Appraising biofuel options in highly politicised contexts: critical issues and lessons from Brazil

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Abstract

The rapidly evolving policy debates around transport biofuels and their sustainability pose serious challenges to the appraisal of different biofuel options. This article highlights those challenges by focusing on the role of the context in general and issue framing in particular in shaping the influence of appraisals. Three interrelated aspects of framing will be highlighted: the interaction between the social and environmental dimensions of sustainability, the role of biofuels within the broader development visions and strategies, and the expectations concerning the potential of future advanced biofuel technologies. Examples from Brazilian biofuel experience will be drawn upon to illustrate the arguments. The article puts forward recommendations for context-sensitive biofuel assessment: adherence to the principle of methodological pluralism, the need to ensure appropriate interaction between the levels of appraisal and decision-making, and the role of the expert as a facilitator of collective learning and genuine interaction in often highly politicised appraisal situations.

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1. Introduction: the context of biofuel appraisal

The recent rapid change in the tone of the biofuel debate has highlighted many of the complexities associated with assessing the sustainability of different transport energy supply options. While biofuels were until recently seen as a ‘green’ alternative to oil based fuels, promising not only to cut greenhouse gas emissions, but also to improve energy security and alleviate the problems face by the agricultural community, they are currently portrayed as an enemy of the poor, cause of rising food prices, with meagre if any climate benefits, and potentially catastrophic impacts on biodiversity. Environmental life-cycle assessments of the currently available first generation biofuels continue to show widely diverging results (e.g. von Blottnitz and Curran, 2007), yet there is an emerging consensus about the need to achieve significant technological innovations if biofuels are to make a positive contribution to sustainability at any significant scale (WWI, 2006). ‘Next generation’ technologies, using non-food feedstocks such as cellulose are suggested as a solution especially to the ‘food vs. fuel dilemma’.

However, it is far from evident that the next generation biofuels would automatically enhance sustainability. Biomass for biofuels may enter into competition with other uses (especially heat and electricity generation), and the extraction of far greater amounts of forest and crop residues may reduce biodiversity and produce harmful effects on ecosystems. While potentially alleviating the food vs. fuel dilemma, the new technologies may create other conflicts between the social and environmental dimensions of sustainability. Next generation technologies promise to dramatically improve the carbon balance of biofuels, but they tend to be predicted on large-scale capital-intensive solutions, thereby possibly compromising many of the expected social benefits, such as the support to rural employment and small-scale farming (WWI, 2006).

In a context of highly conflicting worldviews, conceptions of sustainability and expectations concerning the potential of new, advanced biofuel technologies, appraising the sustainability of different biofuel innovation pathways presents formidable challenges. Biofuels represent a typical – even an extreme – case of decision-making under complexity, ambiguity and uncertainty. Great uncertainties prevail over both facts and values; a multitude of stakeholders – with highly variable potential to influence decision-making – are involved at various geographical and institutional levels; the decision-makers are faced by often contradicting policy objectives; and powerful lobby groups each defend their own agendas. The on-going globalisation of biofuel governance and the emergence of international markets for biofuels have raised the political stakes and have given the debate a North-South policy dimension. Despite the multiple objectives driving biofuel development, both advocates and critics of biofuel policies tend to relate their arguments, implicitly or explicitly, to one or another conception of sustainable development. The criteria used to appraise biofuel pathways indeed critically depend on these underlying definitions.

1 The term ‘next generation’ is employed here, because of the lack of agreed definitions of the meaning of ‘second’ and ‘third’ generation biofuels.
This paper is concerned with the use and influence of appraisals in fostering sustainable biofuel innovation. It starts from the assumption that the political, institutional and cultural context is of primary importance for the influence of appraisal in general, and biofuel appraisal in particular. The focus of the paper is on the role of ‘framing’ in determining the influence of appraisal and the direction of innovation. Two aspects of framing are examined: the impact of the varying definitions of sustainability on biofuel appraisal and the desired direction of innovation, and the role of expectations concerning ‘next generation’ biofuel technologies. Two aspects of sustainability will be emphasised: the interaction between social and environmental dimensions of sustainability, arguably the key policy nexus in biofuel policies; and the place that biofuels are seen to occupy within broader development models and strategies. Brazil is used as a source of concrete examples, given its role as the world leader in biofuel know-how, its long experience of active biofuel promotional policies, its ambitions to become a leading biofuel technology exporter, and its potentially significant role in defining the emerging certification and control systems designed to ensure the sustainability of biofuels.

The paper begins by discussing the concept of appraisal influence, drawing on lessons from research and practice in policy evaluation, assessment and the role of expert knowledge in policymaking. It then argues in favour of greater attention to the political and institutional context as a crucial element in determining the influence of appraisal. The following section addresses the role that the framing of appraisals has in steering the direction of innovation, and analyses one by one three interrelated aspects of framing in biofuel appraisal: the social-environmental interface, the role of biofuels within the broader development visions, and the more specific expectations concerning the potential and evolution of next generation biofuels. The final section pulls together the lessons for biofuel appraisal.

2. Influence of appraisal – direct, indirect on non-existent?

The term ‘appraisal’ is conventionally used to denote either ex ante impact assessments of policies (e.g. environmental, social, sustainability or integrated assessment, strategic environmental assessment) or ex post evaluations of policy effectiveness and impacts. In this paper, appraisal is used in a wider sense, to encompass a broad range of policy advice in the form of expert input. Included are therefore not only assessments and evaluations in the strict sense, but also reports, reviews, scientific and semi-scientific evaluations of different biofuel options.

Conceptual and political roles of appraisal

Arguably, the ultimate ‘raison d’être’ of an appraisal is its influence on policy. However, research on the role of knowledge in policymaking in general, and the influence of evaluations and assessments in particular, has repeatedly found that scientific or technical knowledge input often plays only a minor direct role in actual decisions or policy implementation processes. The direct use of scientific knowledge
by policymakers to change policies is rather an exception than a rule (e.g. Weiss, 1998; Owens et al., 2004). Two indirect types of influence – conceptual and political – are far more common.

First, appraisals’ influence can be conceptual, leading to what Weiss (1987; 1999) has called ‘enlightenment’, or “the percolation of new information, ideas and perspectives into the arenas in which decisions are made” (Weiss, 1999, 471). Research affects decision-makers’ problem definitions, and provides new perspectives on and insights into the problem area, instead of providing information for a single moment of decision, or a single decision-maker that, in fact, often simply does not exist.

Second, influence can be political. This category includes legitimisation, which has frequently been seen in a negative light, appraisals serving as rationalistic rituals aimed at justifying decisions that have already been taken or policies that are already in place (Lampinen, 1992, 30-37; Weiss, 1999, 477). However, legitimisation has its productive side as well, since without legitimisation meaningful policymaking would in fact be impossible; indeed, in a democracy long-term success of any policy depends on its legitimacy in the eyes of the citizenry (e.g. Feinstein, 2002, 434; Valovirta, 2002). A second type of political use is tactical, an appraisal being commissioned, for instance, in order to postpone decision-making by referring to an ongoing study. (Vedung, 2001, 141). ‘Symbolic’ use refers to research being used symbolically, to convey an image or a message (Weiss 1999, 477). Appraisal in such a case constitutes a ‘façade’ intended to give decisions and the appraised organisation an aura of rationality, competence and preparedness to change (Pollit, 1998; Weiss, 1999, 472-473; Vedung, 2001, 141).

It can be argued that the conceptual and political types of influence are particularly important in the case of biofuels, because of the complexity, multilayered nature and high stakes involved in biofuel governance. An example of the conceptual influence is the way in which biofuel debates have been reframed in the light of evidence from appraisals, causing a sudden shift from the conception of ‘sustainable’ biofuels towards one considering biofuels as an expensive policy with harmful environmental and social effects. This shift obviously has its political elements as well, yet the clearest examples of political use and influence of biofuel appraisal come from the biofuel politics in the proper sense of the term. For instance, the Brazilian government uses appraisals strategically in order to demonstrate the sustainability of the country’s ethanol production and thereby ensure future export markets for its products (Furlan, 2006), while biofuel critics appeal to reports pointing out the environmental, social and economic downsides of biofuels (e.g. Mendonça, 2006; e.g. Kenfield, 2007).

**Is influence always desirable?**

The importance of conceptual and political influence highlights another lesson from evaluation and assessment literature, namely the importance of the appraisal process. The concept of ‘process use’ of evaluations (e.g. Patton, 1998; Forss et al., 2002) entails the idea that it is not only the appraisal outcome, but also the process through which outcome is achieved that matters. Appraisals are occasions for mutual learning – not only means of producing the final result in the form of an appraisal report. Appraisals may rarely provide completely new insights – but participants nevertheless frequently state that “it was useful to go through the process”. Appraisal process may
also stimulate networking, policy integration and reflection on policy priorities. (Forss et al., 2002)

The prevalence of indirect impacts, and the importance of ‘process use’ likewise mean that the crafting appraisals to foster ‘intended use by intended users’ is more challenging than one could imagine. Unexpected, unplanned and uncontrollable influence and use – through media, for instance – need to be taken into account, even though they cannot be fully controlled.

Crucial for biofuel appraisal and innovation is the question of directionality: while an appraisal that has no influence on policymaking can clearly be considered as a failure, the presence of influence does not yet prove that the impact has been to the desired direction, for instance sustainability (e.g. Smith et al., 2005). This highlights the crucial role of framing: whether or not any given biofuel option is deemed positively depends on the way in which sustainability is conceptualised in the appraisal. Moreover, the appraisal methods and processes may provoke deleterious side-effects, as brought forward in the vibrant discussion concerning the perverse impacts of performance measurement. Strict performance measurement methods have been accused of diverting attention from the essential to the measurable or from policy to assessment, and for reinforcing hierarchical, authoritarian control instead of fostering creativity (e.g. Davies, 1999; Perrin, 2002b; Davies, 2005). This last point is particularly relevant for innovation policy: there is an inherent tension between the dimension of control, present in any appraisal, and the need to stimulate, risk-taking, creativity, and ‘thinking out of the box’, which are essential for promoting innovation (Perrin, 2002b).

Salience, credibility, and legitimacy of appraisal

Framing is important not only because of it defines appraisal criteria and hence ‘which way is forward’. An assessment is influential only if it ‘rings a bell’, i.e. is sufficiently compatible with the frameworks of thought dominant in the society, and respond to the specific needs of key stakeholders. In other words, assessments need to be credible as to their scientific methods, salient to the potential users, and legitimate in the way the assessment is designed. Credibility denotes appraisal’s scientific and technical believability to a defined user. It can stem from either the process through which the basic information was obtained or from the credentials or other characteristics of the appraiser. An appraisal is salient if it addresses the particular concerns of the user, whereas to be legitimate, it must be perceived as politically acceptable and fair by the user. (Clark and Dickson, 1999; Eckley, 2001)

There are trade-offs between these three conditions and not all of them can be simultaneously fully met. The importance of each criterion varies according to the situation – for instance, credibility tends to be particularly important in the most controversial policy issues, such as biofuels. Furthermore, an appraisal is likely to be more influential when brought to the public debate by a group that enjoys wide respect and credibility, for instance an international organisation. Many of the recent reports calling into question the sensibility of current biofuel policies owe their importance less to the message itself than to the status and reputation of the organisations producing them (Mitchell, 2008; OECD, 2008).
**Repertoires**

Most important element of salience, credibility and legitimacy is that different stakeholders define these attributes differently. What ‘rings a bell’ to one stakeholder does not necessarily do so for another. A crucial element of the appraisal context consists therefore of the stakeholders’ cognitive, strategic, and political expectations concerning the appraisal (Barbier, 1999) and, more generally, their ‘repertoires’, defined as “stabilised ways of thinking and acting (on the individual level) or stabilised codes, operations and technology (on other levels)” (van der Meer, 1999, 390). Because of differences in their histories, experiences, and positions in the relations of power, actors have different repertoires, which they use in the process of sense-making and construction of behaviour. The impacts of an appraisal are therefore essentially determined by the repertoire-based interpretations and (re)actions to the appraisal of the agents involved. Changes in a repertoire do not necessarily arise from the appraisal, but from meaningful reactions of third parties, whose repertoires overlap with or are linked to those of the main actor. Moreover, individuals are generally involved in multiple, partly related social contexts. A minister operates in political circles in a repertoire dominated by party ideologies, parliamentary majorities and accountability. Yet he is also an administrator and therefore focused on economy and effectiveness, or a partner in consultations with societal groups – in repertoires governed by principles of cooperation, harmony and support. (van der Meer, 1999, 390-392)

These repertoires – which govern different actors’ reactions to biofuel appraisals – involve, for the first, different perceptions of what is sustainable and how the social and environmental dimensions of sustainability interact. Secondly, repertoires entail expectations – which concern the appraisals and their function in policy on the one hand, and the role of new advanced biofuel technologies on the other.

**Power and the responsibility of the expert**

These insights highlight three central questions concerning the role and responsibility of the expert conducting the appraisal. First, what responsibility, if any, does the expert have for the indirect impacts, which by necessity are largely out of his direct control? Second, which types of appraisal processes are best suited for fostering appraisal influence? And third, which attitude should the expert adopt in relation to the different normative views and conceptualisations of sustainability held by the various stakeholders and by herself? Ultimately, the questions around the role and responsibility of the expert revolve around symbolic power: who has the power to define the terms of an appraisal?

Full treatment of these questions, central to appraisal profession, is clearly beyond the scope of this paper, yet two starting points relevant for the subsequent sections of this paper merit being highlighted. Firstly, the degree to which an appraisal is influential depends not only on appraisal methods and techniques, but above all, on the appraisal context (e.g. Bina, 2008). Conducting an influential appraisal requires a clear understanding of the prevailing decision-making situation, including notably the relations of power between stakeholders. This allows better understanding of the potential indirect influence of appraisal, even though it by no means guarantees that the expert could have a full control over those impacts. Second, since the expert can
never be neutral in relation to the appraisal, she should not only seek to understand the
decision-making context and her own role in the process, but also be explicit about
the values and assumptions underlying the appraisal, and seek to foster democratic
deliberation, including by empowering the weaker players and perspectives in the
appraisal situation. A key quality standard of good appraisal is the extent to which the
underlying values and assumptions are made explicit, and to degree to which the
appraisal manages to foster democratic deliberation among the often highly
contradicting normative positions held by different stakeholders.

3. Appraisal context, framing and directionality of innovation

The above discussion highlighted the importance of the political, institutional and
cultural context in general and the issue framing in particular for the influence of
appraisal. In the following, three interrelated aspects of framing will be addressed.
First, while the concept of sustainable development may have lost some of the
prominence it had in international environmental policy debate in the early 1990s,
both biofuel advocates and critics need to appeal to one or another notion of
sustainability and/or public interest. While sustainable development is commonly
perceived to consist of three interlinked dimensions, or ‘pillars’ – social,
environmental and economic – the social is arguably the theoretically least developed
of the three, notably when it comes to measurement of sustainable development
(OECD, 2001, 63). The social dimension is the one that often generates the most
controversies, not least in biofuel policy and appraisal as demonstrated especially by
the ‘food versus fuel’ debate. Yet the social is often largely neglected in practical
‘sustainability policies’ (e.g. Bina, 2008). Second, in the final analysis, debates on
sustainability involve placing biofuels within the broader societal development
visions, strategies and theories, which determine ‘which way is forward’. Third, the
appraisal of different biofuel pathways and the desirability of different ‘next
generation’ biofuel visions interact with and are shaped by expectations concerning
the development of new biofuel technologies. These topics will in the following be
treated each in their turn, with examples mainly from Brazil taken to illustrate the
issues at stake.

3.1 Social-environmental interface

There is no commonly accepted definition of the ‘social dimension’ of sustainability,
not least because there is no consensus on what constitutes the ‘social’, in the first
place. Indeed, what defines the ‘social’ is determined by the underlying theoretical
framework. The social dimension is qualitatively different from the environmental
one, since it is bipolar – it refers both to individual and collective levels; it is reflexive
– our perceptions and interpretations of the objective social conditions change
individual and collective behaviour, hence influencing the objective conditions
themselves; and it is immaterial – while founded in material circumstances, the social
phenomena themselves are essentially immaterial, thereby defying easy
straightforward analysis – especially in quantitative terms (Empacher, 2002).

It is hardly surprising then, that defining and analysing the interaction between the
environmental and social dimensions of sustainability should be yet more challenging.
Many of the existing attempts have been based on rather simplistic, yet pragmatic conceptualisations (e.g. OECD, 1998; Coenen et al., 2000), while theoretical attempts based on notions such as capabilities (e.g. Sen, 1987; Robeyns, 2005) or social capital (Grootaert, 1998; Woolcock, 2001) have struggled to make the concept operational.

If reduction of greenhouse gas emissions is taken as an overarching objective of biofuel policy, all ‘social’ issues involving biofuels can be seen to be at the social-environmental interface: the food vs. fuel dilemma, employment, labour conditions and workers’ health, landownership, access to information and decision-making, etc. Different stakeholders hold widely varying opinions on these issues: while ethanol advocates emphasise the positive effects on employment generation, such as the higher wage level of sugarcane cutters as compared to comparable jobs in the agricultural sector, critics point out the often appalling working conditions of the field workers, widespread use of child labour, and the seasonality of much of the employment in the sector (Mendonça, 2006; Smeets et al., 2006; Kenfield, 2007). The recent move by the Brazilian government to ban the burning of the sugarcane fields so as to move from manual to mechanical harvest provides a typical example of a social-environmental trade-off: while abolishing the burning of fields reduces the harmful local environmental impacts (air and water pollution), the attendant health effects (e.g. emissions of particulates and carcinogenic substances released through burning), and improves working conditions, it considerably reduces the creation of especially non-skilled jobs (Macedo and Nogueira, 2004).

On a more general level, questions concern the distribution of social and environmental harms and benefits among social groups, but also equity at global and national levels: to what extent are the consumption and travel patterns of car-owning elites in Brazil and in the ethanol-importing countries justified in view of the social impacts of bioethanol production? The environmental benefits (reduced air pollution) of the Brazilian ethanol programme have largely accrued to the relatively well-off in the country’s urban areas – especially in São Paulo – while the bulk of the social and environmental damage has been borne by the poor in the Northeast, in the form of local water and air pollution, further concentration of land ownership and increasing seasonality of employment (e.g. Grenier, 1985; Smeets et al., 2006).

Finally, the social impacts of biofuels are conditioned by the distribution of benefits from technological innovation for next generation biofuels: the new technologies tend to require large amounts of capital and know-how, which are unlikely to be available in the less developed regions (WWI, 2006). The Brazilian Northeast is unlikely to have the capabilities to reap the benefits from innovation in advanced ethanol technologies. Not only does it lack the necessary human and financial capital, but the region’s industrial elites are known for their long-standing reluctance to invest in productivity improvement. This contrasts squarely with the country’s highly innovative Southeast region, particularly the state of São Paulo. Breaking the long legacy of ‘non-innovation’ remains one of the greatest social challenges in the Northeast. (Ziravello, 1988)

How to appraise social-environmental interface in the biofuels case?

Appraisal of the interaction between the social and the environmental dimensions presents a number of key questions. On a theoretical level, treating the social and the
environmental separately addresses only a part of the relevant topics, i.e. those for which clear causal relationships can be established. A more complex approach based e.g. on a coevolutionary model (e.g. Norgaard, 1994) along the lines of the multilevel perspective familiar from theories of socio-technical transitions (e.g. Geels, 2005; Smith et al., 2005) is likely to be more fruitful. The causal relationships between the social and environmental elements are often analytically highly intractable and where causality can be established, it often operates through the economic dimension. An obvious example is the impact of commodity prices on the location and methods of biofuel crop cultivation, which largely determine the social and environmental impacts.

Understanding the exercise of power is crucial for the appraisal of social-environmental interface. In the Brazilian context, the unequal power relations between São Paulo – the incontestable leader in ethanol sector – and the stagnant Northeast are crucial. Likewise, any treatment of the social problems of the Northeast cannot forego an analysis of the history of highly exploitative relations between the ruling elites and the poor, landless labourers within the region’s coastal ‘sugarcane zone’. Such inequalities have not only an economic dimension, but are reflected also in the unequal access to decision-making structures, and therefore pose a particular challenge to appraisal. Appraisal in general, and that of social-environmental interface in particular, should facilitate reasoned and inclusive debate in the spirit of deliberative democracy. In view of the unequal power relations and capabilities of stakeholders, organising such deliberative processes poses a real challenge. The matter is further complicated by the increasingly multilevel character of biofuels governance: who should participate, and through which mechanisms, in a deliberative biofuels appraisal when the range of stakeholders extends from landless peasants in the Brazilian Northeast to large biotech companies and car owners in Europe and the USA?

Possibly the trickiest appraisal question concerns the social preconditions for environmental and social sustainability. Since the social and environmental conditions in the biofuel producing regions are increasingly influenced by biofuel demand from the wealthier countries and regions, a proper appraisal of the social-environmental interface should facilitate debate on the linkages between the consumption patterns – i.e. travel modes – in the biofuel consuming areas and the social and environmental impacts in the producing regions. In particular, such an appraisal should consider the possibilities of and obstacles to changing the underlying consumption patterns. Such an analysis would also have the merit of broadening the scope from an exclusive attention to technologies towards a perspective encompassing also social innovations.

3.2 Biofuels within the broader development visions

The appraisal of the social-environmental interface is intimately linked with the way in which sustainable development is conceptualised, and indeed, on assumptions about the type of societal development pathway biofuels would enhance. The question is particularly relevant for the developing and middle-income countries eager to build their biofuel sectors as part of their development strategies.
Ever since being brought to the international political agenda soon after the Second World War, the concept of ‘development’ has been subject to varying interpretations. The dominance of the ‘modernisation as Westernisation’ model began to falter, first with the oil crises and economic stagnation in the 1970s, then partly because of the challenge of the emerging ‘sustainability’ agenda in the 1980s, and most recently, with the spectacular transformation taking place in the Asian countries. A number of distinguishing characteristics of the various development theories suggested since the Second World War (for a review, see e.g. Hettne, 1995) are of relevance for biofuel policies and appraisal.

**Key dimensions of development visions**

The first major divide between different development visions goes between theories that presume universal applicability as opposed to those emphasising the context-dependent nature of development strategies. The former often build on modernisation theories and/or neoclassical economics. The advocates of the latter view, by contrast, often evoke the success of the Asian countries (most notably and recently China and India), highlighting the importance of “finding one’s own way” and taking institutions seriously (Schmitz, 2008). A corollary to the universalism vs. context-dependence divide is the methodological debate concerning appraisal methods focusing on macro-level ‘top-down’ studies as opposed to local case-study approach. While arguably both should play a role, views diverge as to the balance and compatibility between the methods. The macro-level appraisals tend to hide the often great regional variation, whereas case studies lack in their capacity to detect general trends of, for example, GHG-emissions reductions resulting from biofuel use, or the global availability of land for biofuel crops. A further related question is that of aggregation vs. disaggregation, that is, to what extent is it feasible and desirable to aggregate and measure on single scale different types of impacts, occurring at different locations and points in time, and affecting different groups of people. Problems with aggregative methods, such as the cost-benefit analysis, are well known: the complexity of environmental problems, the existence of thresholds, tipping points and potentially irreversible effects; ethical and practical difficulties involved in discounting future costs and benefits; the impossibility of interpersonal utility comparisons; the dependence of efficiency on distributional issues; and the inapplicability of the Pareto efficiency criterion when deep disagreements prevail over the goals of society. Disaggregative methods, relying on the principle of ‘weak comparability’ of values, have been suggested as an alternative to aggregation. (e.g. Funtowicz and Ravetz, 1994; O’Neill, 1996; Martinez-Alier et al., 1998; Söderbaum, 1999)

The second divide goes between theories that emphasise internal forces as the main determinants of development, and those stressing the dependence of a country on the external environment. Linked to the external vs. internal debate is the old dispute concerning the respective roles of the State, the market and the civil society, and as a consequence, the diverging attitudes towards free trade and global capitalism. While the early modernisation theories had a clear ‘internal bias’, seeing development as a direct function of a country’s internal capacity to develop, the dependency theories that spread especially in Latin America since the late 1950s in response to the shortcomings of the modernisation theories went to the opposite extreme, often denying the ‘periphery’ countries of any freedom of manoeuvre within a global system governed by the ‘centre’ (e.g. Frank, 1969; Galtung, 1971; Cardoso and
Faletto, 1979). Early dependency theories advocated ‘delinking’ strategies and self-sufficiency aimed at liberating the ‘dependent’ countries from the unfavourable relationship with the ‘centre’ and inspired the import substitution industrialisation (ISI) policies in Latin America. Dependency thinking has continued to influence development thinking and policies in the region even after the ISI policies were abandoned. For example, in Brazil, the arguments of energy independence and national unity were successfully used in the early days of the ethanol programme in the 1970s to gather public support for the ethanol programme in the early 1970s (Sandalow, 2006), while the need to avoid excessive dependence on foreign capital and technology is frequently put forward in discussions concerning next generation biofuel technologies (Sugimoto, 2008).

The internal vs. external distinction may have lost some of its relevance with the advance of globalisation. Key strategic decisions for governments today concern not so much the degree of autonomy and self-reliance as such, but rather the best means of selective integration into the world economy. The ‘delinking’ strategies inspired by dependency theories have largely fallen out of fashion. By contrast, regionalism has become an increasingly popular development model since the late 1980s, as demonstrated for instance by the European integration, and the attempts towards regional cooperation both in Asia and Latin America. However, today’s regionalism is no longer perceived in terms of ‘collective self-reliance’, but as a means to attract more foreign direct investments, achieve economies of scale, increase market size, and gain a better bargaining position vis-à-vis external forces (Nederveen Pieterse, 2001, 58-59). Latin American regionalism could provide a convenient framework for biofuels development, yet it is far from self-evident that the countries of the region would find a common view on issues such as the role of the state in promoting biofuel use and innovation, and the balance between self-reliance and export-orientation. Both in its biofuel policy and agricultural policy more generally, Brazil is clearly seeking export markets and exploiting the high food commodity prices, whereas countries such as Argentina, Cuba and Mexico prioritise self-sufficiency and food security, for instance through imposing export tariffs on agricultural exports (e.g. Downie, 2008).

Rather than emphasising its Latin American allegiance, the Brazilian government, and large parts of its business and academic elite, see biofuels as an instrument for the country’s selective integration in world economy, the state actively facilitating the capture external markets by exploiting comparative advantages (cf. Wallerstein, 1979, 76). The main concern within such strategy is to ensure the country’s competitiveness and leadership in the area of ethanol technology and production (e.g. Bound, 2008), the sustainability of Brazilian biofuel being taken more or less for granted (Furlan, 2006). Technology exports constitute an important element of this ‘ethanol diplomacy’, a way to diversify global supply of ethanol. If Brazil held a disproportionate share of world ethanol markets, importing countries could begin to regard bioethanol as a threat rather than a contribution to energy security (Anonymous, 2008).
The attitudes towards the possible existence of planetary biophysical limits to growth likewise influence biofuel debates. While the modernisation theories and neoclassical or Marxist economics have traditionally downplayed or simply denied the role of external limits – emphasising the self-regulatory capacity of markets or the ‘iron laws’ of global capitalism – the question of limits has been very much in the forefront in biofuel debates. A common reference point has been the global availability of agricultural land for biofuel production, seen by many as the ultimate limiting factor (e.g. Bringezu and Steger, 2005). Views diverge, however, on the meaningfulness of such limits. While some argue that concern for limits is unnecessary as market forces – if let to reign freely – will allocate resources optimally, others place their faith in the ability of new biofuel technologies to push further the current limits to biofuel production (WWI, 2006).

Biofuel visions – ‘policy frames’

Many of the above issues distinguishing different development visions are present in Frow and Levidow’s (2007) analysis of biofuel debates. Their proposed typology consists of three ‘policy frames’: biofuel ‘proponents’, ‘managerialists’ and ‘sovereignists’. These ‘frames’ are close to the three broad development visions identified by Nederveen Pieterse (2001): the neoliberal, the human development and the alternative perspectives.

The proponents adhere to an eco-efficiency framing, inspired by a neoliberal vision, close to the most market-oriented views of ‘ecological modernisation’ (Mol and Spaargaren, 2000). It argues that economic growth, social justice and environmental protection are compatible in a free market framework. Sustainability would require the abolishment of trade barriers to facilitate the entry of new players and countries into biofuel markets. Investment in next generation biofuels is believed to be vital in order to improve crop yields, expand biofuel cultivation to marginal lands, ensure sufficient scale of production, and to minimise harmful environmental impacts. Policymakers should minimise uncertainty, and thereby create an environment conducive to investment. This view is, broadly speaking, represented by international economic organisations (e.g. IMF, World Bank, and WTO). The term ‘proponents’ no longer seems fully appropriate, as reports from international economic and financial organisations such as the OECD and the World Bank have recently criticised biofuel policies. However, their criticism is very much based on the principles of neoclassical economics, such as the need to remove ‘market distortions’ and trade barriers.

The managerialists mediate between proponents and the more radical critical views, trying to manage the conflicts and devise appropriate accountability mechanisms to achieve sustainability. They are close to Nederveen Pieterse’s (2001) ‘human development’ approach, which has its strongest advocates in the UN system. Market distortions would need to be corrected to resolve the mismanagement of resources, which lies at the root of unsustainability of biofuel policy. Unlike the proponents, the managerialists view land not only as a productive resource but also as a social and environmental asset. The view emphasises complexity, context-specificity, supply side policies and integrated government policy approach. It also advocates an integrated approach to appraisal and full life cycle assessments, yet recognising that

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2 Limits are here understood exclusively in the biophysical sense, even though the possible existence of ‘social limits to growth’ has been evoked as early as in the 1970s (Hirsch, 1976).
LCA results greatly depend on the definition of system boundaries. Ownership of the value-added parts of the production chain should be distributed more widely to avoid detrimental effects on livelihoods. Like the proponents, the managerialists place their hopes in next generation biofuels, yet provided that rigorous and binding certification and control systems are in place.

The ‘sovereignists’ are biofuel opponents, who can be placed within the broad, yet heterogeneous group advocating ‘alternative’ development models (Hettne, 1995; Nederveen Pieterse, 2001). Current biofuel development, relying on intensive monoculture and exploitative relations of production, is seen to threaten food security, local livelihoods, biodiversity, and water supplies, as well as leading to displacement of indigenous populations and social exclusion. Trade liberalisation threatens national and popular sovereignty by concentrating resources in the hands of agribusiness and industry, with large landowners as the major beneficiaries of biofuel production. Only small-scale biofuels, produced and consumed locally, are believed to be sustainable. Next generation biofuel technologies are seen to entail high risks, and leave unchallenged the prevailing patterns of intensive monoculture farming and ever-increasing energy demand. New technologies are seen as a way to sneak in genetically manipulated crops and as a pretext to expand current first generation biofuel production. Certification and LCAs are believed to be incapable of addressing the serious, potentially irreversible impacts and the indirect land use changes. Dissenting views are generally represented by international and national human rights and environmental NGOs and labour unions (e.g. Mendonça, 2006; Kenfield, 2007; e.g. da Silva, 2008).

A fundamental dividing line goes between those biofuel visions promoting small-scale biofuel production for local markets as the only sustainable, and others seeing only large-scale biofuel production to provide sufficient economic efficiency as well as environmental benefits at a scale of any significance for climate change mitigation. As an integral element of President Lula’s anti-poverty campaign, the Brazilian government launched in January 2005 the national biodiesel programme, whose explicit aim is to support small-scale biodiesel production from local smallholders’ crops, (e.g. oil palm, castor bean or jatropha). Until today, and despite the subsidies and tax exemptions accorded to small-scale producers, soybeans mainly from large-scale plantations are estimated to account for about 59% of the biodiesel production in the country (Rodrigues, 2006, 22-23), and the great promises of smallholder-sourced biodiesel remain largely unfulfilled. Technically, some of the smallholder crops have a far greater potential yields than soy, which however dominates the market thanks to economies of scale and the support institutions and infrastructures built up over the years. (Horta Nogueira, 2008).

Comparison with the early years of the ethanol programme is interesting in this regard. The ethanol programme grew from needs to ensure national energy security, prevent economic slowdown and protect and powerful car and sugar industries from an imminent collapse, yet it also had social and regional policy objectives. Hence, manioc cultivated by smallholders and sugarcane ethanol from less capital-intensive “mini-distilleries” were foreseen to supply a significant part of the ethanol. Mini-distilleries were uneconomical and unable to compete with the large ones, whereas ethanol yields per hectare from manioc were not high enough to challenge the monopoly of sugarcane as the exclusive ethanol feedstock. The outcome was due not
only to the inherent superiority of sugarcane in converting solar energy into sugar, but also to the learning accumulated throughout the more than four centuries of sugar production, and to ability of the sugar industry lobby to steer the ethanol programme to its own benefit. (Johnson, 1983; Demetrius, 1990) In view of the inherent large-scale bias in the foreseen next generation technologies (WWI 2006), it is easy to see why the next generation promise is seen with particular scepticism by many development NGOs.

**Natural-resource based development model**

The question concerning small and large scale solutions also appears in a specific variant of development models which has recently gained currency among scholars, business leaders and politicians in Latin America. This model would exploit the region’s comparative advantage in natural resources, but in a more ‘intelligent’ manner, through the application of a combination of bio- and nanotechnologies, bioelectronics, new materials and new energies, socially shaped by growing environmental awareness and concerns (Perez, 2008). The current and likely continuing ‘boom’ in commodity prices, fuelled in particular by demand from China and India, would provide resources needed to finance the investments. Development policy would be based on a ‘dual integrated model’, consisting of a world-market oriented sector exploring the technological frontiers on the one hand, and a bottom-up strategy seeking to identify and promote wealth-creating activities aimed at whichever market is the most suitable – local, national, or global. The former half of the strategy would operate as an ‘engine of growth’, while the bottom-up strategy would explicitly aim at poverty reduction. (ibid.) Next generation biofuels could be a precursor and a test case for this new kind of development model, with Brazil as a self-evident leader in the area, thanks to its more than three decades of experience in policies of active biofuel support.

A natural-resource based development model is highly controversial as it openly challenges the ‘resource curse’ hypothesis, which has since the late 1980s gained popularity among academics, international organisations and NGOs. The hypothesis suggests that resource-based development gives rise to negative economic, political and social outcomes, for instance, because of the inability of resource-based development to induce the economy-wide innovation needed to sustain growth in a small open economy (Barbier, 2005; Rosser, 2006).

There is an emerging consensus that the relationship between natural resource wealth and development is not direct, but instead mediated by a number of political and social variables (Rosser, 2006). In other words, inadequate institutions both within and outside of the country are to blame, not natural resources *per se*. However, there are further ‘ifs’ as to both the viability of the resource-based development model and the ability of next generation technologies to contribute to such a vision. First, if applied across the world, technological breakthroughs allowing the exploitation of new raw materials (esp. cellulose) might in fact reduce Brazil’s current advantage in ethanol production, which partly stems from the natural advantage of sugarcane as a feedstock. Second, the articulation between the two strategies – the top-down and the bottom-up ones – is crucial and problematic. In order for the model to be environmentally sustainable, the world-market oriented sectors would need to be ‘greened’. The extent to which knowledge-intensive, environmentally more
sustainable production would achieve sufficient competitiveness in global markets is uncertain and highly dependent on the evolution of international regulatory frameworks. In principle, the ‘greening’ of the world-market oriented half of the economy could be stimulated by the innovations and competitive pressures from the bottom-up half, but a more likely scenario might be a widening of the gap between the ‘green’, ‘small is beautiful’ parts of the economy and the dominant ‘grey’ economy driven by the search for global competitiveness. Also the vision in which sustainability would mainly spring from bottom-up, small scale sustainable niches is problematic in view of the scale and urgency of global problems that would need to be tackled. The local niches would require active nurturing and support from the State and other stakeholders (van der Laak et al., 2007).

The third problem with the resource-based model is perhaps the most fundamental, as it relates to the unequal distribution of power and the questions concerning the possible alliances that could bring about the desired changes. As long as development in the domestic markets is dominated and controlled by local and regional elites, which is very much the case in the sugar and alcohol sector in the Brazilian Northeast, it may be difficult to integrate the local scale ‘sustainable’ niches into a comprehensive development model. The elites might be further integrated into the international value networks, but without generating the links to local grassroots necessary for local development. Another scenario could be that the entire local markets would become further isolated from international markets, which would effectively remove international pressure towards more sustainable production methods. However, arguably pressure from the international community would be essential for progressive social change in the Brazilian sugar and alcohol sector. An attempt by the regional elites to respond to international pressures has been the call for a ‘social certificate’ to ethanol produced in the region, following the example of the ‘social seal’ accorded to biodiesel produced by small producers in the North and the Northeast regions (Bacoccina, 2007). In view of the persistence of the centuries-long tradition of exploitative practices and highly unequal social relationships in the sugarcane-growing zone in the Northeast, such demands raise questions about the viability of progressive change.

3.3 Technology expectations and next generation biofuels

The third issue relevant for the biofuels policy and appraisal context relates to the expectations concerning the future biofuel technologies. There is a growing consensus that for biofuels to be sustainable on any significant scale, technological breakthroughs will be needed to allow the production of biofuel from lingo-cellulose. These ‘next generation’ biofuels would have the advantage of avoiding direct competition with food crops, and the potential yields per hectare would greatly exceed those observed for the current ‘first generation’ biofuels. Opinions diverge as to the date at which such technologies might become commercially viable, but most observers agree that at least ten years will be needed for the maturation of the technology, and that significant government support will be needed to bring about the change.

Earlier research on the role of expectations in shaping the development of socio-technical regimes has pointed at the so-called hype-disappointment cycles, in which
expectations rise rapidly to highly inflated levels, only to collapse soon afterwards, once technologies fail to live up to the ‘hyped’ expectations. Clearly, the current debate on biofuels carries the risk of such a cycle. Since the 1st generation biofuels are increasingly seen as unsustainable, and next generation technologies are portrayed as the ‘only sustainable’ alternative, the stakes are high for the biofuel proponents and policymakers. As long as the promise of new advanced technologies is alive, continuing support to the current biofuels can be justified as a way to build a ‘bridge’ towards more sustainable technologies. By contrast, if a sentiment spreads that the next generation promise rests on unfounded assumptions, the whole biofuel industry comes under threat. Uncertainties concern not only the next generation technologies as such, but also and above all their requirements in terms of institutions and infrastructure. For example, new biofuel technologies would compete with renewable heat and electricity production for the same biomass raw material, and the collection and transport of the raw material would require extensive infrastructure, with largely unknown costs and environmental impacts. (Doornbosch and Steenblick, 2007; RFA, 2008) Uncertain is also whether support to current technologies actually facilitates or indeed hinders the development of radically new biofuel technologies – i.e. is 1st generation a bridge or a barrier to new technologies? A balance must be struck between the needs to ensure the sustainability of biofuel production and to avoid too strict sustainability standards from discouraging innovation and eventually even killing the growing industry.

Like ‘repertoires’, which shape the influence of appraisal, also expectations are a social construct. They are influential not only because individuals act in accordance to their own expectations about technologies, but also because people behave react to the expectations of others. Widely shared expectations become part of a generalised and taken-for-granted social repertoire. Actors assume that others share these expectations or, at a minimum, that they are aware of them and will act accordingly. This is why the conventional explanation to the hype-disappointment cycle – that disappointment is caused by a discrepancy between inflated expectations and the ‘hard’ reality – is insufficient. Many actors may indeed participate in ‘spirals of hype’ without necessarily having an interest in contributing to these expectations. (Konrad, 2006)

Konrad (2006) refers to the way in which certain evaluation criteria are suspended and certain background assumptions taken for granted during the process when expectations are created and a ‘protected space’ is created for a new technology. Once expectations collapse, these criteria are reactivated and the evaluation criteria re-examined. Consequently, the results of technology evaluation are rapidly reinterpreted, without necessarily having changed very much in substance. The performance of technologies is interpreted in the light of the very expectations they are supposed to ‘validate’; the ‘hard facts’ – evaluation criteria – are themselves subject to interpretation. (Konrad, 2006, 438-439)

These insights are critical for biofuel appraisal. Since the criteria for appraising biofuel options and technologies depend on the expectations concerning technological progress, and since those criteria themselves are constructed through social interaction, there is no ultimate “Archimedes’ point” from which to appraise the options. Furthermore, it is easy to see how the appraisal of different first generation biofuel options becomes contingent on the expectations concerning technological progress: for instance, if it is believed that the development of possible next
generation biofuels requires the support of a mature first generation biofuel market and associated institutions, the current technologies are appraised far more favourably than if next generation biofuels are seen as autonomous technologies, with their own development dynamics.

The interactions between generic and localised expectations (Eames et al., 2006), local projects and global niches (Geels and Raven, 2006), and between collective expectations and more specific expectations held by innovation communities (Konrad, 2006) are crucial also for next generation biofuels and their appraisal. Eames et al. (2006) have argued that before the general societal visions – in our case the development visions within which biofuel futures are embedded – can become concrete, they need to be “re-invented and grounded in local agendas and contexts”. This selective translation of the generic visions into local projects and activities involves negotiations of collective expectations that bring to play different social interests. In the case of Brazil, likely points of contestation include the role of the country in global biofuel innovation networks and activities, and the relative importance given to the objectives of ensuring the global competitiveness of Brazil as a biofuel technology supplier on the one hand, and developing small-scale, ‘appropriate’, locally adapted technologies in the poorer regions on the other. Brazil is a major player in shaping expectations around the next generation biofuels, steering innovation efforts, and influencing assessment, standardisation and certification schemes currently under development, and could therefore seek to combine both local development and national competitiveness objectives. At present, innovation for new biofuel (especially ethanol) technology is heavily concentrated in the prosperous Southeast region (Bound, 2008). With the abolishment of the national sugar and alcohol institute (IAA) in 1990, the Northeast lost the institution that had traditionally attended to the needs of the region in particular by developing cane varieties suitable to the local conditions (Lima and Sicsú, 2001).

The fate of manioc and micro-scale ethanol distilleries referred to above provides an interesting example of the role of expectations. The sugar lobby certainly used technology expectations strategically to advance its own preferred option – by emphasising the low yields and poor profitability of manioc in comparison to sugarcane. However, the inferiority of manioc and mini-distilleries was likewise emphasised by academics with no links to the industry (Nitsch, 1990). The arguments by the ‘neutral’ experts then became part of the process whereby expectations were created – both strategically by different interest groups and in more subtle ways, through exchanges of expectations between actors. (cf. Konrad, 2006).

The specific technology expectations held by innovation communities and individuals on the one hand, and the collective technology expectations on the other, are embedded within broader development visions of the kind described in the previous section. This highlights the normative nature of expectations as essential ingredients in ‘utopias’ that stimulate and shape technological development (Berkhout 2006). Technology expectations hence have a double role. On the one hand, they are shaped by the broad development visions: whether a technological expectation is appraised positively depends on the normative development model within which the technology is believed to operate. While the visions of the biofuel ‘promoters’ and ‘managerialists’, referred to above, see cellulose-based next generation technologies as a prerequisite for sustainable biofuels, the alternative visions emphasising
sovereignty see them as detrimental to their preferred development vision. On the other hand, expectations concerning what is deemed as technically possible in the future are themselves influenced by the more general normative framework and policy expectations. For instance, a neoliberal vision might expect markets to stimulate the emergence of large-scale, capital-intensive cellulose-based biofuel systems as the most efficient option, whereas an alternative vision emphasising small-scale community-based development would expect policies to stimulate the emergence of locally adapted, labour-intensive biofuel technologies suitable to production for local markets.

In conclusion, expectations around future ‘next generation’ biofuel technologies play a pivotal role in shaping the way in which current biofuel options are appraised. For example the recent report by the UK government predicting that new advanced technologies would not be available at any significant scale before 2018 (RFA, 2008), would have arrived at quite different policy conclusions, had it placed the breakthrough date of new technologies far earlier. High-level political games are being played as corporate and other actors (e.g. biotechnology and oil industry, ethanol industries, researchers and research institutes) with an interest in promoting specific technologies strategically seek to shape expectations to suit their needs (EU, Brazil, NGOs). The Brazilian government’s interest in demonstrating the sustainability of ethanol produced in the country, and the abundance of agricultural land for sugarcane expansion is a clear example of such a strategic game. However, expectations also emerge in more subtle and unforeseeable manner, through social interaction and communication between different expectations.

4. Conclusions

This paper has argued that the political and institutional context plays a decisive role in affecting the influence of biofuel policy appraisals, illustrating this role through examples on the framing of appraisals. What practical lessons for biofuel appraisal can be drawn from the examples described in this paper?

First, the nature of sustainable development as a contested, open, and multidimensional process implies that any analytical appraisal framework is bound to represent only a temporary agreement, which evolves along with our understanding of sustainability (Simon, 2003, 6). Instead of searching for a universally applicable framework – an idea inconsistent with our understanding of human–environment systems, and therefore theoretically unfounded and practically problematic (Norgaard, 1994; Hukkinen, 2003) – the principle advocated here is one of ‘methodological pluralism’, entailing examination of the topic from various disciplinary and paradigmatic perspectives, and adjusting methods to the context. The futility of trying to compress into one-dimensional measurement the multitude of values, perspectives, and worldviews involved is especially relevant for the appraisal of the social-environmental interface. In the context of highly unequal power relations characteristic to the Brazilian bioethanol institutions, the relatively technical assessments conducted from inside the country’s biofuel regime should be complemented by critical ‘outsider’ appraisals, encompassing the multiple levels affecting biofuel development in Brazil.
It can be argued that the interaction between different dimensions of sustainability, not least between the social and the environmental ones, is best analysed at the local level, where the “questions of socially sustainable development become concrete, where the interactions between the different dimensions are most explicit, and where participation and dialogue are the most feasible” (Theys, 2002; Lehtonen, 2004, 208), 208). As suggested by Theys (2002), the macro level could have the tasks of establishing general principles of sustainability and identifying clearly unsustainable practices. While life cycle assessments can hardly be used to demonstrate the sustainability of a given biofuel option, they can be applied to identify which options are clearly unsustainable. Scenarios for land use changes resulting from the expansion of biofuels at global, regional and national levels could fulfil a similar function. Participatory appraisals and case studies at the local level would be needed to address local and regional variation and social-environmental interactions. Yet adequate participation should be organised at the macro levels as well, together with mechanisms to ensure proper interaction between the macro and micro level appraisals. However, the practical implementation of such an approach poses challenges. Which would be the institutions able to ensure adequate interaction between the levels and appropriate participation mechanisms to facilitate truly democratic deliberation? How to ensure that the appraisal framing and the implementation of sustainability policies (e.g. certification systems) are not jeopardised by capture by powerful interests – not only at local, but also at the international level?

While definite answers and ready-made solutions to these questions do not exist, systematic analysis of power relations and the policymaking context in which the appraisals take place should be an essential yet alone insufficient condition for success. Disaggregative appraisal methods are demonstrably more conducive to democratic deliberation (e.g. Stagl, 2007), and should therefore be given priority. Yet the question is not one of choosing between aggregation and disaggregation, but striking a balance between the two, taking into account the purpose, communication context, and the organisational scale of the appraisal. Appropriate level of aggregation should be sought through deliberation, in an attempt to attain ‘representative diversity’ across production sites, stakeholder types, and performance issues. (O’Connor and Spangenberg, 2004, 3).

A further challenge is organising appraisal in such a way as to facilitate debate on the development models and strategies underlying specific biofuel options and advocated by different stakeholders. This should involve on the one hand ‘empowerment’ of the weaker perspectives – which may or may not mean empowering specific weaker stakeholder groups – but also constant efforts to make explicit the assumptions and values underlying appraisal, including the underlying technology expectations and their links with the broader development visions. In this way, both the process and outcome of biofuel appraisal could contribute to development as a process of collective learning, as suggested by Nederveen Pieterse (2001, 158-159). The appraisal expert would have a key responsibility in such processes – not as an ‘independent’, ‘neutral’ outsider, but as a context-conscious facilitator of meaningful and well-informed interaction between stakeholders. Navigating in the highly politicised context of biofuel assessment is anything but straightforward, yet the solution is to embrace the context and politics, rather than hiding behind the veil of illusory neutrality.
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