. URL (accessed June 2007): http://www.oecd.org/findDocument/0,3354,en_2649_36831301_1_119829_1_1_1,00.html

OECD (undated b). International futures programme. URL (accessed June 2007): http://www.oecd.org/findDocument/0,3354,en_2649_36831301_1_119829_1_1_1,00.html

Porter, T. (1995). *Trust in numbers*. Princeton, NJ: Princeton UP.

Van Lente, H., & Rip, A. (1998). The rise of membrane technology: From rhetorics to social reality. *Social Studies of Science*, 28, 221–254.

Cornering the Futures Market in 'Bio-epistemology'

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The Organisation for Economic Co-operation and Development (OECD) announced in 2005 that its International Futures Programme (IFP) would embark on a two-year project to 'design a bioeconomy policy agenda for governments' (OECD, 2006a: 1). The aim of this project is to assess and devise strategies necessary for facilitating, over the coming 30-year period, the sustainable growth of the bioeconomy defined therein as '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' (OECD, 2006a: 1).

The IFP intends to achieve these objectives through a number of means. It will first 'assess how pervasive biotechnological applications are likely to become given our rapidly increasing biological knowledge' and then go on to:

... examine 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

innovation to achieve high level social and economic goals. (OECD, 2006a: 1)

The authors anticipate that a number of impediments to the expansion of a robust, global, bioeconomy will be identified through this exercise including 'policies and regulations [that] are increasingly out of step with biotechnological development' (OECD, 2006a: 3). Proposed remedies include identification of 'a more dynamic policy framework—legal, regulatory and institutional—which would be more conducive to the development of a bioeconomy and its contribution to economy and society more generally' (OECD, 2006a: 4).

These programme goals are articulated in the 'institutional ephemera': documents, briefing papers, press releases and so forth that now routinely accompany the launch of such projects, but which, perhaps because of their very ubiquity in this age of information, go, all too frequently, unanalysed. A review of these documents reveals, however, their significance as historical artefacts that bear witness to the ways in which the concept of 'the bioeconomy' is being constructed and mobilized (as both an epistemological device and realized practice) early in the twenty-first century. It is evident, for example, that these documents (including, notably, the Scoping Document published in March 2006) begin by generating, whether by design or accident, a very particular, and I thought rather unusual, historiography of the recent political economy of the life sciences.

First, a strong case is made throughout the documents for the exceptionalism of biotechnologies (as a technology) and the political economies to which they give rise. A formal typology of the elements of the bioeconomy that (ostensibly) set it apart from other 'innovation cycles' is set out within the Scoping Document (OECD, 2006a: 7). It is this exceptionalism that provides the rationale for the development of a highly specialized agenda for realizing the capitalization of value from their exploitation. There was also, second, a curious temporality to this historiography—evidenced in statements that the benefits and value of advancements in biotechnology and the life sciences are, as yet, largely *prospective*. I would like to examine these two premises in more detail, for it is upon them that so much of the

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