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Ethical risks of environmental policies: the case of ethanol in North America

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Policy to address the environmental impacts of transportation fuel derived from conventional oil is frequently focused on the promotion of alternatives such as biofuels. While there are some biofuels that can be developed with relatively few impacts, others can result in broader, complex social concerns that should be included in the policy debate. These concerns include impacts arising from the conversion of natural landscapes and changes in food supply. To help inform policy development, this paper raises a series of questions to encourage a fuller debate and proposes a methodology to capture ethical risks related to the energy and environmental choices. This methodology should be applied to policies that encourage a transition to fuel alternatives for transportation – whether unconventional fossil fuels or corn ethanol.

FOOD VERSUS FUEL, NEW DEVELOPMENT VERSUS CONSERVATION

In 2004, the transportation sector produced 6.3 Gt (gigatonnes) of CO_2 (carbon dioxide) emissions, accounting for 23% of global CO_2 emissions from energy.[1] Of this, road transport contributed 74%. Concerns over climate change and energy security have resulted in growing interest in the production of alternative transportation fuels. Yet, energy transitions are complex and may result in unintended tradeoffs if not designed carefully. The ongoing debate over energy projects and their location has spilled into new areas, including important social concerns related to food supply and ultimately the conversion of natural landscapes. The use of land for energy developments means it's not available for alternative productive uses and may result in negative environmental impacts.

The trade-offs from these choices are typically hard to measure as they are based on societal values that are often non-monetary, especially when considered over long time horizons. Increasing pressure from stakeholders and special interest groups has added a new dimension to policy development, namely the question of whether choices made in the public interest should somehow take into account ethical in addition to economic or monetary considerations.

Policy makers may develop rules or standards to correct perceived market failures, such as not accounting for the costs of CO_2 emissions in private market decisions. However, the outcomes may still include unintended consequences. For instance, setting a rule for renewable energy generation to temper expected GHG emissions may encourage the market to efficiently allocate responses to control emissions, but it may still fail to achieve certain social improvements because ancillary environmental concerns were not anticipated or managed. Other negative market implications may also emerge, including price manipulation from withholding product or information about product availability.

A case in point is the use of corn ethanol as a supplement or alternative to liquid fuels derived from conventional oil. A key driver for increased global demand comes from the United States, where a federal fuel standard that mandates increasing renewable energy content for transportation fuels has stimulated new investment and accelerated growth of the corn ethanol industry. Expansion of this industry, however, is directly related to increasing demands for new land conversion (extensification) and corresponding intensification of and investment in processing facilities. Increased production of some biofuels raises important social as well as economic issues that should be addressed within the policy and regulatory process. Some of these are issues may be grouped under the term ethics[2] or ethical choices in decision-making. This paper explores the ethical implications of a corn ethanol transportation system and the manner in which they can be included within policy. It proposes a tool, known as Wide Reflective Equilibrium,[3] as the basis for a more informed debate in the future.

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[1] Kahn Ribeiro, S., S. Kobayashi, M. Beuthe, J. Gasca, D. Greene, D. S. Lee, Y. Muromachi, P. J. Newton, S. Plotkin, D. Sperling, R. Wit, P. J. Zhou, *Transport and its infrastructure. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the IPCC*, (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007).

[2] Here we use the term ethics as broadly as possible to indicate a set of principles of right conduct where the morality implied is not necessarily prescriptive but adheres to a set of social guidelines where public health, welfare and overall economic stability is not compromised by a single or set of decisions.

[3] WRE is a method that attempts to produce coherence in an ordered standard of beliefs held by a particular group, namely (a) a set of considered moral judgments, and (b) a set of moral principles. It was developed by John Rawls in: *Rawls J (2001) Justice as fairness: a restatement* (Harvard University Press, Cambridge, MA).

ETHANOL POLICY CONTEXT

Ethanol produced from corn is a convenient proxy for the biofuels industry. This fuel can be derived from plant sugars as well as cellulose, which is principally available today from corn. Between 2000 and 2009, the U.S. ethanol industry grew exponentially, from 1.6 billion to 10.6 billion gallons per year. To provide some context, while ethanol production has increased sevenfold since 2000, bitumen production from Alberta's oil sands has tripled. The increased demand for corn arising from the biofuel industry, in addition to that required for food production, can be expected to have significant and long-lasting impacts on agricultural practices as well as markets. This is due in part to the primary role of corn as a mainstay crop throughout North America, which in turn has implications for agricultural demand for capital and finance in addition to committed land use.

In the past, biofuels were considered less greenhouse gas (GHG) intensive than fossil fuels.[4] The U.S. federal government responded by developing volume requirements for renewable fuels as part of transportation fuel policy within the Renewable Fuel Standard (RFS).[5] This standard mandates a minimum amount of renewable fuel to be used in the U.S. transportation market and provides assurance for investment in production capacity.

Recent research suggests that assumed GHG benefits from increased use of corn-based ethanol may have been overstated. Emissions from indirect land use change occur when biofuels production displaces agricultural production, leading to additional land use change elsewhere. Some studies suggest this land use change ultimately causes an increase in net greenhouse gas emissions. When such market-driven effects are included, the lifecycle GHG emissions for U.S. corn-ethanol may increase from 135 grams of carbon dioxide equivalent per megajoule (g CO_2e/MJ) (excluding the land uptake carbon credit of 62 g CO_2e/MJ), to 177 g CO_2e/MJ, which is nearly double that of gasoline at 92 g CO_2e/MJ.[6] There are a variety of uncertainties around these net impacts related to the choice of time horizon, economic models, the vulnerability of ecosystems, natural disturbance regimes and effects of climate change. Some authors suggest that these estimates may be low,[7] while there has been debate regarding the comparability of fossil and land use emissions.[8]

Despite these limitations, the results have prompted policy makers across the U.S. to attempt to manage market-driven emissions from land use change by modifying the Renewable Fuel Standard to increase proportions of cellulosic biofuel, biomass-based diesel and advanced renewable fuels.[9] More than half of the 32 billion gallons of renewable fuel that will be required in the transportation fuel system by 2022 is currently expected to be cellulosic ethanol, which is included in the 65% that will be produced by advanced methods. An

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4 Farrell A. E., Plevin R. J., Turner B.T., Jones A.D., O'Hare M., Kammen D.M., *Ethanol can contribute to energy and environmental goals*, Science (2006), 311:506–508.

5 http://www.epa.gov/otaq/fuels/renewablefuels/index.htm

6 Searchinger, T., R. Heimlich, R. A. Houghton, F. Dong, A. Elobeid, J. Fabiosa, S. Tokgoz, D. Hayes, and T.-H. Yu, *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Chang*, Science (2008), 319:1238 - 1240.

7 Plevin, R. J., M. O'Hare, A. D. Jones, M. S. Torn, and H. K. Gibbs. The greenhouse gas emissions from market-mediated land use change are uncertain, but potentially much greater than previously estimated. Environmental Science & Technology (2010).

8 IPCC 2000b, *Land use, land-use change, and forestry*, (Cambridge, UK ; New York, Cambridge University Press).

9 http://www.epa.gov/otaq/renewablefuels/420f10007.htm#2

additional 15 billion gallons of corn ethanol is expected for production, increasing current production by approximately 1.5 times. Despite changes in the RFS, the amount of first generation corn ethanol that is expected to be introduced is significant.

The use of corn ethanol has been proposed as a policy prescription to increase energy security as well as diversify the energy supply. However, this prescription has created a dynamic tension in the policy arena. Biofuels have historically been viewed positively in terms of greenhouse gas emissions and negatively in terms of land conversion and the impact on food and fibre production. As suggested above, using ethanol solely as a means to lower emissions may not be productive or efficient; nonetheless, recent policy directives have encouraged and stimulated significant increases in corn-based ethanol production, especially in the United States. While a complete transition to biofuels is not contemplated or even viable in the near term, significant shifts in demand or in required content could substantially alter the structure of current biofuels markets and landscapes across the world.

Ethical consequences of a corn ethanol transition – questions that should to be asked.

The transportation fuel industry relies on the assumption that there will be a dynamic and growing demand for hydrocarbon-derived fuels. As with any market, shifts in use patterns, availability, preferences and prices imply trade-offs and ultimately substitution between commodities and alternative uses. The trade-offs involved with an emerging new market for corn products come from direct competition with other land uses such as conserving natural areas, rural communities and food production. This highlights the need for a framework of ethical considerations that can improve decisions in this arena. Identifying the trade-offs, options and alternatives to current fuels should be a high priority for many levels of government, especially those concerned with climate policy.

Increased production of transportation fuel alternatives can lead to a broad range of outcomes, ranging from positive economic returns for fuel producers to negative broader cultural or economic effects. Included in this range, but difficult to quantify, are those socioeconomic conditions that we categorize as ethical issues. One way to ensure these issues are addressed is to raise a series of questions to expand the debate, help shape the nature and value of the ultimate decisions and take into account the implied moral hazard of change and use intensification.

The transition to alternative fuels is a dynamic process and the debate among stakeholders is occurring in a variety of forums. Spanning these debates are a set of questions that have grown from the ethical implications of increasing corn ethanol production. The set of questions can be broad, including impacts from land to water use. For simplicity, this paper is focused primarily on landscape impacts arising from increased production of corn ethanol.

1. *Should biofuel production be managed with regard to effects on food and agriculture critical to poor populations?*

A widely debated issue is the effect of increased biofuels production on agricultural markets. If demand increases, the price of the feedstock will increase in response. In the absence of new cropland or if land conversion lags increased demand, this can be expected to increase the price of food produced from the same feedstocks. Shortages will affect regions and countries dependent on trade of these commodities. Runge & Senauer[10] summarized the impacts that occurred in 2006 in the short-term response to increased production of corn ethanol:

> "In late 2006, the price of tortilla flour in Mexico, which gets 80% of its corn imports from the U.S., doubled thanks partly to a rise in U.S. corn prices from $2.80 to $4.20 a bushel over the previous several months…. With half of Mexico's 107 million people living in poverty and relying on tortillas as a main source of calories, the public outcry was fierce."

On the other hand, increasing the production of cellulosic ethanol may limit the ability of developing countries to establish new agricultural production, limiting economic development opportunities. Furthermore, increased commodity prices may provide opportunity for farmers in less-developed countries to respond to increased demand by expanding production on the long term. This dilemma calls for a well-designed transition to larger-scale biofuel production of any nature.

2. *Biomass typically produces less energy per unit of land over short timescales when compared with other sources of energy. Should we be developing low intensity energy if it results in the destruction of more land and natural areas than high intensity energy?*

Low intensity development is often assumed to be more environmentally benign than high intensity development. An inherent trade-off exists between these choices. Higher yields are derived from higher intensity development, meaning they require less land than low intensity methods. The 'spared' land could be used for many things: untouched natural areas, other industrial development such as forestry, or urban development. In the case of biofuels, it is necessary to consider the amount of land required as well as the dynamic nature of agricultural yields.[11] Victor & Ausubel[12] indicate that smarter agricultural techniques could be employed to increase future yield, freeing land for other uses. As much as 400 million hectares of land could be spared if farmers increased yields by 2% a year in the U.S.[13] Increasing yields could provide additional feedstock without committing additional lands or competing with other agricultural uses. As a result, there are direct benefits of an intensified biofuel system – higher yields may correlate with less new land conversion.

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[10] Runge C. F., Senauer B., *How biofuels could starve the poor*, Foreign Aff 6 (2007) (3):41–53.

[11] Berndes G., Hoogwijk M., van den Broek R., *The contribution of biomass in the future global energy supply: a review of 17 studies*, Biomass Bioenergy (2003) 25:1–28.

[12] Victor D. G., Ausubel J. H., *Restoring the forests*, Foreign Aff (2000) 79:127–144.

[13] Ibid.

3. *Land use impacts of large scale biofuel production may be significant and are likely to be persistent. Should we only be focusing on the ecological after-effects of climate change rather than the land impacts created by potential changes in energy systems?*

It has been estimated that by 2050 climate change could drive between 18% and 35% of terrestrial species to extinction.[14] Simultaneously, the development of new energy systems on the landscape may result in large scale land transformation, also driving a variety of species to extinction. While it is unclear whether climate impacts to terrestrial ecosystems may be diminished by shifting to biofuels, it is clear is that ecosystems are at risk from increasing agricultural production for biofuels. Equally important is to understand risks caused by climate change policy. As Vitousek et al.[15] state: "The use of land to yield goods and services represents the most substantial human alteration of the Earth." If biofuels are the primary focus of climate change policy, the reduction in greenhouse gas emissions may not save more species and ecosystems than what is lost through the land transformed for biofuel production.

Abandoned farmland in the U.S. provides a telling example of a trade-off between increasing some forms of ethanol production and conserving ecosystems. According to one study, the U.S. could deploy 58 million hectares of abandoned farmland, equivalent to 88% of the size of Alberta, to grow biofuels for energy.[16] This land would likely have a lower yield than prime farm land, requiring the conversion of larger areas of land. But this land also significantly overlaps the land set aside for the Conservation Reserve Program (CRP). This program, developed by the U.S. Department of Agriculture, has the objectives of providing dependable income to farmers, reducing erosion on unused farmland, and preserving wildlife and water quality.

4. *Should we consider potential effects on rural and urban economies?*

Increased corn ethanol production can potentially generate a significant amount of economic development in rural areas. This, however, is unlikely to be broadly distributed, reflecting the low density of widely dispersed rural populations. Ugarte et al.[17] estimate that in the U.S. alone, if 60 billion gallons (230 billion litres) of ethanol and 1.6 billion gallons (6.1 billion litres) of biodiesel were produced per year, 2.4 million jobs would be created between 2007 and 2030, mostly in the nation's rural economies. Though this is double the production that is expected by 2022, the magnitude gives some idea of how much economic impact large scale biofuels development may have on rural areas.

Large uncertainties exist in the estimates for economic gains. Higher production levels of ethanol feedstocks may affect feed requirements and may thus offset higher prices of grains for farms.[18]

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[14] Thomas C. D., Cameron A., Green R. E., *Extinction risk from climate change*, Nature (2004) 427:145–148.

[15] Vitousek P. M., Mooney H. A., Lubchenco J., Melillo J. M., *Human domination of earth's ecosystems*, Science (1997) 277:494–499.

[16] Campbell, J.E. et al., *The global potential of bioenergy on abandoned agriculture lands*, Environ. Sci. Technology (2008). This number has been cited by the EPA, but is not found explicitly in the paper.

[17] Ugarte D, English B, Jensen K, Hellwinckel C, Menard J, Wilson B., *Energy resources and global development: economic and agricultural impacts of ethanol and biodiesel expansion study* (2006). Available online at: www.ethanol-gec.org/information/Ethanolagimpacts.pdf.

[18] Forge F., *Biofuels—an energy, environmental or agricultural policy?* Library of Parliament, Science and Technology Division, Government of Canada. Available at: www.parl.gc.ca/information/library/PRBpubs/prb0637-e.htm#why.

Large uncertainties exist in the estimates for economic gains. Higher production levels of ethanol feedstocks may affect feed requirements and may thus offset higher prices of grains for farms.[18] In addition, the international market will certainly determine the feedstock price. If incentives are put in place to increase ethanol, farmers will shift their crop production to ethanol feedstocks. The increase in supply would decrease the price of the feedstock and decrease supply of other crops. The effect on other feedstocks is yet unclear but may also have impacts on food prices. With economic investment in the rural economy, there will be shifts in rural culture and land use as well. The exact impacts cannot be forecast with certainty, but past experience with conversion of open space and agricultural lands suggests rural population displacement, increased land costs and shifts in investment patterns.[19]

ETHICS AS A NEW MEASURE IN POLICY PLANNING

Most conversion of land in North America over the past century has been driven by an economic investment imperative than can be characterised as utilitarian in nature.[20] As used here, the concept includes the idea that the moral worth of an action is determined *solely* for its usefulness in maximizing utility, or minimizing negative utility. The right or good decisions are those that maximize net benefits and increase the greater good. There are inherent flaws in this doctrine, however, as noted by Harper and Stein,[21] who suggest the economic rationale of utilitarianism ignores important moral concerns such as autonomy, rights, justice and equity. Taken alone, utilitarianism exhibits little concern for the equitable distribution of costs within a society, even if the general consensus is that something is morally wrong.

Equally important in this discussion is the difficulty of assigning numeric or financial values for land use changes that defy quantification. Some values, such as wilderness value and existence value,[22] are not easily assigned monetary values. However, normative ethics and newer techniques such as Rawl's process of Wide Reflective Equilibrium[23] (WRE) provide a means by which ethical implications can be included within policy formation such as in policies related to conditional land use permits or climate control standards. The principle involved is a dynamic reiterative 'test' of a system of beliefs (or moral standards) against other beliefs held by individuals or society. The test, arguably a normative one, compares the ways in which some of these beliefs support others, develops coherence among the widest set of beliefs, all the while revising and refining them at levels where they are challenged or in conflict. Here, a process such as WRE can be the principal guideline to consider ethics within policy development, a lens through which new and controversial findings can be considered.

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[19] For a discussion of this issue see Brown, DG, Johnson, KM, Loveland, TR, and Theobald, DM, *Rural Land-Use Trends in the Conterminous United States, 1950–2000*, Ecological Applications (2005) 15:1851–1863; Carrión-Flores, C. and Irwin, EG, *Determinants of Residential Land-Use Conversion and Sprawl at the Rural-Urban Fringe*, American Journal of Agricultural Economics (2004), Volume 86, Number 4, 889-904; Bockstael, Nancy E. *Land use externalities, open space preservation, and urban sprawl, Regional science and urban economics* (2004) 34.6, 705-25.

[20] Broadly adapted from J.S. Mill as the greatest benefit for the greatest number, J.S. Mill, *Utilitarianism*, first published 1863.

[21] Harper T, Stein S., *Dialogical planning in a fragmented society: critically liberal, pragmatic, and incremental* (Center for Urban Policy Research Press, (2006, New Brunswick, NJ).

[22] Walsh, R.G.,Loomis, J.B., and Gillman, R.A.,*Valuing Option, Existence, and Bequest Demands for Wilderness Land Economics*, Vol. 60, No. 1 (Feb., 1984), pp. 14-29.

[23] Rawls J., *Justice as fairness: a restatement* (Harvard University Press, 2001, Cambridge, MA).

WRE provides "a coherentist method of explanation and justification used in ethical theory, social and political philosophy, philosophy of science, philosophy of mind and epistemology."[24] Political positions must be justified to other citizens on the grounds of beliefs and political values. The WRE process can be used to critique, develop, and reform public institutions, seeking coherence in information utilized and ultimately the value of the decisions made.[25] The system relies on a dialogue-based approach. For some biofuels, this would optimally require biofuels proponents to consider the ethical implications associated with agricultural feedstocks. The WRE process could be used to identify potential ideological distortions,[26] for example, that all renewable energies are environmentally benign. With this moral lens, ideological distortions can be brought to light and the policies for attenuating climate change can subsequently be developed with the opportunity to consider ethical implications. Such a process encourages policymakers to consider a fuller range of impacts caused by policy and determine which policy alternative is the fairest to those affected.

Ultimately, the public debate should embrace a discussion of whether including or mandating a wide range of biofuels would generate or increase ethical conflicts. If biofuels can be produced by means that do not require large tracts of land, for example deriving biodiesel from yellow grease, or cellulosic ethanol from agricultural waste and wood products, the attraction for utilizing these bases will increase. Similarly, there could be significant ethical upside if biomass production could be generated by reviving large tracts of degraded land across the world, where there is minimal conflict with conservation.

CONCLUSIONS

There is a missing link today between methods of energy policy development and ethical considerations associated with broader social decision- making. Because the ethical implications of the transitions to new energy systems are seldom considered, the choices we make may have negative moral consequences and corresponding social costs. Employing normative planning techniques in response to this can allow society to move beyond reductionist, utilitarian policies by taking into account broader measures of social wellbeing. Tools like WRE can help expand and bring discipline to the debate. Better indicators, such as those that describe land use impacts, are needed to determine the implications of climate change policies. These are likely to improve energy and related environmental policies if they include aspects of the environment that society values. Ultimately, this would require scientific investigation to occur alongside the WRE process and could increase regulatory costs of compliance as well as processing. However, the benefits, when measured over a longer time horizon, are sure to be net positive. This may be especially true when other associated, difficult-to-measure impacts, such as water quality or land use, are taken into account. As with all energy transitions, there will be trade-offs in relation to biofuels systems that are likely to

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[24] Nielsen K., *Naturalism without foundation*, (Prometheus Books, 1996, New York).

[25] Ibid note 17.

[26] Stein S., Harper T., *Rawls' 'Justice as Fairness': a moral basis for contemporary planning theory*, Planning Theory (2005) 4:147–172.

be difficult to measure and compare, especially at the outset. While it still may make sense to further develop these systems, the increasing complexity and the expanding number of voices in the energy-climate debate calls for a greater balance in resolving the demands of industrial growth and the ethical conflicts that are implied by land conversion and the transformation of publicly owned resources.

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