The inclusion of Environmental concerns in the development of Biofuel Policies for Transport

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Abstract

Biofuels are providing an increasing percentage of the transportation fuel in Europe. The reference value given for a potential expected market increase has been 5 % by the end of 2010, presumably half of this increase would need to be supplied by trade and international biofuel markets according to the European Commission. An important question that needs addressing is whether international trade on biofuels for transport can be developed in a way that is socially and environmentally sustainable. This paper attempts to provide an initial answer to this question. The paper provides a comparative review of the characterization and accounting of environmental impacts of biofuel production, distribution and consumption that informs the development of local policies and decisions about import/export capabilities in selected countries. The paper consists primarily on a summary report on the findings of a desk-study review of official national published reports, websites, and comparative international studies. The scope of the search considered general assessment on biofuels published in at least three European countries, international organizations and a couple of other main biofuel producer/consumers (US, Brazil). The findings are grouped in categories: regarding the assumptions and emphasis given in each country/study, listing the environmental implications considered and the development of frameworks to handle the sustainability impacts of biofuel production. The results seek to highlight critical findings and compare diverse policy development in terms of areas of emphasis, emerging concepts, use of frameworks for analysis of environmental impacts, setting of targets and conditions for sustainability. The study reveals that significant uncertainty remains in methodologies and factors used to assess environmental impacts.– including calculations of GHG and energy balances. Further development of the life-cycle assessment tool for biofuels is essential specifically to give greater attention to subjects such as human, social and ecological health, biodiversity and land changes, all of which need to be featuring as prominently in the assessment as the concerns about climate change and resource depletion. The need for the emergence of new institutions at the local level that can give credibility to monitoring efforts and global implementation of stringent sustainability standards for biofuel production, distribution and consumption appears to be one of the greatest and more difficult challenges that needs addressing.

1 Introduction

- Biofuels seen as solution to multiple problems (energy security, climate, development), but soon challenged by events come to be contested in several grounds (food security, environment, climate, sustainability).
- Europe is the third largest marked/producer of biofuels (IEA-reference) and this development has been helped by the targets established by European union of 5,75% biofuels for transport by 2010, and the latest 10% renewable by 2020.
- With the escalating demand for 1st generation biofuels (bio-ethanol but mostly bio-diesel in Europe) European countries have reacted differently but all together a more cautious approach than the U.S which overtook Brazil as the largest producer in 200? (IEA-study).
- While some EU countries have been taking accelerated steps (policies, direct programs) to meet the targets and beyond (Germany, Sweden), others have advanced more cautiously producing a number of studies that evaluate their domestic potential for biofuel production and taking progressive steps to meet those targets (UK, Netherlands). Still others (DK) have kept a low profile on the development of 1st generation biofuels and are attempting to leap frog to produce 2nd generation biofuels.
- While early studies assigned a significant large potential for biofuels production to Europe in general (references), this potential was largely concerned with the availability of land for cultivation, the energy yields per ton of product and potential contributions to climate change emission reduction (references);
- As biofuel markets develop a number of issues of greater significance where soon made evident and need urgent international consideration.
- Of particular relevance to this review is the characterization and accounting of environmental impacts of biofuel production for export as there exists growing expectation that in coming years an increased share up to half of the EU biofuel supply in 2030, will be supplied by trade and biofuel markets (European Commission, 2006).

Objectives Aim of paper

-To highlight and summarize critical points on the treatment of environmental and social implications of local biofuel production, distribution and consumption affecting import/export capabilities.

-To highlight critical findings that could affect policy development (e.g. emerging concepts and/or frameworks for analysis of environmental impacts, sustainability criteria, monitoring frameworks, new institutional setup).

2 Methodology

-The paper orientation is a policy analysis. The main preocupacion is with the evolution of the “policy process” associated with biofuels production and consumption as it deals with transport and environment.

-The paper develops a comparison of basic knowledge of policy content, processes and impacts;

-As such it takes a look at the different governmental approaches taken in individual EU countries toward the development of biofuel domestic markets (transport); how the addition of a endogenously generated demand for biofuels results on specific pressures for the fast development of a full fledge bioenergy industry in many developing countries, with good and not so good consequences; and how we may be in need of taken now strong steps to bring under track forces that now have been unleashed in one as yet undesirable direction, before more harm is done to the speed at which 1st generation biofuels are deployed and .

-It places importance to national policy initiatives, presented in official documents and major studies produced by international institutions to orient those policies. For technical references the readers are invited to look deeper into the many references available today on the technical aspects of biofuel development.

-The paper dwells into the EU documentation and the Danish case and discusses different aspects using as a context the experiences in UK, Netherlands and Sweden, the review included:

- One Review paper (1996-2004)(Summary 47 studies examples from North&South America, Australia, Europe,China, India and South Africa.

- Six Country reviews (Brazil(2008); Brazil (2007);Switzerland(2007); UK(2007); Italy(2005); USA(2007).

-Six EU reports(EU Comission(2003, 2003,2005,2006); EEA(2006,2007);

-Seven International (IEA(2004); OECD(2008); GEF(2007); UN-Energy (2007); International Food Policy Research Institute (2006)

A total of 20 scientific papers, scenario studies and diverse assessments on the future of biofuels at a larger scale have been revised.

The initial classification placed the reports according to their scope of analysis:
Country Level: (Zahet al. 2007); (Giampietro and Ugliati 2005); (Martinelli and Filoso 2008);(Elghaliet al. 2007); (De Almeida 2007); (Kammenet al. 2007);
European level: (European Environmental Agency (EEA) 2006); (European Environmental Agency (EEA) 2007); (European Comission and Directorate General for Research 2006); (Wakkeret al. 2008); (Mehlinet al. 2003); (Kavalovet al. 2003); and

International Level: (United Nations 2007); (Organisation for Economic Cooperation and Development (OECD) and International Transport Forum (ITF) 2008); (Fulton, Howes, and Hardy 2004); (Global Environmental Facility (GEF) and Scientific and Technical Advisory Panel (STAP) 2007); (Rosegrantet al. 2006); (Blottnitz and Curran 2007); (Steenblik 2007); (Woods and Diaz-Chavez 2007)

3. How the studies address Environmental Concerns

3.1 What is included in the Assessment of Environmental Implications?

--Brazil: soil degradation, deterioration of aquatic systems, nitrogen pollution, destruction of riparian ecosystems, consequences of sugar cane burning; public health and social issues such as: respiratory diseases from sugarcane burning, exploitation of cane cutters (Martinelli, 2008)

--Italy: biophysical constraints associated with societal metabolism (flow of food); and with feasibility of an energy sector based on biomass(labor, land, water) (Giampietro,2005)

--Switzerland: performed an Ecological LCA: most of the environmental impacts can be attributed to the agricultural cultivation of the feedstock. Study shows there is a trade-off between minimizing GHG emissions and a positive ecological LCA.

--USA: Principles and Criteria Environmental standards for Biofuel Crops (Kammen, Farrell, et al. 2007):

Conservation of carbon stocks
– Protection of above-ground carbon
– Protection of soil carbon
-Conservation of biodiversity
– Conservation of important ecosystems & species
– Basic good biodiversity practices
-Sustainable use of water resources
– Efficient water use in water critical areas
– Avoidance of diffuse water pollution
-Maintenance of soil fertility
– Protection of soil structure and avoidance of erosion
– Maintain nutrient status
– Good fertiliser practice
-Good agricultural practice
– Use of inputs complies with relevant legislation
– *Use of inputs justified by documented problem*
– Safe handling of materials
-Waste management
– Waste management complies with relevant legislation
– Safe storage and segregation of wastes

--International: GEF: soil, water, biodiversity, land degradation, water and food production, job creation, development co-benefits. (GEF/STAP 2007)

- International UN-Energy: Sustainability Issues
-Ability of Modern Bioenergy to provide Energy Services for the Poor
-Implications for Agro-Industrial Development and Job Creation
-Health and Gender Implications of Modern Bioenergy
-Implications for the Structure of Agriculture
-Implications for Food Security
-Implications for Government Budget
-Implications for Trade, Foreign Exchange Balances, Energy Security

-Impacts on Biodiversity and Natural Resource Management
-Implications on Climate Change

3.2 A review of the assumptions made in the EEA Report (2006) regarding how much biomass can Europe use without harming the environment revealed that:

-The report defined a large environmental compatible potential of Europe as: biomass technically available assuming no additional pressures to biodiversity, soil and water resources compared to a development without increased bioenergy production.

-Large potential assumed that only land released from food and feed production (as a result of increased agricultural yields and market liberalization, etc) could become available for bioenergy. Unfortunately this assumption was proven wrong as farmers in Europe demonstrated they preferred to produce products within certain prices, and the combined effect of subsidies plus the CO2 rights trading system led to an increased demand for biomass and replacement of cultivations of corn, cereals soy (Petrou, 2009).

-The large potential found was also assuming the introduction of advanced biomass conversion technologies.

-Finally ther report considered a number of environmental constraints for biodiversity, limits to maintain cultivated agricultural areas, minimize soil erosion, maintain current protected forest areas etc, which could inform the setting of standards in the new EU VE Directive. Otherwise as direct environmental constraints the more specific environmental constraints used in this study are difficult to replicate as "assumptions" or "constraints" intended to delimit imported biofuels in our variante scenario.

4. Addressing Social Concerns

4.1 Affecting Future Policy Development:

Emerging Concepts

A *code for ethanol* production that is environmentally sustainable and economically fair. (Martinelli, et all(2008)

Desirability of an energy sector powered by biofuels: multicriteria approach, criteria of performance, concepts of societal and ecosystem metabolism (Giampietro and Ugliati 2005).

Sustainability safeguards (standards) (sustainable land use management, exclusion of biofuels by clearing forest land, exclusion of production of biofuels with negative or uncertain GHG emissions); *Interlinkages and multiple benefits-* biodiversity&rural development; *integrated national biomass* strategies. GEF/STATP(2007)

Environmentally-compatible biomass potential:(European Environmental Agency (EEA) 2006);

4.2 Analysis of performance (economic, social), projections

-Economics of Biofuels: most studies address to some degree biofuel market development, or deal with International markets and trade barriers (Steenblik, 2007; VIEWLs Wakker, et al.,2008).

-Environmental and Social Impacts: called for but not studied in detail in UN, GEF, the two Brazilian studies

5. Addressing Economic, Climate and Energy security concerns

5.1 A number of studies develop scenarios focusing on:

--Land use changes
--Food Balance
--Vision on Technical Potential
--Techno-Economic Potential
--Desirability
--Exploring Pathways within transport
--Global Scenarios (production, cost, trade, other sectors)

5.2 Scenario Scope

--Amount of *Biomass Technically available* without increasing environmental pressure
--Food Balance: Changes in *World prices of Feedstock*
--Vision: *Technology Road Map*
--*Techno-Economic Potential* of EUCandidate Countries
--*Desirability:* societal and ecosystem metabolisms
--Pathways: Road, Inland Navigation, Rail, Airplanes
--Global Scenarios: larger socio-economic impacts cost, trade, employment, other stationary sectors (heat)

5.3 Scenario: Methods

--Most studies follow a quantitative approach
--Very complex sets of assumptions/boundary definitions
--One includes a Participatory & qualitative approaches PRELUDe
--Many studies claim LCA based but not really performing a full life cycle analysis.
--Environmental concerns down to energy and GHG emission considerations
--Larger socio-economic impacts cost, trade, employment, not fully on board.

6. Development of Sustainability Criteria, Frameworks, Institutional concerns

Can a focus be given to the design of policies that reward environmental performance and sustainability of biofuels? A look into the EEA report and the EU Sustainability criteria

6.1 Development of frameworks

-Sustainability framework ”whole system analysis” for Assessment of bioenergy systems (case UK) assess potential future trajectories of technologies and relate them to social acceptability through stakeholder participation. Linked to TSEC-Biosys a mayor research program (Elghali et.al 2007)

-Integrated Assessment of Large-Scale Biofuels Production (case Italy) (Giampietro 2005)

-Framework for Analysis of Energy&GHG Impacts (case USA)(Kammen, Ferrel et all 2007) http://rael.berkeley.edu

-UN-Energy a sustainable bioenergy framework for decision-makers (2007) More a list of key sust. Issues

6.2 Treatment of Environmental Implications of Imported Biofuels:

-*”In 2005* ***trade*** *covered about 10% of the world’s ethanol consumption. The percentage of vegetable oil used for biofuel feedstock (or as SVO) and biodiesel that was sourced abroad is unknown, but unlikely exceeded 10% of the market in 2005”* (*Walter et.all, 2007 quoted in* Steenblik, R, in OECD 2008)

-*”Half of the EU biofuel supply in 2030 could be covered by domestic production and half by imports” (European Comission and Directorate General for Research 2006)*

-Current requirements considered being imposed on biofuel trade on either *feedstocks (*such as palm oil); or *final products* that relate to non-product-related processes or *production methods*. The standards and regulations under consideration concern:

a) Private sector standards: voluntary
Round Table on Sustainable Palm Oil www.rspo.org ; Better Sugar Cane Initiative www.bettersugarcane.org ; Round Table for Sustainable Biofuels drafted principles and criteria for biofuel sustainability: -green house gas life-cycle efficiency; -environmental impacts (biodiversity, soil, water); -social impacts (labor rights, food security; -easy of implementation

b) Government voluntary standards: reward performance

c) Regulation for tax exemptions or subsidies

d) Regulations linked to achievement of a policy goal(Steenblik, R, in OECD 2008)

Leading examples:

UK's Renewable Transport Fuel Obligation, http://www.dft.gov.uk/pgr/roads/environment/rtfo/. Oblige fuel suppliers to provide 5% by 2010 of their aggregate sales as biofuels and to submit reports on net GHG savings and sustainability of the biofuels supply. (Steenblik, R, in OECD 2008)

USA: Low Carbon Fuel Standards Developments (LCFS) USA-North America Renewable and Appropriate Energy Laboratory - rael.berkeley.edu (Kemmen&Farrell, 2007)
o California: regulations to be in effect 2010
o Federal bills: Boxer, Feinstein, Obama, Inslee, etc.
o British Columbia (May, 2007), WA, OR, AZ, NM, MN, and…?

Netherlands: Cramer Commission (May07)
http://www.mvo.nl/biobrandstoffen/download/070427-CramerFinalReport_EN.pdf

Global Round Table on Sustainable Biofuels
http://www.bioenergywiki.net/index.php/Roundtable_on_Sustainable_Biofuels

Steering Board request for feedback and comments on draft principles from stakeholders around the world (05jun07). Global outlook on: GHG emissions, economics of biofuels, certification, potential for 2nd generation fuels, potential for Brazilian ethanol exports: the latest Round Table report OECD/ITC, 2008. You can access parts of the final report at this link: http://www.internationaltransportforum.org/jtrc/roundtables.html

Eu Directive. An important step regarding effects on environment from biofuels was given last December with EU VE Direktive. Article 17 starts laying ground for "Sustainability Criteria for Biofuels and other liquid bioenergy" However, most of the work is still in progress and a couple of Comissions are currently working on defining more precisely the content and extent of this article. One of the committee will produce a proposal for a "system of verification" of the sustainability criteria. Next June there should be more concrete work coming out on how this system will work.

A further review to the content of Articles 17, 18 and 19 of the Directive (Teknologi Rådet, 2009) shows that:

-Similarly to EEA report the criteria seeks to limit the type of land that can be devoted to biofuel production (not forest, other protected areas, etc)

-The way to deal with biofuel production in other countries is via reports (one every 2 years to the EU Parliament describing effects of biofuels policies on food prices etc) policies could be reviewed upon results of this report. Report will also cover other sustainability conditions as social sustainability and other development questions.

-The way to deal with international markets will be trading ONLY with countries through multilateral and bilateral agreements, with countries committed to respect and report on these criteria. Also only countries that have ratify a number of international conventions (child work, equal salaries for women and men, community development of land, protection of wild animals and so forth)

-The articles set a number of deadlines for future development of this directive, of the criteria and of the system for verification and certification (it mentions that a system based on 'Mass-balance' will be established.

-Mentioned specifically there is a large list of land areas were biofuel production should not take place such as: critical ecosystems, natural protected areas (wetlands, forest, grass areas with high biodiversity value); areas set aside for erosion control, it sets criteria for protection of earth, water, air, CO2 reduction, utilization of raw material, deforestation, pressure on land use replacement or extension.

-Other criteria that will be reported in the bi-annual reports deal with social sustainability: rights to access to land, child labour, other job conditions, contributions to regional and local development and effects on food market prices. However, the directive expects that countries will be able to report on this, I am not sure that this will amount to specific enforcement of "social sustainability criteria" that can be subject to verification.

-Verification and close attention to the social- economic is vital as these factors can create all the conditions for exploitation of the environment via for example: pressure for competing land use, intensive use of pesticide and fertilizer leading to contamination of surface water (eutrophication, eco-toxicity); indiscriminate use of genetically modified organisms (GMO's) in biomass cultivation. GMO´s are restricted in Europe but not elsewhere. The directive, by the way, does not mention GMO's use restrictions or standards.

-A significant increase of imported biofuels will also need to consider the effects of fossil fuels use in transport and the logistic needed in such an enlarged biomass cultivation, harvesting, collection, and world-wide distribution. All of this can lead to the development of a large locked economic sector with disastrous global importance (Petrou, 2009)

The German Advisory Council on Global Change (WBGU, 2008) advice that "this is a task that can only be accomplished through world-wide cooperation and the creation of an international regulatory framework: e.g. a revised UN climate regime

The WBGU 2008 report reconsiders what is the global sustainable potential of energy crops considering as in the EEA report:
-Future land requirements for food security
-Nature conservation
-Exclusion of reserved lands wetlands, forest
-Climate emissions
-Irrigation

However they go beyond and after this technical potential they substrate:
-economic and political viability
-pre-conditions for rapid realization of the technical potential:
-minimum level of security and political stability
-significant investment activity
-fragility of the state (civil war)
-infrastructure related and logistical capacity
-basic level of regulatory competence (to implement sustainability requirements)

WBGU 2008 defines 5 regions in light of these factors (were the potential for sustainable biofuel production could take place)
-Central and South America (tropical and subtropical latitudes) 8-25 EJ/year
-China (good political and economic conditions) 4-15 EJ/year
-Indian subcontinent (2-4 EJ/year)
-South- East Asia (1-11 EJ/ year)

-However the report sees particular challenges in all of these areas in the form of high land-use density, risk to food security, deforestation and need to conserve biological biodiversity

-Undesirable developments from unregulated bioenergy expansion such as land-use conflicts, lost of ecosystem services and products, risk to soil and water, indirect competition for land, food security, increase of emissions by the conversion of ecosystems even exacerbating climate change.

7. Concluding Remarks on this Summary:

- Regarding Assumptions-Methods Methodologies (Blottnitz & Curran 2006, p616)

--Plenty of Detailed energy& GHG assesments http://www.joanneum.at/biomitre/
--Studies should be selected to fill critical gaps: e.g.: ecological life cycle assessments
--Assessment must be cradle-to-grave as significant air quality impacts may be associated with the bio-ethanol used in internal combustion engines.
--More attention to the safeguard subjects of human and ecological health need to feature more prominently next to those of climate change and resource depletion concerns

- More General from all studies

-Significant uncertainty remains in methodologies (and factors) used to calculate GHG and energy balances. Also true for other environmental impacts.– Development of life-cycle assessment tools is essential (Woods, 2007; Kemmen& Ferrel,et all 2007; Blottnitz & Curran 2007)
-More attention to the safeguard subjects of human, social and ecological health need to feature more prominently next to those of climate change and resource depletion concerns (Blottnitz & Curran 2007)
-New institutions & Regulations linked to achievement are likely to be required to account for all impacts (Woods, 2007; UN-Energy 2007; GEF/STAP, 2007)

- Other concluding remarks from this review in light of more recent studies:

Can international trade on biofuels develop in a way that it is both socially and environmentally sustainable?

-Since there are as yet no established sustainability standards for biofuels, their import and use pose problems.
One major vexation: One major issue is that boundaries for studies are necessarily drawn somewhat arbitrarily. Is it fair to include the caloric intake of farm workers versus oil workers (farming is more labor-intensive)? Then there's the matter of competing values, which LCAs can't really help with. If one kind of biofuel speeds us toward energy independence more quickly, is it okay to sacrifice natural areas? Is groundwater pollution more important than air pollution?

Mark Delucchi is a research scientist at the Institute of Transportation Studies at the University of California–Davis says "the field needs to push much further to be useful for judging policy questions. "It's not enough to have an orderly accounting of energy yields," he says. "You have to figure out the effects of biofuels on natural systems and on markets worldwide, and no LCAs do this."….. "you have to start with the broadest possible system in the longest possible time frame, and then ask yourself, What's the most we can simplify it without losing so much representational robustness that we can no longer be sure that we are adequately representing reality?

And Delucchi also says." So the system boundary is the geophysical and economic system of planet Earth. There's no getting around that". That's what the problem is.

Responding to a far more ambitious list of ecosystem and economic issues than other LCAs—especially those, still widely cited, that are limited to just "oil versus biofuels" energy comparisons

-The promotion of use of biofuels that do not meet minimum standards should be avoided (the German WBGU (2008) even recommends a swift phase-out of the promotion of biofuels for transport purposes, a frozen of quotas for blending biofuels with fossil fuels and complete removal within 3 to 4 years. (pp8)

-Subsidies and CO2 emission rights counteracts food production, fails to keep farmers on their lands by making the cultivation of biomass used for biofuel production more attractive to farmers than that corresponding to biomass use as raw material for other products leading to increase market prices (Petrou, 2009)

-Having said that most reports recognize that where residues are used (timber waste, liquid manure, straw) the impact on greenhouse gas balance is indeed positive, there is a big potential and there is no adverse effect on food production.

-Also the use of perennial tropical plants such as Jatropha, sugar cane or oil palms that are grown on degraded land (not on freshly cleared land or agricultural land) also have a positive CO2 balance.

- An international biofuel supply chain includes complicated logistic for transportation and storage, including farming machines, tractors, trucks, which all add to a negative impact in the overall's system environmental performance. Still is an open question whether this system have the potential to be sustainable.

-Regarding Decision Making issues: there is so much that need to go into evaluation of biofuel's production systems, lots that needs to be discussed with different criteria groups (business, environmental and social criteria) however the question emerging from all these is to which extent will the decisions concerning such a system be influenced by this type of criteria?

-A rapid shift towards biofuels will push the social and environmental issues forward along with the need to account for them in making policy. To decipher the tangle of counter claims necessary to go through LCA and heaps of data.

In comparing biofuel options, the ledgers of even the simpler LCAs account in detail for a long list of energy and material inputs, including fossil fuels, for producing an energy crop, processing it into ethanol or biodiesel, and distributing it. Also included are the energy and resources it takes to manufacture the fertilizers, pesticides, tractors, combines, trucks, and other equipment, and, in some studies the energy it takes for farmers to live or for their labor force to commute to work. Other LCAs have evolved beyond comparing energy returns to account for at least some outputs—especially environmental effects

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