THE LOST INNOCENCE OF ETHANOL:

POWER, KNOWLEDGE, DISCOURSE, AND U.S. BIOFUEL POLICY

by

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B.S., University of Melbourne, 1997
M.A., Clark University, 2007

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

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Abstract

In the United States, rationales for corn ethanol policies have included national energy security, air pollution abatement, clean technology development, and climate change mitigation. The ostensible benefits of corn ethanol have been used to justify the transfer of federal funds toward corn and ethanol production subsidies, consumption mandates, and import restrictions, plus substantial research and development efforts. Public and private sector funding has also focused on efforts to commercially develop biofuels from advanced technology using cellulosic biomass. Despite decades of public and commercial interest, cellulosic ethanol has failed to commercialize, corn ethanol remains heavily dependent on subsidies, and each of the alleged benefits of ethanol has been hotly disputed.

This research examines the links between interest groups and rationales for biofuel policies. Drawing from Foucauldian discourse analysis, the research identifies key discourses supporting and opposed to biofuel development, and their relation to broader issues in environmental and energy politics. This approach involved a detailed review of newspaper archives, policy documents, Congressional bills, committee hearings and debates, governmental and non-governmental reports, and scientific research findings. It reveals how a powerful coalition of agricultural interests succeeded in harnessing biofuel discourses to popular public and political environmental and energy concerns.

The primary discourses identified were *Environmental Bureaucracy*, *Free Markets*, *Ecological Modernization*, and *Limits*. A common element in the first three of these was *Techno-Optimism*. A *Limits* discourse opposed ethanol expansion, primarily based on a narrative of competition for agricultural land, and stood apart from other discourses in its mistrust of science and technology to resolve environmental problems. The research concludes that

Foucauldian discourse analysis provides a useful tool for examining key shifts in policy debates, for clarifying the relationship between scientific knowledge and discursive power, for understanding divisions within environmental discourse, and for revealing the importance of scale in environmental public policy process.

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List of Abbreviations

AAA	American Automobile Association
ADM	Archer Daniels Midland
API	American Petroleum Institute
ARCO	Atlantic Richfield Oil Company
BIWG	Biofuels Interagency Working Group
BNEF	Bloomberg New Energy Finance
BTU	British thermal units
CAFE	Corporate Average Fuel Economy
CARB	California Air Resources Board
CAA	Clean Air Act
CBO	Congressional Budget Office
CCS	Carbon Capture and Storage/Sequestration
CEO	Chief Executive Officer
CRP	Conservation Reserve Program
CRS	Congressional Research Service
D	Democrat
DIPE	diisopropyl ether
DOE	Department of Energy
EISA	Energy Independence and Security Act of 2007
EPA	U.S. Environmental Protection Agency
ETBE	ethyl tertiary-butyl ether
FAO	Food and Agriculture Organisation of the United Nations
GAO	General Accounting Office
GHG	Greenhouse Gas
GMA	Grocery Manufacturers' Association
HCFCs	hydro-chlorofluorocarbons
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
ILUC	Indirect (or Induced) Land Use Change
IPCC	International Panel on Climate Change
LCA	Life-cycle Analysis
MTBE	methyl tertiary-butyl ether
NAAQS	National Ambient Air Quality Standards
NAS	National Academies of Science
NSTC	National Science and Technology Council
NCGA	National Corn Growers' Association
NAFTA	North American Free Trade Agreement
PL	Public Law
R	Republican
RFA	Renewable Fuels Association
RFG	Reformulated Gasoline program
RFS	Renewable Fuel Standard
RFS2	The revised Renewable Fuel Standard
ROR	Renewable Oxygenate Requirement

RTFO	Renewable Transport Fuels Obligation
RVP	Reid Vapor Pressure
SPR	Strategic Petroleum Reserve
SUV	Sports Utility Vehicle
TAME	tertiary-amyl methyl ether
TBA	tertiary-butyl alcohol
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States of America
VC	Venture Capitalist
VEETC	Volumetric Ethanol Excise Tax Credit
VOC	Volatile Organic Compound
WTO	World Trade Organization

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Dedication

To my Anam Cara, who always said I had a knack for writing.

Chapter 1 - Introduction

In October, 2007, at the United Nations (UN) headquarters in New York, Special Rapporteur on the Right to Food, Jean Ziegler, told a news conference that converting farmland for biofuels constituted a "crime against humanity" and demanded a five year moratorium on biofuels derived from food crops (UN 2007). The delay, Ziegler argued, would allow time to develop advanced biofuels, using non-food crops. Twenty months earlier, in his State of the Union Address, President G.W. Bush informed the American public that biofuels would play a lead role in alleviating the country's addiction to oil (The White House 2006). Technological advancements would enable the production of ethanol, "not just from corn but from wood chips and stalks or switch grass." At the same venue in January, 2007, the President announced his administration's ambitious goal of expanding domestic biofuel production to 35 billion gallons per year by 2017 (The White House 2007). The broader objective, he said, was for biofuels to replace more than three-fourths of American oil imports from the Middle East by 2025 (The White House 2007). A Democrat-led Congress then passed major new energy legislation – the Energy Independence and Security Act of 2007 (EISA) – which mandated the consumption of 36 billion gallons of biofuels by 2022, most of which would be derived from non-food crops. The new law gave biofuels credit for reducing greenhouse gas emissions from vehicles compared to the combustion of conventional gasoline or diesel. Dozens of new ethanol refineries were built in the 'Corn Belt' region of the Midwest, and ethanol production grew sharply (Figure 1-1). Yet no sooner had President Bush signed EISA into law than scientific reports emerged blaming the production and use of biofuels for emitting substantially more greenhouse gases than fossil fuels. Scientists disparaged biofuels for competing with valuable farmland, and for indirectly contributing to clearing of rainforests in Brazil and Indonesia. Food commodity prices spiked in

2008, sparking riots and violence in Africa, Asia, and Latin America. Officials at the World Bank, the United Nations, and other international development and agricultural institutions attributed a large share of the 'food crisis' to the expansion of biofuels.

Clearly, if there is an objective truth about biofuels, not all of the above statements or claims can be correct. Nonetheless, each actor makes some claim to legitimacy and authority, whether through their position in elected public office, the officialdom of state bureaucracy, the academic rigor of scientific journals, or the editorial exposure of mass media. How, then, should such disparate claims of biofuels be compared and analyzed? To a large degree, the official, publicly stated biofuel policy objectives – typically related to energy security, urban clean air, or climate change mitigation – are accepted at face value. This is all the more surprising given, firstly, that the policy objectives for advancing biofuels have changed substantially over time, and secondly, that there remains a lack of conclusive evidence that any of the objectives have been met (as will be discussed). The research in this report seeks to fill this gap by applying discourse analysis to the claims made by biofuels' proponents and opponents. A discursive approach enables exploration of the rationales for biofuel policies, exposing disparities in power and knowledge, without privileging one perspective over another.

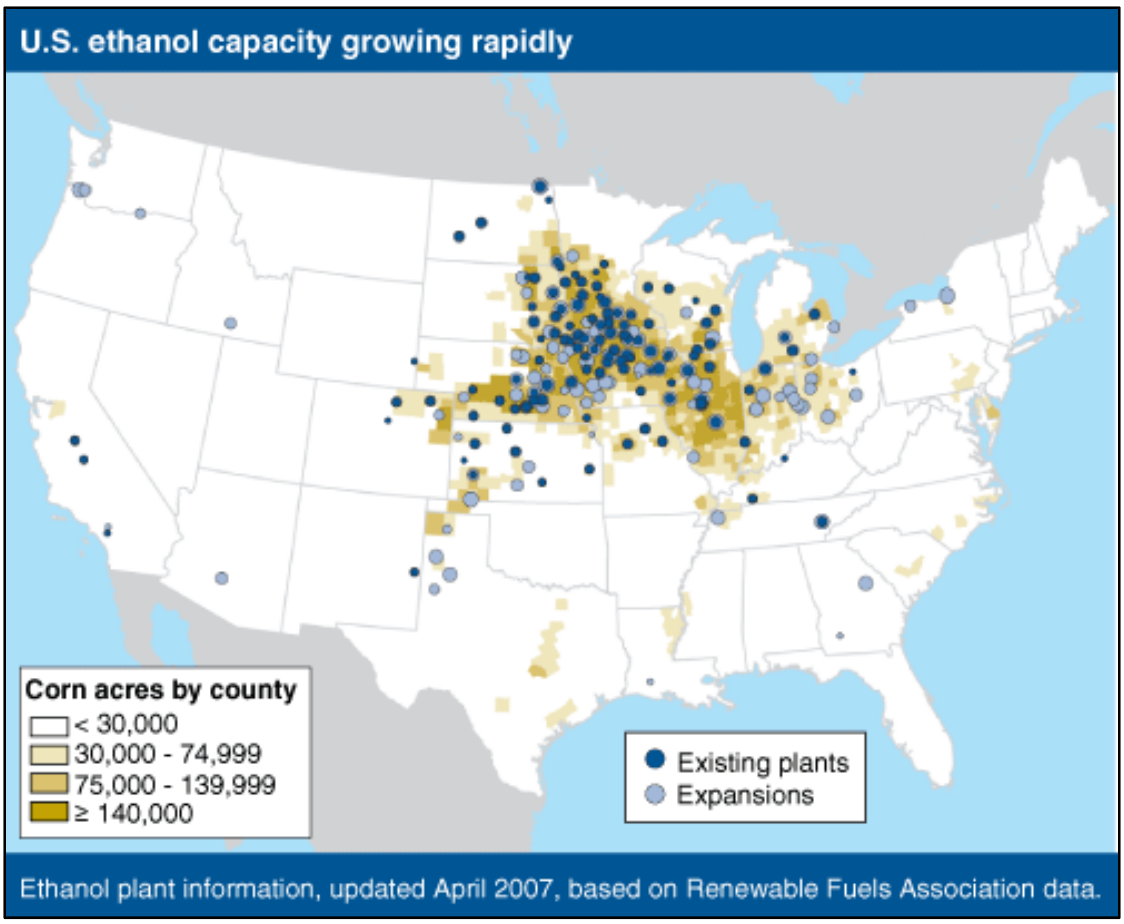

Figure 1-1 Existing and Planned U.S. Ethanol Refineries and Corn Acreage in 2007 (Wescott 2007b).

Before entering the doctoral program in geography at Kansas State University in 2008, my background was in natural resource management and international development. At that time, corn ethanol and other biofuels held widespread public and policy interest, and a frenzy of refinery construction suggested optimism that ethanol might alleviate record-high fuel prices. While the farmers I spoke to expressed enthusiasm for biofuels, I read with concern reports of groundwater depletion and other harmful environmental impacts. At the national policy level, a striking discord appeared to exist between exuberant praise for biofuels' economic and environmental benefits and scientific and international policy reports blaming biofuels for

various environmental and social ills. This dissonance suggested that neither the scientific nor the public policy aspects of biofuels were settled. A review of available literature led me to conclude that the federal government was a key locus of power in framing not only policies themselves, but the manner in which biofuels were to be understood by the public. Congressional policy tends to build incrementally, necessitating a historically grounded approach to the study of policy development. Though biofuels have a commercial history dating to the earliest days of the automobile, my research extended back to the 1970s, when the first major national laws on biofuels were implemented. Since then, the rationales for biofuel policies have shifted markedly under different political persuasions and socioeconomic circumstances. In some cases the rationale did not seem to fit with standard economic logic. For example, if ethanol could be imported cheaply, why were import tariffs imposed? Why was the commercialization of cellulosic ethanol promised so assuredly, despite eluding developers for so long? These and other questions led to a historically grounded, discursive approach to analyzing ethanol policy.

The second reason for my interest in ethanol policy was that I saw it as emblematic of broader social and environmental issues of our time. An inescapable feature of twenty-first century life is being confronted by a set of extraordinarily complex and interlocking issues associated with modern society, including the specter of climate change, the geopolitical and economic threat of volatile energy supplies, the risks to personal health from the release of toxic substances into the atmosphere, and a seemingly intractable tension between economic growth and environmental decline. Science, of course, does much to measure the scope and scale of these problems. Problems beget solutions, and the mass media enthusiastically report on research findings and technological breakthroughs that herald more energy efficient or cost

effective living and working conditions. Congressional lawmakers reside over, and help define and prioritize, these issues, bringing their perspectives and political affiliations to bear on how solutions are devised and scripted into law. Biofuels offer an important window into the inner logic and workings of the most powerful country's political system with respect to the dilemmas it faces concerning energy and the environment.

To proponents in Congress and the White House, corn ethanol seemed to exemplify the successful harmonization of science and policy to substantially reduce dependence on foreign oil, ameliorate urban air pollution, and mitigate climate change. To critics, it appeared to represent an egregious case of special interest politics and government largesse masquerading as 'green' technology. My goal is not to resolve this tension but to expose the underlying discursive elements, the hidden suppositions and taken-for-granted understandings in the most important policies shaping ethanol. Ethanol policy offers valuable and cautionary insights into the possibilities and pitfalls of policies ostensibly designed to confront energy insecurity or environmental problems associated with greenhouse gas emissions and land use change.

Chapter 2 - Discourse Analysis in Environmental Policy

2.1 The Discursive Approach to Environmental Policy

In this chapter I examine the discursive approach to environmental policy, critique Foucauldian discourse analysis, and review discourse-analytical research in the field of environmental policy. Despite efforts to develop cleaner energy alternatives, the American economy continues to operate primarily based on fossil fuels – coal, oil, and natural gas. The extraction, refining, transportation, and consumption of these resources are regulated by and deeply intertwined with federal policies concerning energy and the environment. Energy policy is inherently environmental policy, and much is revealed about lawmakers' priorities by their allocation of limited taxpayers' funds toward encouraging energy production, energy conservation, or the expansion of alternative energy supplies – nuclear power and 'renewables' including solar, wind, geothermal, hydropower, and biofuels. The context in which such renewables are sought is based on the widely held idea that modern, industrial economies must navigate a transition from unsustainable fossil fuels to alternatives, because fossil fuel supplies will not meet demand, or because the environmental health of the planet requires it, or both.

A characteristic and problematic feature of environmental challenges is their scientific uncertainty. Environmental issues "do not present themselves to us in well-defined boxes" (Dryzek 2013:9), but depend on myriad actors – scientists, politicians, journalists, activists, environmental groups and others – to generate and frame knowledge. Consider the manner in which environmental issues become widely known. In some cases – such as the BP/Deepwater Horizon oil spill in the Gulf of Mexico – the perpetrator, the cause, and the effects seemed relatively evident to the lay observer. Yet even under those circumstances, it is not at all certain what lasting economic and environmental impacts occurred, how compensatory money should be

spent, how to mitigate damage, or how to avoid such disasters in the future. Many environmental issues – agrochemical pollution, soil erosion, urban sprawl, smog, acid rain, ozone depletion, climate change, habitat depletion – gain public attention gradually, as iterative investigations and technological advancements reveal new insights. For a response to an environmental condition to become law, it must first be recognized and defined as a problem amenable to policy solutions (Stone 1989). Yet there is no single, authoritative arbiter of how to define or respond to environmental problems (Feindt and Oels 2005). The inherent uncertainty in the process of constructing an environmental problem amenable to a policy solution enables the manipulation of scientific and political narratives to suit particular interests.

The definitions and meanings given to environmental problems have great bearing on the outcome. Take the notion of American 'energy independence,' mostly used in reference to a perceived need to reduce or eliminate oil imports. Critics (e.g., Littlefield 2013; Luft and Korin 2013) have repeatedly discredited the notion as unrealistic in the foreseeable future and criticized politicians' hackneyed use of the term. Nevertheless the idea of energy independence continues to hold meaning for the American public, so from a political perspective, it retains discursive cachet. The definition of a problem, such as 'dependence on foreign oil,' should not be mistaken as a simple reflection of an environmental problem but as a contingent process that frames the set of plausible solutions (Kingdon 1984).

The field of science concerned with public policy analysis has undergone rapid and substantial change (Fischer and Forester 1993; Fischer 1998; Fischer 2003, 1). Until recently a pervasive view was that science and politics occupied separate domains, the former governed by objectivity and fact, the latter by subjectivity and values (Hawkesworth 1988; Stone 1988; Fischer 2003, 4). This normative dichotomy enabled analysts to envision a distinct process of

scientific inquiry informing a separate process of rational public policy making. Indeed many in the social and natural sciences today see themselves as apolitical and describe their work as "informing the policy process." Policy research was seen essentially as an apolitical, empirical process of using standardized methods for collecting information about social phenomena, with the expectation of producing generalizable patterns, models, or theories which could be applied in different social contexts (Hawkesworth 1988; Fischer 2003).

An undermining deficit in this approach is that it failed to attribute motivations and interests to those with a stake in policy outcomes. In other words, it was blind to the interaction of power and knowledge. An illustration of the inadequacy of this approach to environmental policymaking and of the murky boundary between science and politics is government funding. The U.S. has among the world's largest public agriculture and energy research programs. At the federal level these institutions depend on budgetary decisions for funding. An uncritical view of the policy process overlooks the fact that politics itself drives the funding by which scientific investigation takes place. The problems tackled by government-funded scientists are not derived in a vacuum – their meaning and purpose stem from the social and political context in which funding is allocated. As is described later, research and development funding for renewable energy sources, as well as for fossil fuels, is by no means constant or apolitical.

In contrast to the technocratic, empirical view, the pluralist theory of policy making is one which envisions a marketplace of policy goals supported by individuals, non-governmental interest groups, and political parties. While the role of the public at large may be limited to periodically electing representatives, stakeholders actively compete to have their views heard and their preferred policies enacted. A basic premise is that policies are determined by the groups which mobilize the greatest resources and bring the largest influence to bear on policy decisions.

Yet pluralism requires that all stakeholders participate or are represented in the policy debate – a premise that is shown not to hold in the case of corn ethanol policy. The theory is challenged by several considerations: not all policy incentives are explicit; political parties and interest groups do not necessarily fit predetermined ideologies, beliefs, or agendas; and even the terms of the debate itself may be manipulated according to stakeholders' interests. As will be shown, a long range view of corn ethanol policy reveals that it does not align with political ideology. Ethanol's strongest advocates in Congress have more in common geographically than ideologically – they span both political parties in the Midwest. At various times ethanol policy has been driven by Democrats and Republicans in both houses of Congress and in the White House. It is well known, moreover, that the first presidential caucus is held in Iowa, the premier ethanol producing state, and that this geopolitical peculiarity creates a strong incentive for candidates to tout any pro-ethanol credentials.

The shortcomings of positivist approaches prompted reconsideration of what it meant to 'do' policy analysis, and led in the 1990s to what is now referred to as a discursive or argumentative turn in the social sciences. One key advantage of a more explicit focus on discourse was recognition of the social construction of knowledge (Demeritt 2001; Forsyth 2003; Rydin 2005). What this meant was that no field of representation, whether science, politics, or journalism, should be treated as though it has unfettered access to impartiality, or conveys a simple reflection of reality (Massey 2001). Rejecting the false dichotomy of politics and science, discourse analysts brought a sharper focus to the means as well as the ends of policy design, including the interests involved and the specific use of language and meaning in policy itself. The discursive turn was also described as argumentative, encapsulating the idea that discourse analysis was concerned with the various interlocutors, as well as with the analytic coherence and

rhetorical performance of their arguments (Fischer and Forester 1993, 4). In some policy processes scientific knowledge is deliberately ignored; in some, opposing interests contest discursively ambiguous concepts; and in yet others, rhetorical justifications are deployed to mask hidden agendas. Prominent examples of each of these are found in the history of laws enacted to promote soil conservation, clean water, clean air, wildlife habitat, and other environmental benefits. Focusing more directly on the participants allows analysts to reveal their interests and self-representation to the policy process.

One of the criticisms leveled against discourse analysis and other social constructionist approaches was that if all knowledge claims are subjective and partial, how can the analyst determine which are valid and important and which are not? In geography, a related line of thought concerned the social construction of nature. To those within the discipline concerned with the physical environment, the notion that it was 'socially constructed' seemed troubling (Demeritt 2002). I see no advantage in dwelling on this debate over the literal (i.e., ontological) or metaphorical construction of nature or reality other than to clarify my own stance. This research accepts a *realist ontology* – that nature, events, and objects really exist – and a *hermeneutic epistemology* – that knowledge is socially constructed, and shaped by such things as interaction with and understanding of the environment (Litfin 1994, 26).

Discourse analysis is now a well-established approach in the social sciences and in environmental policy studies (Sharp and Richardson 2001; Rydin 2005; Waitt 2010). In 2005, the *Journal of Environmental Policy and Planning* devoted a special issue to the topic.[1] As the number of papers using discourse analysis in social science journals increased, it became apparent that the terms 'discourse' and 'analysis' were being interpreted in multiple ways

[1]Volume 7, Issue 3, 2005.

(Jorgensen and Phillips 2002). In the next section I explain what I mean by the Foucauldian discourse analysis approach used in this research.

2.2 Foucauldian Discourse Analysis

I draw upon the work of French historian and social theorist Michel Foucault, who advanced a unique approach to the study of discourse. For Foucault, discourse frames and organizes how all things meaningful are thought about and communicated. In his view, discourses privilege one way of thinking or understanding over others. Foucault was fascinated by how certain patterns of thinking and acting – certain discourses – were practiced in institutional settings, such as hospitals, clinics, prisons, and schools. He observed that practices changed dramatically over periods of history, and theorized that these changes were due to disruptions of one discourse by another. I follow Foucault's concern with historical context and his fascination with how dramatically discourses can change from one period to the next (Hall 1997).

Possibly Foucault's greatest contribution to discourse analysis was his idea that knowledge and power reinforce one another: "there is no power relation without the correlative constitution of a field of knowledge, nor any knowledge that does not presuppose and constitute…power relations" (Foucault 1980, 27). Foucault's notion of power is not a formal, top-down, repressive, dominating, controlling one, but communicative and relational. He described power as "capillaries" in a diffuse network between interpersonal relations, by which actors internalize the ways of thinking and behavioral norms governed by prevailing discourses (Rydin 2003, chapter 3). Thus, if lawmakers develop policy based on a particular body of knowledge, this knowledge attains a high level of authority and legitimacy – of discursive power

– irrespective of its veracity. Foucault's approach suggests that instead of pursuing 'the truth' it is more important to understand how and why particular arguments and not others are credited with truthfulness (Sharp and Richardson 2001). Combining these two Foucauldian elements – historical context and knowledge-as-power – frames an analytical approach in which real changes in society and politics can be viewed as the outcome of shifts in the relative influence of different discourses.

Discourse here is taken to mean "*a group of statements which provide a language for talking about – a way of representing the knowledge about – a particular topic at a particular historical moment*" (Hall 1997). To study ethanol policy discursively, then, is to study the ways knowledge and power have formed particular ways of thinking about ethanol policy in particular periods of time. The analyst is compelled to ask: who generates knowledge about ethanol (e.g., scientists, politicians, environmentalists, journalists, lobbyists), what are their motivations and claims to legitimacy and authority, and what effects do these have on policy outcomes? It is easy to imagine that each of these claimants has distinct ways of apprehending and communicating about corn ethanol (Hajer 1995, 46). At the same time, it is likely that no single claimant has a comprehensive knowledge of ethanol from all perspectives (Hajer 1995, 63).

Foucault's work has been criticized as ambiguous or contradictory, and these criticisms serve as caution signs for this research. Foucault depicted his "subjects" (e.g., prisoners, psychiatric patients, homosexuals) as essentially trapped within prevailing discourses. He portrayed discourses as pervasive yet unstable entities whose very prominence made them susceptible to being undermined or supplanted. Foucault was so inclusive in his definition of discourse as to offer little direction on which statements were important for analysis and which are not, exposing his research to criticisms of selectivity. If all power was decentered and

relational, it was difficult to see which relations resulted in concrete outcomes (such as federal laws) and which did not. Moreover, if actors were merely subject to the norms of a discourse, it was difficult to see how a discourse might change or be supplanted (Rydin 2003, 26). Some scholars eschewed Foucault's poststructuralist project altogether on the basis that it went too far in rejecting the agency of actors (e.g., Jorgensen and Phillips 2002, 13-18).

A more practical notion of power accommodates unanticipated consequences (of which there are plenty in energy policy), path dependency, and the possibility of stakeholders being affected by circumstances beyond their control. In this research, individuals and groups are credited with having agency to influence discursive practices. My interpretation of power is not limited to the discursive sense but includes such influences as political donations, elections, and special interest lobbying. My goal is to explain how discursive shifts took place by anchoring these changes in historical and social contexts. Certainly discursive shifts are influenced by real world events, such as oil prices, embargoes, renewable energy technologies, and declining urban air quality. This research aims to combine discursive and material changes in their historical contexts, and thus to show how certain discourses become decisive at particular times. The final caveat is that this research is not strictly aimed at developing policy recommendations; it is intended to explore, analyze, and explain the social construction of U.S. federal ethanol policy.

2.3 Literature Review: Discursive Analyses of Environmental Policy

Much was left to Foucault's contemporaries to articulate the advantages of his approach. What follows is a review of the most relevant literature concerning discursive analysis of environmental policies. The first two reviews are by two of the leading proponents of discourse analysis in environmental policy – political scientists Maarten Hajer and Karen Litfin (Dryzek

2013, 11). The remaining reviews concern either agriculture (Dixon and Hapke 2003; Lehrer and Becker 2010) or renewable energy (Szarka 2004; Palmer 2009; Stevenson 2009), and thus are closely applicable to biofuels.

Hajer (1995) applied Foucauldian analysis to Dutch and British governments' responses to the problem of acid rain. Finding Foucault's theorization of the discursive structures too abstract, Hajer developed the 'mid-range' concept of a '*storyline*.' A storyline is a pithy shorthand narrative of a discourse or a combination of discourses. Storylines help position actors with respect to who or what caused the problem, who is responsible for finding solutions, and how. Groups of actors who agree on a storyline form a '*discourse coalition*'. Participants in a discourse coalition need not share the same interests or goals (if they did they would likely constitute a social movement), but share a common set of language and ideas (Hajer 1995). Analyzing storylines and discourse coalitions gave Hajer greater purchase on how one discourse might come to be supplanted by another. Storylines must be continually upheld and adapted to shifting circumstances to maintain preeminence. Hajer argues that political responses to acid rain in the 1980s must be understood in the historical and discursive context of 'ecological modernization', a discourse which suggests that environment and development can progress together. In the case of acid rain, ecological modernization theorizes that existing institutional arrangements can be modified, such as by regulating emissions from coal-fired power plants, without impairing economic progress (Hajer 1995, 3).

In the UK, Hajer found two distinct storylines and coalitions: traditional/pragmatist and ecomodernist. The former stressed a commitment to science and research to ascertain the extent of sulfur dioxide (SO_2) pollution and how to solve it. In the 'pragmatist' view, since electricity is vital to the economy, coal power plants should continue to operate until acid rain could be

proven harmful. Environmentalists and some lawmakers bitterly opposed the pragmatist storyline. These ecomodernists argued for immediately retrofitting power stations with scrubbers to abate SO_2 pollution. Both groups deployed a narrative of science to further their argument. Whereas the pragmatists wanted further investigation of the problem of acid rain before making costly repairs, the ecomodernists wanted an assessment of the health and environmental risks of continued pollution. British reluctance to accept blame for acid rain and to take preventative measures earned it the moniker of the "dirty man of Europe" (Hajer 1993). Scientific knowledge played a crucial role in shaping acid rain as a problem in need of policy solutions. The Dutch response to acid rain was distinctly more alarmist. Instead of procrastinating on the problem, the Dutch government practiced an "apocalyptic discourse invoking religious sentiments" (Hajer 1995, 266). It swiftly acknowledged the seriousness of the problem and sought the participation of industry, environmental groups, and experts to engineer an acceptable solution. Paradoxically, despite what seemed like a unified understanding of the need for an urgent response, the practicalities of assessing and ameliorating acid pollution became the driving concern. Dutch scientists got bogged down in the technical complexities of measuring how much acid precipitation a forest could tolerate (the 'critical load') before vitality was impaired. In the end both governments accommodated the environmental and health concerns over acid rain by regulating the installation of desulphurization equipment, though coal-based power production continued.

Karen Litfin (1994) discursively analyzed the international accord to ban the global production of chlorofluorocarbons (CFCs), the Montreal Protocol. Where Hajer focused on the state regulation of a polluting industry, Litfin's focus was on the interface of international politics and the science of ozone depletion. The Montreal Protocol marked the first international

treaty on an environmental problem, negotiated in Canada in 1987 under the leadership of the United Nations Environment Programme (UNEP). The agreement to ban substances that harm the ozone layer was lauded as an exemplar of international environmental cooperation. Yet Litfin's investigation revealed that "atmospheric science did not provide a body of objective and value-free facts from which international cooperation emerged" (Litfin 1994, 6). As in British acid rain discourses, in the U.S. an industry-based discourse was mobilized around support for the status quo (or 'business as usual' in terms used in global climate change and other discourses) – that is, no regulation on CFC production, while an opposing precautionary discourse centered on notions of risk and responsibility (Litfin 1995).[2] The former discourse was supplanted by the latter in the lead up to the Montreal meeting. Initially, computer-generated models of global ozone change depicted a very modest rate of thinning. However, a discursive switch occurred with the discovery of a stratospheric region over Antarctica, where ozone concentration was particularly low. Widespread media reportage of NASA's time lapse video of the expanding 'ozone hole' discredited the computer models and raised the public profile of ozone depletion as a problem needing to be fixed. NASA's findings corroborated analysts' assertions that the ozone layer was being dramatically reduced by CFCs. This lent weight to a discourse of caution mobilized by the U.S. Environmental Protection Agency (EPA) and the U.S. State Department.

Once Antarctic ozone depletion had been conclusively linked to CFCs, a struggle developed over potential substitutes (Litfin 1994). CFC producers such as Du Pont argued that

[2]The best known definition of the precautionary principle was articulated in Principle 15 of the Rio Declaration on Environment and Development, which emerged from the UN Conference in Rio de Janeiro on June 3-14, 1992. It says that "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

hydro-chlorofluorocarbons (HCFCs) were a safe alternative, and succeeded in delaying the complete cessation of HCFC production until 2030. However, EPA scientist John Hoffman used a specific measure of ozone health ('chlorine-loading') based on CFC emissions and Antarctic ozone depletion, which became influential on ozone discourse. Hoffman prescribed an immediate 85 percent reduction in CFC emissions to restore ozone to its pre-CFC level of 2 parts per billion of chlorine.[3] This approach was quickly accepted and became conventional – the same figure was used in the UK House of Lords and in subsequent ozone treaty revisions. Without the Antarctic 'hole,' other methods might have been taken. Litfin's research demonstrates the inseparability of knowledge and interests in environmental policy making. Actors made use of selected knowledge to mobilize discourse to suit their interests. The CFC industry initially opposed regulation but then positioned itself to capitalize on substitutes. A key shift took place with NASA's imagery of Antarctic ozone that enabled a cautionary discourse to take hold and result in the Montreal Process treaty and its revisions. Litfin ascribes the term '*knowledge brokers*' to describe influential information framers, including NASA's Robert Watson and EPA's John Hoffman. The notion of knowledge brokers is helpful in modifying Foucauldian analysis to incorporate actors' ability to mobilize certain knowledge claims to shape discourse.

Discourse analysis can be applied not only to environmental problems such as acid rain and ozone depletion, but to their solutions. Biomass energy, including biofuels like ethanol, are conventionally categorized in the renewable energy sector, alongside wind, solar, hydro, tidal, and geothermal power. Both Szarka (2004) and Stevenson (2009) explored the mobilization of

[3]John Hoffman chaired the EPA's Ozone Protection Task Force from 1985 to 1988. At a UN-sponsored workshop on CFC control in Leesburg, Virginia, September 8-12, 1986, Hoffman presented "The Impact of Control Strategy Alternatives in Meeting Future Demands for Chlorofluorocarbons," in which he discussed the idea that an immediate 85 percent reduction of CFCs was needed to stabilize atmospheric ozone concentrations (Litfin 1995, 259).

wind power discourse in Europe, a region which leads the world in wind farming technology. Stevenson (2009) explored the mobilization of discourse around onshore wind power in Wales. The Welsh government demonstrated commitment to becoming a global leader in renewable energy by setting ambitious renewable energy targets and by undertaking a spatial planning process to find optimal sites for wind farm development. Large scale wind farms were preferred as these were considered the most efficient means of achieving the national energy goals. It was assumed that most planning issues, where they arose, would be at the local scale, so corresponding effort was committed to resolving any community-based issues concerning wind farm development. However, conflict arose which hindered the process of updating the government's policy on wind power. Stevenson identified three main discourse coalitions: a pro-wind development coalition which mobilized a discourse of environmentalism and especially climate change mitigation, an anti-wind coalition focused on local visual or landscape conservation, and a third group which was concerned primarily with Welsh economic opportunities but was not intrinsically for or against wind power. Much of the conflict between the actors supporting these discourses hinged on the scale at which the discourse was aimed: global, national, or local. An obstacle to the pro-wind coalition was that their discourse of concern with mitigating global climate change did not translate easily to pro-wind decisions at the local scale. The anti-wind coalition sought to protect what they saw as the uniqueness of Welsh landscape and countryside, and was particularly opposed to large-scale wind farms. However, members of this coalition were unable to integrate broader discourses of national economic growth and global climate change. Ultimately the coalition most focused on Welsh economic opportunities was most influential on the policy process, particularly because of their commitment to spatial planning and to a consultative process to reach consensus.

Also on wind power in Europe, Szarka (2004) analyzed wind discourse coalitions in Denmark, France, and the UK. He identified three discourse 'ideal types' from the work of Dryzek (1997) and Rydin (2003): scientific rationality, economic rationality, and communicative rationality. Szarka argued that a fourth discourse could be added to wind power dialogues: moral conviction (I later refer to this as *Civic Stewardship*). In this case EU policymakers appealed to Europeans' sense of duty to do their part in mitigating climate change by investing in renewable energy. Szarka thus sought to draw a clear line between climate change strictly as a scientific rationality and one based on moral obligation. Both pro- and anti-wind development discourses drew primarily on scientific rationality, so much so, in fact, that the image of the wind turbine is arguably an iconic image of renewable energy technology (Szarka 2004). With a salient parallel to the case of biofuels, Szarka found that conservation groups felt drawn into 'the debate' over wind power, but presented ambivalent responses. Friends of the Earth, Greenpeace, and some 'green' political parties favored wind turbine development. Others, such as the Land Trust, Countryside Agency, and BirdLife International, felt compelled to take a generally positive stance on renewable energy, but had reservations about wind farms. The latter groups were influenced by anti-wind discourses, which argued that wind farms were inefficient, unreliable, unsightly, and damaged the local environment. Despite strongly pro-wind policies in the EU, wind power development so far had been modest. France already obtained 90 percent of its electricity from carbon-free sources (75 percent from nuclear and 15 from hydropower), thus meeting its emissions targets largely without wind power. The UK has been achieving emissions reductions, but by replacing coal with natural gas rather than renewables. Denmark, arguably with the strongest public commitment to wind farms, added substantially to wind power generation, but wind farms did not actually reduce the number of operating coal power plants.

Even in Denmark, wind power's contribution to climate change mitigation has thus been minimal, suggesting that there is far to go before renewables actually reduce the consumption of non-renewables (and thus greenhouse gas emissions).

Discourse analysts have also focused research on particular bodies of policy, rather than on discrete environmental problems. Dixon and Hapke (2003) examined the social construction of U.S. agricultural policy, with a focus on the 1996 Federal Agricultural Improvement and Reform (FAIR) Act (P.L. 104-127), or Farm Bill. They traced prominent discourses in American farming history, notably including the rise of Jeffersonian agrarianism in the mid-1800s. In the 1900s agrarianism branched into agrarian populism and an enduring discourse of "family farming." However, 20th century technologies enabled farming to operate more like a business or an industry. The 1996 farm bill hinged on Senate debate involving competing visions of what farming meant in America: one was a discourse of freeing farmers from the restraints of big government and allowing them the freedom of the market, and the other was a discourse of family farmers needing a safety net to survive under the market dominance of giant multinationals. Both sides appealed to a discourse of farming as a paragon of American virtue. The Republican-controlled Congress dismissed the discourse of "family farming" and established a vision of entrepreneurial farmers competing in a global market. This vision, along with strong exports and high commodity prices, was short-lived. As prices fell, the safety net discourse resurfaced and was firmly reestablished in the Farm Security and Rural Investment Act (Farm Bill) of 2002.

Lehrer and Becker's (2010) discourse analysis of the Food, Conservation, and Energy Act of 2008 (P.L. 110–234; 2008 Farm Bill) follows Dixon and Hapke's lead and intersects with my research on biofuels (c.f. Lehrer 2008). U.S. agricultural policy has long been at odds with

the country's espoused position of international trade liberalization. In the mid-2000s, World Trade Organization (WTO) talks were expected to put pressure on the U.S. to reform its agricultural policy by reducing commodity subsidies. However, events transpired that facilitated a shift in discourse away from subsidy reform. WTO trade negotiations in Doha, Qatar, collapsed without agreement on commodity subsidies. The November 2006 U.S. elections won Democrats control of the House and the Senate, shifting the focus of agricultural policy from trade to domestic concerns. Third, a resurgence of interest in biofuels opened opportunities for various agricultural interest groups to align themselves to advance their own interests. The rhetoric of WTO–compliance faded and was supplanted with enthusiasm for biofuels. Support for biofuels was particularly popular in Congress because increased grain prices reduced subsidy payments, thus bringing the U.S. closer to compliance with WTO regulations. Ultimately, the 2008 Farm Bill contained strong financial incentives for biofuel development, particularly from non-food crops such as grasses and trees.

Finally, Palmer (2010) examined the discursive formation of the UK's leading policy on biofuels, the Renewable Transport Fuels Obligation (RTFO). The RTFO bears a remarkable resemblance in both content and timing to the U.S. Energy Independence and Security Act (signed in October and November 2007, respectively). The introduction of the RTFO was surrounded by debate and controversy. Palmer identified an alliance of pro-biofuel groups, including petrochemical companies and some environmentalists, which centered their arguments on the notion of sustainability. Other environmental groups and experts opposed biofuel mandates on the basis of arguments concerning the environmental and social impacts of land use change (biodiversity loss, deforestation, and food insecurity). Like Litfin, Palmer explored the rhetorical divisions put in place between science and policy. He called this "boundary work."

For example, the pro-biofuels groups appealed to the notion of science when they suggested that the impacts of biofuels on indirect land use change (such as in tropical regions) were a novel problem for scientists to explore in more detail, but not a problem that should overturn biofuel development (Palmer 2010). In fact, some critics agreed that there was a great deal of uncertainty regarding indirect impacts, while others challenged the notion that scientific investigation would resolve the existing problems with biofuels. Biofuel critics appeared to have the weaker argument at the time when the RTFO was passed, but subsequently influenced the British government's decision in 2008 to conduct a review of the impacts of biofuels (the Gallagher Review). Palmer attributes this influence to the high level of public trust placed in the 'moral authority' of environmental groups. The Gallagher Review marked a distinct discursive shift in position on biofuels, adopting as it did much more precautionary language than the RTFO. The review concluded that indeed the indirect impacts of biofuel production were prohibitively complex and "therefore irresolvable" (Palmer 2010). While the Gallagher Review offered hope to biofuel critics, it did not recommend a complete withdrawal of state subsidies for biofuels. Anti-biofuels discourse had mobilized around notions of environmental precaution (as in Hajer's acid rain case study), and had achieved official recognition in the form of the Gallagher Review, but failed to overturn RTFO policy (Palmer 2010).

2.4 Chapter Summary

The argumentative turn in the social sciences, and the emergence of social constructionist, and especially discursive, approaches to policy analysis guided the methods used in this research. First, a discursive approach explicitly examines the actors involved in the policy process, and the reasons for their actions. Second, it investigates the influence of communication

and language in the political process, such as, for example, by showing how poorly understood energy or environmental circumstances come to be defined as problems in need of particular policy solutions. Combining these first two points, discourse analysis examines the policy arena to understand how particular actors and interests seek to frame the definition of an environmental (or energy) problem so as to influence the range of acceptable solutions. To this end, the concepts of knowledge brokers (Litfin 1994), discourse coalitions, and storylines (Hajer 1995) are useful tools. Foucault was especially concerned with the use of knowledge as a means of power, and with the historic periodicity of discourses. Ultimately, these tools and techniques are used to explain how particular policies do or do not come about, and how such policies persist or change over time.

Chapter 3 - Research Methods

Discourse analysis is a perspective on society, including on academic scholarship itself; it frames both an analytical and a methodological approach. This chapter on methodology is therefore partially subsumed by the previous comments on discourse analysis. Especially given how open Foucault's works, and discourse analysis, are to interpretation, however, this section seeks to explain precisely how the research is conducted.

A useful starting point for understanding Foucauldian discourse analysis is to contrast it with positivist or rationalist analysis, as is summarized in Table 3-1 below. Whereas a positivist analysis may begin (implicitly, perhaps) with the notion that language is a simple reflection of reality and thus not a matter of critical concern, Foucauldian analysis is very much concerned with how language is used to convey certain meanings and interests. Foucault endorsed a reflective and iterative approach to the topic of study, which contrasts with a deductive approach, such as setting out to test a hypothesis. Analogously, there are no accepted academic procedures for testing the 'rightness' or 'wrongness' of a political ideology or an environmental worldview. Ethanol policy is at once an object of analysis in its own right and a lens through which to examine theoretical issues in the discourse analysis of environmental policy. Methodologically, then, this project does not proceed from inquiry chapters to 'results;' rather the analysis is applied throughout all three historical sections (outlined below).

Table 3-1 Theoretical distinctions between Foucauldian and Positivist/Rationalist analysis.

	Foucauldian Discourse Analysis	**Positivist/Rationalist Analysis**
Language	Language mediates between the world and the way it is perceived. Actors manipulate language to suit their interests.	Language is a neutral system of meanings that describe the world. Language is an unproblematic or literal reflection of reality.
Truth	Truth claims are mediated by language, and are thereby socially constructed. Truth is relative to the people who produce it and their power relations in society.	Truths (or facts) exist independently of the observer. Science can empirically reveal objective truths, such as through observation or experimentation.
Policymaking	Policymaking is an arena of struggle among interests and discourses.	Policymaking is concerned with values, whereas science is concerned with facts. Policymaking is a rational process of choosing optimal public policy from a range of options.
Power & Knowledge	Power and knowledge are coproduced. Knowledge is communicated by actors with interests in particular outcomes. Power is not limited to official channels; it is found in all relations, and may be informal or institutionalized. An important source of power is that which privileges certain discourses while marginalizing others.	Power and knowledge occupy separate realms. Power is manifest in official authority, such as the judicial system, branches of government, and the military. Scientific inquiry is geared toward the production or discovery of useful knowledge.

First, policy making is viewed not as a rational process but as an arena of struggle over discourses (Sharp and Richardson 2001). It would be naïve to assume that politicians and bureaucrats always act "in the public interest." Rather, it is understood that government programs often have disparate social effects, such that a majority of taxpayers subsidize a small group of beneficiaries. The likely or actual beneficiaries have a strong material incentive to form lobbying organizations to curry favor with politicians to maintain or enhance favorable policies. Thus there is an interplay of incentives and material interests at play in the discursive arena in

which politicians and lobby groups interact. Contrary to Foucault's emphasis on hegemonic discourses and discursive 'regimes,' this research accepts the idea of multiple, competing discourses at any given time (this situation is described in Chapter 6). Lawmakers themselves would likely find this concept intuitive, since their job demands a fine-tuned instinct for distinguishing between the practicality, veracity, and popularity of the range of possible stances on a policy issue. Hajer's '*storylines*' and '*actor coalitions*'[4] are useful tools for capturing the notion of actors aligned in common ways of thinking and talking about issues. At times, for example, environmental conservation groups found themselves in an unlikely alliance with big oil companies in opposition to questionable claims by ethanol proponents. Storylines are pithy summaries of a way of viewing the world. The storyline that '*ethanol improves national energy security*' is suggested by the titles of some of most prominent ethanol legislation: the Energy Security Act of 1980, the Energy Policy Act of 2005, the Energy Independence and Security Act of 2007.

The second point is that the terms of a debate are not taken as fixed or impartial, but as contingent. Key discursive terms, including 'renewable fuel,' 'energy crisis,' 'energy security,' 'environment,' and 'technology' are not taken to have immutable, unproblematic meanings, but are understood to be messy and contested. Knowledge is understood to be not simply a reflection of reality, but a claim made by a stakeholder. In all cases the analysis of discourse involves carefully and critically reading the material, suspending, as far as possible, preconceived biases (Waitt 2010). Where possible, claims are checked against counter-claims. In some cases scientific evidence does not support, or indeed contradicts, policy decisions. Analyzing discourse involves unpacking the socially constructed meanings which have

[4]I prefer the term 'discourse coalitions,' to emphasize that the discourse provides the point of cohesion, rather than the actors themselves.

influenced ethanol policy; thus close attention is paid to the judgments, assumptions, omissions, inferences, and implications inherent in policy rhetoric.

The third point of approach concerns historical context. The point is to examine the tactical productivity of a discourse in terms of its traction on power and knowledge, in relation to alternative discourses. Unfortunately, Foucault's approach revealed little about why discourses retain or lose their effect. To help overcome this weakness, a subtly different view of the role of actors is advanced. Foucault overstated his case in implying that subjects are 'stuck' inside the discourses available to them. In contrast, I see actors not fixed in position – for example, as ethanol producer, 'corn-state' legislator, environmental lobbyist, petroleum industry spokesperson or scientist – but standing outside of discourses and deploying them purposefully to suit their goals (Hajer 1995, 53). There are practical limits to the spatial and temporal scale at which to analyze. While a journal article could be written on the discourse analysis of each law concerning U.S. biofuels, drawing out the key events and discourses over several decades of ethanol policy-making is a challenge requiring a broader approach.

While many U.S. states have their own biofuel policies, this research sought to capture the broader trends in policy change by focusing at the national level. The historical context is divided into three periods, based on stages of continuity and flux in ethanol development. The analysis begins in 1973, when geopolitical and economic crises prompted a fundamental change in energy policies, through the end of the Reagan Administration. The second stage is bounded by two major energy bills – the 1990 Clean Air Act Amendments and the 2005 Energy Policy Act. The final section follows the boom years of ethanol production until the end of 2013, by which time a series of setbacks and policy changes had begun to undermine support for ethanol. In each section, the goal is to answer the following questions vis-à-vis federal biofuel policy:

- Who are the key knowledge brokers?
- What are the main discourse coalitions?
- What influence did the knowledge brokers and discourse coalitions have?
- What are the main political narratives or storylines used?

Based on my examination of the above, in the discussion I seek to explain why certain discourses dominated biofuel policy at different periods of time (see also Table 7-2). My conclusions will draw implications from biofuel policy discourses to the broader sphere of public policy and environmental issues.

The next research consideration concerned the choice of material. The starting point was federal public laws, which themselves were manifestations of prevailing discourse. It is worth noting a couple of distinctive features of Congressional policymaking. First, laws tend to progress iteratively, often written 'in the heat of the moment' without a great deal of analysis of consequences. It is very common for legislation to modify an existing law, and rare for a law to introduce an unprecedented idea. Bills tend to end up as complex collations of only loosely related policies (and sometimes not even that, in the case of omnibus bills). They reflect intricate policymaking avenues through the American political system, which often necessitates compromise and alteration in Congressional committees, in and between the House and the Senate, and before or after reaching the White House. Laws with reference to ethanol (or biofuels more generally) probably number in the hundreds; the goal was not to examine each one, but to selectively focus on those laws and related policies which had the greatest influence on the development of the industry. 'Ethanol policy' thus should not be construed as a series of laws concerned only with ethanol. Rather, the policies I refer to are almost invariably small

components of much larger bills, often (but not always) under the rubric of energy, environment or agriculture (see Table 7-2).

Broadening out from policy documents (often accessed via the Federal Register) were related content in the form of Congressional committee hearings, Congressional records (such as floor debates), and the White House website. The legislative branch agencies, including the Congressional Budget Office (CBO), Congressional Research Service (CRS), and Government Accountability Office (GAO, formerly the General Accounting Office) provided valuable assessments of the likely consequences of particular policies. In some cases the websites of government agencies, including the EPA, the Department of Energy (DOE), and the U.S. Department of Agriculture (USDA) were useful, particularly for background information.

Many of the claims concerning ethanol lay in the scientific realm, which led to a thorough review of findings published in scientific journals, including *Conservation Biology*, *Nature, Science, Scientific American, Proceedings of the National Academy of Sciences, Energy Policy, Environment and Planning*, *Environmental Science & Technology*, *Policy Studies Journal*, *Journal of Environmental Planning and Management*, *Journal of Environmental Engineering*, *Journal of Environmental Policy and Planning*, *Millennium: Journal of International Studies*, and *Oil & Gas Journal*. More lengthy scientific reports were available from the National Academies of Science, DOE/USDA research centers, and the DOE's Energy Information Administration (EIA). The mainstream media, of course, mediate and greatly influence the public outlook on political and scientific news. I purposely sampled from across political persuasions and geographic spheres of the major national newspapers by searching the archives of *The New York Times, The Wall Street Journal, The Washington Post, USA Today*, and the *Chicago Tribune*. I also drew from mainstream periodicals including *Forbes*, *National*

Journal, *National Review*, *TIME*, *The Atlantic*, *The New Yorker*, and *The Economist*, as well as National Public Radio, CNN, and Bloomberg News. Online searching for ethanol policy documents led to some of the most clearly articulated positions by non-governmental groups, including those concerned with public policy and environmental conservation. The Renewable Fuels Association, the country's most prominent ethanol lobby group, maintains a particularly informative website. Finally, non-governmental organizations (NGOs) concerned with international politics (e.g., the Council on Foreign Relations) and development (e.g., Oxfam, ActionAid, the Earth Institute, the Earth Policy Institute), as well as international governance institutions, including the United Nations and the World Bank, provided valuable insights from international perspectives.

Chapter 4 - Ethanol Policy from 1973 to 1988

> *The use of vegetable oils for engine fuels may seem insignificant today but such oils may become, in course of time, as important as petroleum and the coal-tar products of the present time.* – Rudolph Diesel (1912)

There are two important and far-reaching discourses apparent in the federal government's political responses to the energy crises of the 1970s, which are the focus of this chapter. These are *Environmental Bureaucracy* and *Techno-Optimism.* In retrospect it is clear that the policies enacted in this period, and the discourses which framed them, would have lasting consequences for the development of the corn ethanol industry. *Environmental Bureaucracy* is concerned with the role and responsibility of government in addressing social and economic issues. Dryzek (2013, 75-98) uses the term *Administrative Rationalism*, and describes it as a worldview which legitimates the efforts of government institutions – including scientists, economists, and other experts – at solving technical problems for the state. He captures the notion of *Environmental Bureaucracy* in the phrase: "leave it to the experts," in that the experts are the scientists and administrators employed by the state to address problems such as oil shortages (Dryzek 2013). The term *Environmental Bureaucracy* is used here to emphasize the idea of government agencies solving environmental problems, including ethanol/energy issues. The clearest understanding of *Environmental Bureaucracy* is found by standing it against fundamentally different worldviews, including *Free Markets* – the notion that environmental problems are best solved through deregulation and free market competition – and *Civic Stewardship* – the notion that environmental problems are best solved through public participation, and learning through experimentation (Dryzek 2013). One of the consequences of taking an *Environmental Bureaucratic* view of an environmental problem is that decision-making power and authority is

concentrated in the relevant government institutions. As is discussed below, political responses to the energy crises of the 1970s were premised on wresting control and authority over oil markets in order to stabilize prices.

The second major discourse of this period is *Techno-Optimism*, an over-confidence in the potential for technological and scientific advancements to solve environmental problems (Alexander 2014). *Techno-Optimism* is typically paired with some other discourse, depending on whether confidence is placed in government (*Environmental Bureaucracy*), in markets (*Free Markets*), or in people (*Civic Stewardship*) to devise technological and scientific solutions.[5] The most significant biofuel-related policies arose within a discursive framework of over-confidence in the capacity of government institutions to devise and administer technological solutions to the energy crises caused by turbulent geopolitical events in the 1970s.

4.1 The 1973 Oil Crisis

Prior to the 1970s, U.S. energy policy was primarily concerned with encouraging domestic energy production, and was little concerned with environmental consequences. Oil and gas exploration and production were encouraged through tax subsidies that enabled companies to deduct costs associated with drilling and depletion of the resource (Sherlock 2011). Ethanol offered a means of fueling the earliest motor vehicles, and during the Great Depression corn ethanol subsidies were promoted as a means of boosting farm incomes (Kovarik 1998; Carolan 2009). However, after the Second World War oil production increased rapidly – more than doubling from 1940 to 1970 – and interest in alternative fuels faded. Federal energy policy took a dramatic turn in the 1970s. America's rising oil consumption and declining oil production

[5]Chapter 7 returns to this point.

exposed a vulnerability that became a prominent feature of public discourse during the 1973 OPEC-led oil embargo. At the time, the U.S. imported approximately one third of its petroleum (EIA 2013a). The resulting fuel shortages and high prices demonstrated a surprising geopolitical weakness in America's economic dependence on oil imports, and sparked concern about future supplies. Millions of drivers were affected by the rationing of fuel purchases and by long queues outside gas stations, and the economy was hindered by the disruption in flow of goods and services. It was clear that this problem was on a scale that demanded a national political response. President Nixon initiated Project Independence to wean the U.S. off imported oil:

> Let us set our national goal, in the spirit of Apollo, with the determination of the Manhattan Project, that by the end of this decade we will have developed the potential to meet our own energy needs without depending on any foreign energy sources (Nixon 1973).

Both *Environmental Bureaucratic* and *Techno-Optimist* discourses are discernible in Nixon's speech. His implicit argument was that energy was too essential to the nation's economy to be left to the vicissitudes of global markets, necessitating strong state intervention (Grossman 2009). He evoked a discourse of scientific endeavor by referring to the work of government agencies like the National Aeronautic and Space Administration (NASA, which administered the Apollo program) and the U.S. Army Corps of Engineers (under which the Manhattan Project was undertaken) to solve the energy crisis. These two discursive features of the government's response to the "oil crisis" – state regulation and technological supremacy – would have important implications for biofuel policy.

4.2 National Energy Policies Take Shape

State intervention in energy markets increased dramatically through the 1970s. The Nixon administration initiated gasoline price controls which were extended into the Ford and Carter administrations. The Strategic Petroleum Reserve (SPR) was created during the Ford Administration via the Energy Policy and Conservation Act of 1975 (EPCA; P.L. 94-63) as a defense against sudden oil shortages, following the oil embargo. The EPCA also ushered in the first vehicle fuel efficiency regulations by setting Corporate Average Fuel Economy (CAFE) standards for automakers. Similarly, the National Energy Act of 1978 (P.L. 95-617 to 95-621) imposed a 'gas guzzler tax' on fuel inefficient vehicles. President Carter staked his credibility on addressing the "energy crisis," which he likened to the "moral equivalent of war." He announced a ten-point plan to foster national energy security, the centerpiece to which was centralizing government energy strategy. He sought national policies that promised to ensure continued economic growth, to protect the environment, to reduce vulnerability to oil price shocks, and to promote energy conservation. The long term goal was to develop renewable forms of energy to power the American economy. He oversaw the establishment of the Department of Energy (DOE) with the primary goal of securing energy supplies and reducing oil imports. He set a goal of producing 500 million gallons of ethanol in 1981, increasing to two billion gallons in 1985.[6] The DOE's Office of Alcohol Fuels launched an Alcohol Fuels Program with the purpose of increasing production and reducing the cost of ethanol. This was to be achieved by use of loan guarantees, cooperative agreements with producers, and funding on research and development (DOE 1980). A series of national energy policies were directed at

[6]On September 22, 1980, President Carter spoke at the Lincoln Land Community College, at which he said that "Our strong emphasis on gasohol will make farmers more self-sufficient and all Americans more secure. Eighteen months ago virtually no gasohol was being produced in this country. We now have the capacity to produce 135 million gallons of ethanol, and by 1981, next year, we should reach 500 million gallons of ethanol. My goal is that by the end of 1990 we'll produce enough alcohol fuel to replace ten percent of all America's gasoline use" (Public Papers of the Presidents of the United States 1981).

energy conservation measures and regulations, research and development of energy alternatives, and encouraging domestic fossil fuel production.

4.3 Archer Daniels Midland and Corn Politics

The federal government's approach to technological innovation was to support a diverse portfolio of promising energy alternatives, while still investing heavily in conventional fossil fuel and nuclear power research and development. Solar, wind, geothermal, ocean thermal, synthetic fuels, and hydroelectric projects were all allocated research and development funding. Corn ethanol had been used as a vehicle fuel in the past, but had lost market share to gasoline (Carolan 2009). In the 1970s, the U.S. agricultural industry was characterized by surplus grain production and low prices. As had occurred in the past, agribusinesses and farm interest groups lobbied for political support to foster markets and improve farm incomes. With regard to ethanol, the man at the forefront of this effort was Dwayne Andreas, CEO of Archer Daniels Midland (ADM), the largest agribusiness in the country (Keeney 2009). Andreas was the Chief Executive Officer of ADM from 1971 to 1997, and was on the company's board of directors for over 30 years, until 2001. As head of ADM, Andreas used financial contributions to wield influence over politicians at the highest level for three decades (Weiss 1990; Bovard 1995; Carney 1995; Manning 2004). Andreas was a shrewd policy entrepreneur, and one of the most profligate political donors of his time; he donated liberally to both Democrats and Republicans, including Hubert Humphrey, Richard Nixon, Jimmy Carter, Bob Dole, George H. W. Bush, Bill Clinton, and Tip O'Neill (Bovard 1995; Carney 1995). He used his high level connections in Washington, D.C. to convince "politicians such as Senator Bob Dole (R-Kansas) and President Carter that ethanol offered a way out of the 1973 OPEC oil embargo that had sent the American economy reeling"

(Keeney 2009). Subsidies that enabled corn ethanol to compete with gasoline would open an enormous new market to agricultural interests, including the National Corn Growers Association and ADM.

4.4 Biofuel Optimism

Inside political and scientific circles some believed that corn ethanol could be replaced by an even more productive ethanol industry based on cellulosic feedstock (the above-ground biomass of the plant, rather than the grain). Plant cell walls are composed of tightly bound cellulose, lignin, hemicellulose, and other compounds, giving the plant durability and rigidity. In 1976, physicist and environmental scientist Amory Lovins wrote *Energy Strategy: The Road Not Taken?*, published in *Foreign Affairs*. If there is an individual who epitomizes support for a discourse of *Techno-Optimism*, it is Amory Lovins. His energy strategy described "exciting developments in the conversion of agricultural, forestry and urban wastes to methanol and other liquid and gaseous fuels" (Lovins 1976). He confidently predicted that the U.S. could use these sources of biomass to create a biofuel industry which would reach a scale 10 to 14 times the size of the wine and beer industry and would replace gasoline entirely with biofuels (Lovins 1976). Lovins co-founded the Rocky Mountain Institute, an energy 'think tank' dedicated to advancing the efficient use of resources to promote a "secure, prosperous, and life-sustaining world" (RMI 2014). Lovins has won dozens of awards, including a MacArthur genius award, for his lifelong work in energy innovations. *The Wall Street Journal*, *Foreign Policy*, *Newsweek* and *TIME* have praised Lovins as one of the world's most influential energy thinkers. Lovins is politically engaged – he has testified repeatedly before Congress to offer his energy expertise and recommendations, and has advised many countries' political leaders on energy policy. He

continues to be a key knowledge broker in his capacity as a charismatic scientist projecting optimism in the role of technology for solving environmental problems. Though his 1976 forecast proved false, Lovins repeatedly predicted, in *Factor Four: Doubling Wealth, Halving Resource Use* (1997), *Natural Capital* (Hawken et al. 1999), *Winning the Oil Endgame* (2004), *The World in 2007* (2006), and *Reinventing Fire* (2011) – that cellulosic ethanol would become a major contributor to U.S. fuel needs. Lovin's predictions appear to follow the old quip that 'cellulosic ethanol is the fuel of the future, and always will be.' It is surprising then that the findings and predictions on cellulosic biofuels made by Lovins have not been subjected to greater critical scrutiny. Throughout the history of modern U.S. ethanol policy, a remarkably enduring techno-scientific trope has been that a cellulosic ethanol industry will soon be commercialized. It does not seem to have impeded Amory Lovins' career that his predictions on cellulosic ethanol have not so far materialized. To the contrary, through his speaking engagements and publications, Lovins continues to play a prominent role in persuading the public that advanced biofuels will soon dominate domestic fuels.

Lovins was not alone in predicting a major role for cellulosic ethanol in powering American cars. A 1980 General Accounting Office report on ethanol as a motor vehicle fuel concluded that it was "entirely feasible that the Nation's vehicle fleet could be operated on …[gasohol]…by the year 2000" by using cellulosic crops such as wood, agricultural residues, and municipal solid waste (GAO 1980). Yet other, more sober, assessments of the potential of biofuels were available. In 1978 the DOE published a position paper on alcohol fuels which estimated that even if all available farmland other than what was needed for domestic food production were used for ethanol, it would supply no more than eight percent of total liquid fuel

demand, and concluded that "the claims of the more extravagant gasohol proponents, that this source of fuel could virtually solve the energy crisis, are quite exaggerated" (DOE 1978, 2).

4.5 National Ethanol Policies

Those in favor of fostering an ethanol-based fuel supply, primarily based on corn, began to wield influence over key energy policies in the late 1970s. The National Energy Act of 1978 (P.L. 95-618) established significant and enduring regulations which marked the beginning of the modern era of ethanol production (Tyner 2008).[7] Kansas Republican Senator Bob Dole, senior member of the Senate Agriculture Committee, introduced legislation that would provide a tax exemption for gasohol (a blend of nine parts gasoline and one part ethanol), effectively a subsidy of 40 cents per gallon of ethanol produced. This subsidy kick-started the industry, and ethanol production rose from just a few million gallons to approximately 50 million gallons sold as gasohol in 1979 (DOE 1980). The oil price shocks triggered by the Iranian Revolution confirmed and reinforced fears that dependence on foreign oil threatened the American economy. Congressional enthusiasm for finding solutions to the nation's energy problems was reflected in a dramatic spike in federal funding on energy research and development, which in inflation-adjusted dollar terms, peaked late in Carter's term before declining over the next two decades (Margolis and Kammen 1999; GAO 2008). As a percentage of GDP, the decline was even more dramatic. In its first few years the DOE received a massive flow of federal funds for energy research and development, which it divided among fossil fuels, nuclear power, renewables, and efficiency. Funding for renewables and energy efficiency was never as large as

[7]The National Energy Act of 1978 comprised five statutes (P.L. 95-617 to 95-621): the Energy Tax Act, the Natural Gas Policy Act, the National Energy Conservation Policy Act, and the Public Utility Regulatory Policies Act.

for nuclear power or fossil fuels (Sissine 2008), yet the federal government made it clear that finding energy solutions was a high priority.

In 1980, national energy policy was revised, with greater financial incentives for ethanol production. The Crude Oil Windfall Profit Tax Act of 1980 (WPTA; P.L. 96-223) extended the gasohol tax credit and established an excise tax on the difference between the market and a baseline price of oil, designed to capture 'windfall' or unexpected revenue during sudden spikes in oil prices (Lazzari 2006). The government revenue was channeled into alternative energy projects including ethanol refinery construction. The notion of a windfall profit itself revealed a shift in the way many in Congress viewed the oil industry. Whereas previously the emphasis was on encouraging the oil and gas industry's development, now it turned to focus on consumer demand for affordable fuel. A certain level of industry profit was acceptable, but not an 'excessive' amount, especially when the driving public faced high gas prices. The WPTA came at a time when price controls were being lifted, and an anticipated rise in U.S. oil prices was expected to yield massive profits to the oil industry. However, the WPTA backfired by dampening domestic oil production and escalating U.S. dependence on imported oil by between eight and sixteen percent (Lazzari 1990).

The Energy Security Act of 1980 (P.L. 96-294) went beyond the 1978 energy act by enforcing a national plan for biomass development. The bill's supporters had come to endorse the notion of promoting domestic ethanol as a means of replacing imported oil:

> (1) the dependence of the United States on imported petroleum and natural gas must be reduced by all economically and environmentally feasible means, including the use of biomass energy resources; and
>
> (2) a national program for increased production and use of biomass energy that does not impair the Nation's ability to produce food and fiber on a sustainable basis for domestic and export use must be formulated and

> implemented within a multiple-use framework (Biomass Energy and Alcohol Fuels Act of 1980).[8]

The bill directed the Secretaries of the Departments of Energy and Agriculture to design a plan for the production of 60,000 barrels per day of alcohol fuel by December 31, 1982, increasing to ten percent of national gasoline consumption by 1990. It also provided guaranteed loans for refinery construction. Corn ethanol represented a technological innovation which had already been proven in motor vehicles, and was thus a low risk investment, and ostensibly could be scaled up to replace ten percent of national gasoline consumption. However, it had become apparent that ethanol could be more cheaply imported. Sugarcane ethanol in Brazil was far more productive than corn ethanol, and Brazilian imports threatened to undermine the domestic industry. The policy response to the availability of cheap Brazilian ethanol was the clearest early indication that U.S. agricultural interests outweighed energy security concerns. Led by Kansas Senator Bob Dole, corn ethanol supporters in Congress moved to impose a tariff of 40 cents per gallon on ethanol imports. Opponents pointed to free-market principals, and argued that a tariff would impose an added cost on U.S. fuel consumers, and that it violated America's stance on opening markets to foreign trade (Koplow 2007). Nonetheless, a 40 cent-per-gallon import tariff was imposed as part of the Omnibus Reconciliation Act of 1980 (P.L. 96-499). President Carter used these bills as political capital, announcing the tariff and millions of dollars in subsidies just weeks before the 1980 elections.

The 1980 elections were, in large measure, a discursive struggle over how best to respond to the 'energy crises' and strengthen American economic prosperity. The Reagan campaign promoted a discourse of tax cuts, small government, free markets and deregulation. The Reagan Administration undermined several key weaknesses in the *Environmental Bureaucracy* of the

[8]The Biomass Energy and Alcohol Fuels Act of 1980 is the second of six bills in the Energy Security Act of 1980.

Carter Administration. The new discourse of *Free Markets* refuted the wisdom that the federal government could and should regulate energy markets. While the Carter administration invoked a central role of government as a problem solver, the Reagan administration projected a political narrative in which government itself was the problem.[9] The new administration banked on the idea that energy markets worked best without government intervention, and set about dismantling many of the alternative energy programs which the Carter administration had established (Copulos 1985). On the day he took office President Reagan abolished regulatory controls of the oil and gas industries, subjecting them to global prices. Oil consumption had declined due to the economic slowdown, and when oil production increased, prices fell dramatically in 1981. The CAFE standards were rolled back and the Crude Oil Windfall Profits Tax was repealed in 1988. The Reagan Administration cut the EPA's budget and staffing, and filled powerful agency positions with people who would toe the party line (Kraft and Vig 2003). There were rumors that the new administration planned to abolish the EPA (Rosenbaum 1995, 208-209), and the DOE (CQ Researcher 1981). Spending on energy research and development was reduced, and a new emphasis was placed on limiting unnecessary or onerous government regulations; one of President Reagan's earliest executive orders[10] was to commit all executive branches of government to conduct cost-benefit analyses to determine that any proposed regulation would deliver benefits to society that outweighed its costs. President Carter's solar panels were, metaphorically and literally, removed from the White House roof by President Reagan.

[9]In his inaugural address President Reagan declared "…government is not the solution to our problem; government is the problem."

[10]Executive Order 12291 on February 17, 1981.

Notwithstanding the free market rhetoric from the White House, Senate Republicans were instrumental in strengthening the ethanol tax subsidy and import tariff. In the Tax Reform Act of 1984 (P.L. 98-369), both the ethanol subsidy and the tariff were raised from 40 to 60 cents per gallon.[11] Even with these extra supports, ethanol's prospects began to look decidedly grim. Corn ethanol producers operated within margins set by the input price of corn and the retail price of gasoline. As 1980s oil prices slumped, margins declined, despite favorably low priced (and heavily subsidized) corn. Over half of all ethanol plants closed by the mid-1980s. Clearly the assumption that gas prices would continue to rise, closing the gap with alternative energy costs, proved incorrect. The energy crises appeared to have vanished, dispelled by free markets and deregulation. However, the free-market approach failed to induce the kind of investment in renewable energy needed to make them competitive. Low fossil fuel prices dampened economic incentives for private investment in alternatives.

4.6 Biofuel Lobby Groups

While entrepreneurial individuals, including Dwayne Andreas, had influenced key policy makers in the 1970s, the representation of ethanol interests became more organized in the 1980s. The Renewable Fuels Association (RFA) was formed in 1981 as a lobby group for renewable fuels, primarily corn ethanol, and would become the most influential ethanol lobby group in Washington DC. The RFA was frequently called upon to testify before Congress on behalf of the ethanol industry. The RFA drew membership largely from ethanol producers, and since dues were based on the volume of ethanol produced, RFA contributions were dominated by major

[11]Congress altered the ethanol tariff and production subsidy many times. The amounts ranged between 40 and 60 cents per gallon, until both regulations were allowed to expire at the end of 2011. Some exemptions to the tariff were made for ethanol imported from Caribbean countries.

ethanol producers like ADM. Other ethanol lobby groups were formed in the 1980s, including the Clean Fuels Coalition and the American Coalition for Ethanol (Glozer 2011). Support for corn ethanol also came from the National Corn Growers Association (NCGA), American Farm Bureau Federation, and the American Agriculture Movement (Weiss 1990). By the late 1980s, however, with waning public support for ethanol subsidies, the ethanol lobby turned to a new set of policy developments (Weiss 1990), discussed in the next chapter.

4.7 Chapter Summary

In the period from 1978 to 1980, major new biofuel-related policies were enacted, including an ethanol tax subsidy, an ethanol import tariff, subsidies for refinery construction, funding for alternative energy research and development, and a plan to expand biofuel production to meet ten percent of national gasoline demand. These arose within a discursive framework of *Environmental Bureaucracy* – centralizing within government agencies authority and control over the energy problem, and *Techno-Optimism* – overconfidence in the ability of scientific and administrative experts to resolve the energy crisis through new technologies, such as the development of a cellulosic ethanol industry. The Reagan Administration introduced a competing discourse – *Free Markets* – which emphasized instead the primacy of private enterprise and competition as the means of solving energy problems. With low oil prices through the 1980s, the biofuel sector struggled to compete, and many refineries closed down. Investment and research in alternative energies dwindled, and ethanol interests formed more organized lobby groups to promote new policies for the development of biofuels.

Chapter 5 - Ethanol Policy from 1989 to 2005

For biofuels, the defining narrative and policy framework of the 1990s concerned air quality. Declining air quality in many of America's major cities had become a national political issue, and Congress moved to regulate, *inter alia*, the composition and environmental performance of gasoline. While the Reagan Administration's policy orientation toward deregulation and private sector competition appeared to be vindicated by the fall in oil prices in the early 1980s, the same *Free Market* approach did not resolve the growing problem of traffic congestion in American cities, nor the health problems related to toxic air pollution from a rising number of vehicles on American roads. Unlike in other regulatory contexts, polluting industries did not argue that air quality problems did not exist, or that the problems were exaggerated, or that the scientific evidence was so uncertain that regulations should be delayed until further investigation yielded better data.[12] Instead, they became close stakeholders in the negotiations over how to modify existing regulations. The focus of this chapter centers on the discord and tension between the science of air pollution abatement and the interests of politicians, industries, and government branches. In the aftermath of the terrorist attacks of September 11, 2001, and with measurable air quality improvements (though not due to the use of ethanol oxygenate), the clean air narrative fell lower on the political agenda while energy security rose. The period is bookended by two major pieces of energy and environmental legislation: the Clean Air Act Amendments of 1990 and the Energy Policy Act of 2005. Powerful commercial stakeholders in the political process included automakers, the oil and gas industry, and producers of fuel

[12]The history of air quality regulation in the Los Angeles Basin in the 1940s and 1950s provides a point of comparison. Automakers initially denied any responsibility for the smog that had begun to blight the city. It took years before the scientific evidence, as well as local activism, was sufficient to convince policymakers of the need to legislate on emissions-controls in California vehicles (Elkind, 2011).

additives including ethanol and methyl tertiary-butyl ether (MTBE). Major environmental organizations, and prominent environmental advocate Vice President Al Gore, played pivotal roles in policy decisions, reinforcing ethanol's discursive credentials as a "clean," renewable energy technology. The period marked a return to the dominance of *Environmental Bureaucracy*, essentially because air pollution abatement was widely understood to be a problem on a national scale, well beyond what any individual could address. The EPA was the government branch central to the regulation of air quality. The pliability of the agency at the hands of White House and Congressional leaders is examined below. What becomes apparent is that political interests concerning corn ethanol repeatedly trumped scientific evidence on the air pollution abatement benefits of oxygenated fuels. The corn ethanol lobby proved strikingly successful in harnessing public concern with clean air and energy security to its promotion of subsidies, exemptions from strict air quality regulations, and ultimately even a national mandate for renewable fuel consumption. While the storyline shifted from energy security in the 1970s, to clean air in the 1990s, and back to energy security in the early 2000s, *Environmental Bureaucratic* and *Techno-Optimist* discourses remained remarkably favorable for pro-biofuel policies.

5.1 National Air Quality

Following the 1970 Clean Air Act amendments, the EPA developed national ambient air quality standards (NAAQS) for a list of known pollutants – carbon monoxide (CO), tropospheric ozone,[13] particulate matter, sulfur oxides (SO_x), nitrogen oxides (NO_x), and lead. Revisions to NAAQS are made over time, as the agency deems appropriate. In 1973 the agency had begun

[13]Stratospheric ozone (in the upper atmosphere) is natural and protects us from ultraviolet light. This paper is concerned only with anthropogenic, tropospheric (ground-level) ozone.

the gradual process of phasing out lead from gasoline. The most widespread and problematic of the pollutants with air quality standards set was ozone. Tropospheric ozone is a colorless, odorless gas formed when sunlight triggers reactions between volatile organic compounds (VOCs) and NO_x. Even at low concentrations, ozone was known to inflict health costs on people. Major anthropogenic producers of these chemicals include industries, power plants, and motor vehicles. Motor vehicles were estimated to contribute roughly half of all VOCs and NO_x emissions, and three quarters of total CO emissions (EPA 2014a). By the 1980s, many large cities were shrouded in smog– brown haze composed of ozone from motor vehicles, and other air particles, during the summer months. It was apparent that the 1970 and 1977 amendments to the original Clean Air Act of 1963 had not curtailed pollution-induced health problems in American cities. While mobile source emissions per vehicle were declining, the number of vehicles continued to increase and congestion was worsening. In 1989, an estimated 67 million Americans were living in cities that did not meet NAAQS (NRC 1991). There was a growing scientific consensus that air pollution was imposing substantial health and environmental costs. Hall et al. (1992) valued the annual health benefits of clean air in California's heavily polluted "south coast air basin" alone at almost 10 billion dollars, or over 1600 lives saved in a region of 12 million residents. Nationally, the Lung Association reported that the annual health costs from illness and premature death due to air pollution could reach 50 billion dollars (Cannon 1990).

5.2 Bush's "Environmental Presidency" and Air Pollution

Vice-President George H.W. Bush sought to distance himself from President Reagan in his own campaign, and promised to be an "environmental president" (Yergin 2011, 458). Bush was noted for pointing out that "those who think we are powerless to do anything about the

'greenhouse effect' are forgetting about the 'White House effect.' As president, I intend to do something about it" (The New York Times 1989). Also in 1988, prominent NASA scientist James Hansen testified before the Senate Energy and Natural Resources Committee and said he was 99 percent certain that an observed climatic warming trend was caused not by natural variation but by human-induced emissions of greenhouse gases (Shabecoff 1988). Media coverage of the exceptionally hot, smoggy summer of 1988, and the Exxon Valdez oil spill in March 1989 (shortly after Bush became President), added to growing public concern over human impacts on the environment (Dunlap 1991; Dunlap 1993; Kraft and Vig 2003). Growing public sentiment in favor of environmental regulation appeared to portend an end to the gridlock that had stalled Congressional action on air pollution for over a decade (Bailey 1998, 227).

In June, 1989, President Bush announced his administration's proposal to address "acid deposition, toxic air pollution, and urban air quality" (EPA 1990). Urban smog was to be tackled using tighter exhaust emission controls, alternative fuels, and low-emission vehicles. President Bush signaled to Congress that he wanted new clean air legislation as the cornerstone of his environmental presidency, but regulating air quality and pollution from motor vehicles presented difficult tradeoffs for lawmakers. Industry groups including automakers and petroleum companies, as well as environmental conservation groups, sought to have their voices heard at the discussion. The Sierra Club, Natural Resources Defense Council, Environmental Defense Fund, and Union of Concerned Scientists, lobbied Congress to set stricter tailpipe emissions standards for automakers, as had been done in the past. Auto and oil industries expressed concern with the economic costs of tighter clean air regulations. The EPA knew that it had to weigh the regulations it was directed to enforce and the limits of what could reasonably be imposed on industries without excessively impacting costs and competitiveness (Bailey 1998).

5.3 Fuel Economy Standards and the Flex Fuel Loophole

The Alternative Motor Fuels Act of 1988 (P.L. 100-494) introduced new CAFE (corporate average fuel economy) requirements for automakers. CAFE regulations had been in place since 1975, but automakers knew that their profits were greatest from popular vehicles which had very low fuel efficiency. However, the federal government gave automakers credit toward their CAFE obligations for producing 'flexible fuel vehicles' (FFVs). FFVs contain modified engines and fuel lines that enable them to run on E85 or neat gasoline, or any blend in between.[14] The law allowed automakers to meet CAFE standards while avoiding more expensive fuel-efficiency modifications to their vehicles. In the period from 1992 to 2005, over five million FFVs were produced for the domestic market (EIA 2005). The Energy Policy Act of 1992 (P.L. 102-486) included a requirement that federal and state government agencies purchase a set proportion of alternative fuel vehicles for their fleets (Yacobucci 2005). E10 was not considered an 'alternative fuel' because it did little to reduce gasoline consumption, whereas E85 was eligible. The U.S. Postal Service became the nation's biggest buyer of FFVs, with over 30,000 flex-fuel trucks and minivans. Of these, few were consistently fueled with E85 because it was not widely available; over 92 percent of the fuel consumed by the Postal Service was standard gasoline (Kindy and Keating 2008). The new vehicles had larger engines and poorer fuel economy than the vehicles they replaced, and were estimated to have consumed an *additional* 1.5 million gallons of gasoline (Kindy and Keating 2008).

[14]The term E85 is misleading since it never contains 85 percent ethanol. The highest legal blend is 83 percent ethanol, two percent denaturant, and 15 percent gasoline. In cold weather, the blend of gasoline is increased to as much as 49 percent. Most commonly, E85 contains 30 percent gasoline, two percent denaturant, and 68 percent ethanol (DOE 2013).

A serious deficiency of these policies was that there was no guarantee that drivers would fuel their FFVs with E85. In making their calculations on how to credit automakers toward CAFE standards, the EPA assumed that FFVs would be filled with E85 half the time. A full-sized SUV, such as a Chevrolet Tahoe, with a fuel economy of just 16 miles per gallon on gasoline, would be credited with achieving 27 miles per gallon because it could be fueled on E85 (*Consumer Reports* 2011). However, automakers at the time had no incentive to advertise FFV's advantages. Even if drivers were aware that they could use E85, access to E85 fueling stations was limited. Less than one percent of the nation's fueling stations sold E85, and most were located in the Midwest. The consequence was that while automakers embraced FFVs because they could claim that they were meeting CAFE standards and avoid more expensive fuel efficiency modifications, only about one percent of FFV fuel consumption was E85 (MacKenzie et al. 2005). Ironically, since many FFV models were gas-guzzling large SUVs and pickups, their use actually *increased* oil consumption by an estimated 80,000 barrels per day in 2005 (MacKenzie et al. 2005).

5.4 Oil Companies Experiment with Reformulated Gasoline

With the removal of lead from gasoline, oil companies began experimenting with ways of retaining vehicle performance while reducing harmful emissions. There were many ways of reformulating gasoline, depending on how it was refined and what, if any, additives were added to enhance gasoline's properties. A feature of such experimentation was that no fuel was perfectly clean; all fuels required tradeoffs between different types of pollution – such as reducing CO emissions without increasing VOC emissions. Certain VOCs found in reformulated gasoline are known toxins, including benzene, toluene, and xylene.

Responding to political pressure on the oil industry to come up with cleaner fuels, Atlantic Richfield Oil Company (ARCO) announced in 1989 that it had developed a reformulated gasoline, which it called EC-1 (EC stood for emissions control), that reduced emissions and could be used in older vehicles that were not equipped with catalytic converters (pre-1975 cars and pre-1980 trucks) (Bryner 1993, 134). ARCO had blended gasoline with small quantities of methyl tertiary-butyl ether (MTBE), an oxygenate derived from methanol that assisted combustion. Oxygenates were added to gasoline to raise the oxygen content and promote more efficient fuel combustion (thus reducing CO pollution), particularly under adverse conditions such as in cold weather when fuel was prone to escape from the engine unburned and cause pollution. ARCO had been producing MTBE since 1979, once it had received approval from the EPA to use MTBE in small quantities as a gasoline additive (McGarity 2004), and had grown to become the world's largest producer of MTBE. ARCO clearly had a vested interest in promoting its reformulated, MTBE-blended gasoline (Franklin et al. 2000), and advertised it as a cleaner form of gasoline. Within months, competitors including Conoco, Marathon, Phillips, Shell, Exxon, Diamond Shamrock, and Chevron likewise began producing 'cleaner burning', 'environmentally friendly' reformulated gasoline products, almost all of which contained MTBE (McGarity 2004). Refiners began mixing MTBE with gasoline in areas that did not meet NAAQS. In 1988 Denver required use of an oxygenate blend during the winter months to control carbon monoxide emissions. Other regions soon followed suit.

5.5 Congress Legislates Reformulated Gasoline Requirements

The developments in reformulated gasoline had an important influence on Congressional debate over ambient urban air quality (Stikkers 2001). Whereas previous regulations aimed at

reducing emissions from mobile sources had focused on imposing fuel efficiency standards on automakers, in 1990 the debate turned to the formulation of the fuel itself (Adler 1992). The Bush Administration and EPA administrators wanted to see a reformulated gasoline (blended to burn more cleanly than conventional gasoline) program put into effect (Adler 1992). The Bush Administration favored the expansion of pure methanol (M100). While this drew support from methanol producers, environmentalists, the EPA, and Congressional leaders from areas with severe air pollution, automakers complained about the cost of vehicle modifications, and proponents of other oxygenates argued that the legislation should not prescribe one oxygenate over another (Weber 1998, 121). Legislators with interests in corn ethanol were among those opposed to methanol. They saw reformulated gasoline policy as a lucrative opportunity to expand ethanol production in the multi-billion dollar oxygenates market. Pro-ethanol legislators were supported by ethanol lobby groups, including Archer Daniels Midland, the Renewable Fuels Association, the Clean Fuels Development Coalition, and the National Corn Growers Association (NCGA) (Adler 1992). Based primarily on cost, the leading oxygenates were MTBE and ethanol. Legislative support for each of these alcohols reflected their disparate geography of production: virtually all ethanol was produced in the Midwest, whereas most MTBE production was in the Gulf Coast.

Ethanol-blended gasoline had several disadvantages compared to other oxygenated gasoline blends, and to neat gasoline. It had a higher volatility than MTBE. Volatility – a fuel's propensity to evaporate – is a key environmental indicator because evaporation releases toxic ozone precursors into the atmosphere. MTBE has a higher energy content (93,500 British thermal units (BTU) per gallon) than pure ethanol (76,100 BTU per gallon), though neither are as energy dense as gasoline (114,000 BTU per gallon). MTBE was cheaper than ethanol, and

unlike ethanol, MTBE could be transported conveniently using existing pipelines. Ethanol's ability to absorb water and corrode pipes meant that it had to be stored and transported separately by truck, rail, or barge, adding significantly to its cost. Pro-ethanol legislators had much to gain in finding ways to distinguish ethanol favorably from other oxygenates based on *fuel composition* rather than on environmental performance (Adler 1992). One key difference was oxygen content. A ten percent blend of ethanol was known to have an oxygen content of about 3.5 percent by weight, higher than any other ten percent-blended oxygenated gasoline (Adler 1992). At the same blend proportion, MTBE's maximum oxygen content was 2.7 percent (Adler 1992). In January 1990 pro-ethanol Senators added a measure to the bill (S. 1630) that would mandate that gasoline sold in CO nonattainment areas contain 3.1 percent oxygen. This was a level that would clearly give ethanol a monopoly. Moreover, higher oxygen content did not linearly correlate to lower harmful emissions: oxygenation above approximately two percent was found to increase emissions of ozone precursors (Greve and Smith 1992, 35). In fact, this was why the California Air Resources Board (CARB) later imposed their own limit on oxygen content of 2.2 percent (CARB 1998). Thus, while oxygen content was the key feature used by pro-ethanol legislators as a means of promoting ethanol, its use above approximately two percent oxygen content was *detrimental*, rather than beneficial, to ozone levels.[15] To compensate for the negative effects of higher oxygen content, a provision added that oxygenation must not produce a net increase in NOx emissions and achieve a 15 percent reduction in VOC emissions compared to 1990 levels. It must also reduce toxins (VOCs, including benzene, butadiene, formaldehyde, and acetaldehyde) by 15 percent by 1995 and 25 percent by 2000. The EPA requested that the clean air amendments focus initially on the nine smoggiest urban areas in the country – Chicago,

[15]The relationship between fuel oxygen content and ozone production is nonlinear, and depends on such factors as the ratio of NOx to VOC. Thus a higher oxygen content does not necessarily produce less ozone.

Los Angeles, New York City, Houston, Baltimore, Milwaukee, Philadelphia, San Diego and Hartford.[16]

Oil industry representatives and methanol supporters immediately denounced the 3.1 percent proposal as a giveaway to the ethanol industry (Adler 1992), and asserted that Congress was too prescriptive in specifying the content of a fuel instead of delegating those details to the relevant specialists in the EPA and DOE. The Senate Committee on Environment and Public Works all but admitted that the 3.1 percent level was essentially designed to benefit the ethanol industry (Adler 1992). Idaho Republican Senator Steve Symms noted in the Senate Report of the Committee on Environment and Public Works that "in the absence of other avenues through which to encourage domestically produced ethanol to enter the fuel stream, this [requirement] is necessary" (Adler 1992, 10).

5.6 The Daschle Amendment

In the course of the debate, environmental organizations came to have a significant influence on reformulated gasoline requirements. They supported reformulated gasoline as a practical and expedient means of achieving clean air. On 29 March 1990, South Dakota Democratic Senator Tom Daschle proposed an amendment (amendment 1423 to amendment 1293) in the Senate. He thanked his colleagues – Kansas Republican Senator Bob Dole and Iowa Democratic Senator Tom Harkin – for their help with the amendment and praised their leadership in efforts "to stimulate national demand for agriculturally derived fuels" (Congressional Record 1990). The 'Daschle Amendment', as it became known, would mandate a year-round oxygen content of 2.7 percent in the same nine smoggiest cities, beginning in 1994

[16]Sacramento's start date was June 1, 1996.

(Greve and Smith 1992, 34). As in the earlier bill (S. 1630), the Daschle Amendment set specific oxygenate parameters – no greater than 25 percent aromatic hydrocarbons, no more than 1 percent benzene, and a 15 percent reduction in VOC emissions compared to emissions from conventional gasoline. As expected, Senator Daschle's bill drew support from Midwestern senators and agricultural groups.[17] The senator openly acknowledged that the amendment was expected to more than double demand for ethanol (Congressional Record 1990). Notably, however, it also won support from environmental conservation groups, including the Sierra Club, the Natural Resources Defense Council, the Environmental Defense Fund, the National Wildlife Federation, and the National Audubon Society.[18] The Daschle Amendment was opposed by the White House, as well as by the petroleum industry, and some senators assumed that this would cause the bill to be vetoed (Greve and Smith 1992, 34). The figure of 2.7 percent was significant for the same reason mentioned earlier: since it would be difficult for any other oxygenate to achieve that oxygen content, the proposal would virtually guarantee ethanol's dominance of the market. Senator Daschle's highly prescriptive requirements for reformulated gasoline raised suspicions that this was a ploy to serve the narrow economic interests of the corn ethanol industry and had little to do with clean air. Louisiana Democratic Senator John Bennett Johnston argued that once emissions standards were set, scientists and engineers should be allowed to develop the most cost-effective means of achieving them, under the guidance of the EPA and DOE (Neff 2005). Daschle argued that the prescriptive requirement was necessary because the

[17]Cosigners of amendment 1423 included Senators Dole (R-Kansas), Harkin (D-Iowa), McClure (R-Idaho), Dixon (D-Illinois), Durenberger (R-Minnesota), Grassley (R-Iowa), Simon (D-Illinois), Exon (D-Nebraska), Kerrey (D-Nebraska), Burns (R-Montana), Conrad (D-North Dakota), Wirth (D-Colorado), Leahy (D-Vermont), and Pressler (R-South Dakota).

[18]Senator Daschle also acknowledged the support of the National Governors Association, National Clean Air Coalition, Sierra Club, Citizen Action, Renewable Fuels Association, National Corn Growers Association, Renew America, Farm Bureau Federal, American Agriculture Movement, SAFER (Safer Air through Fuel Enhancement, Reformulation and Reforestation), National Farmers Union, National Farmers Organization, Arizonans for Clean Air Now, Idaho Ethanol Fuel Association, and Clean Fuels Development Coalition (Congressional Record 1990).

EPA had failed to adequately regulate the process by which oil companies were experimenting with fuel oxygenates, and pointed out that there were several EPA-approved oxygenates which oil refiners could choose from (Congressional Record 1990). Theoretically, refiners could choose from numerous ethers or alcohols, including ethyl tertiary-butyl ether (ETBE), tertiary-butyl alcohol (TBA), tertiary-amyl methyl ether (TAME), diisopropyl ether (DIPE), and methanol. But based largely on cost, the two main oxygenates were MTBE and ethanol, and the 2.7 percent oxygen content gave ethanol a strong advantage. In a press release in Kansas, Senator Dole – a cosponsor of the Daschle Amendment – noted that "the amendment will help both methanol and clean-burning, domestically produced ethanol and is strongly supported by the national corn growers and renewable fuels association" (Dole 1990). He noted that "if the proposal becomes law, Kansas ethanol producers and the farmers that supply their feedstock will see a significant growth in this industry" (Dole 1990).

The petroleum industry, led by the American Petroleum Institute (API), and the Bush Administration opposed Daschle's measure, claiming that the amendment would drive up fuel costs. The petroleum and auto industries funded a million-dollar campaign with ads in major newspapers to discredit the bill as a giveaway to the ethanol industry (Wald 1990). They urged Congress not to specify which type of fuel blend to use (which they derided as "government gas") and to allow markets to decide how to meet the clean air standards. Yet environmental groups knew from experience that if the bill was too vaguely written the EPA would not have sufficient legal authority to enforce it. Environmental and ethanol goals were wedded in support of the Daschle amendment (Greve and Smith 1992, 36), which passed easily in the Senate, by 69 votes to 30, and the House counterpart passed by voice vote. However, White House officials expressed their opposition to a bill they said could drive up the cost of gasoline and was overly

inflexible to the auto and oil industries. Debate continued all summer, then on September 29 the White House wrote to the House-Senate conference committee suggesting a compromise solution including "(1) a 15 percent reduction in VOC and toxic emissions, as defined in the Senate bill; (2) a minimum 2 percent oxygenate requirement; and (3) a general equivalency program starting in 1993, with full phase-in by 1995" (Neff 2005). The final bill had strong bipartisan support in both the Senate (89 votes to 10) and the House (401 votes to 25).

The result was that two gasoline reformulation programs emerged. A Reformulated Gasoline (RFG) Program set a year-round 2.0 (down from 3.1 percent) percent minimum oxygen content in areas with the nine worst ozone nonattainment areas, beginning in 1995, and extending to other 'opt-in' areas. The second was the Daschle Amendment, renamed the Oxygenated Fuel Program, which initially mandated a minimum 2.7 percent oxygen content in 39 CO nonattainment areas (mostly in industrial northern cities) in the colder months, beginning in 1992. That amount of oxygen content was supplied by adding approximately 15 percent MTBE by weight, or 7.5 percent ethanol by weight. A prominent environmental lawyer for the Sierra Club, A. Blakeman Early[19], tried to explain how it was that his and other environmental groups had backed a proposal that seemed dubious in terms of ozone reduction:

> We had the opportunity, by putting the oxygenate requirement in the [RFG section], to get the support of those members [of Congress] who were responsive to the corn and ethanol industry, as well as those who might be influenced by the MTBE manufacturers (Reichhardt 1995).

The Sierra Club thus understood that its environmental goals were divided between ethanol and MTBE interests. By favoring a 'fuel neutral' reformulated gasoline policy, the

[19]E. Blakeman Early coauthored Sierra Club reports critical of President G. W. Bush's record on the environment, including Bush and the Environment, the Straight Story: Ticking Toxic Time Bombs (1988) and Holding Our Breath: The President's 3-Year Campaign Against Clean Air (1992).

Sierra Club had tried not to disaffect either of the two main oxygenate makers. Ethanol was renewable but had air pollution disadvantages; MTBE was non-renewable but had air pollution advantages.

President Bush signed the Clean Air Act Amendments of 1990 (CAAA, P.L. 101-549) on November 15. The CAAA classified areas of the country according to attainment or nonattainment of national ambient air quality standards, imposed stricter standards on vehicle emissions, enforced the use of reformulated gasoline according to the RFG and Oxygenated Fuel programs, imposed new measures to control acid rain, and established several programs to protect the public from health risks from exposure to a list of 188 recognized toxic air pollutants (McCarthy 2005). EPA Administrator William K. Reilly announced that:

> During his 1988 campaign, the President vowed to amend the Nation's clean air laws, saying that "every American expects and deserves to breathe clean air." The Clean Air Act Amendments of 1990, signed into law today, triumphantly fulfill that pledge. Through his leadership, the President broke the 13-year clean air stalemate by submitting an innovative, market-based bill which will achieve the nation's environmental goals in the most effective manner (EPA 1990).

The Sierra Club's Daniel Weiss expressed praise for the bill: "The breathers' lobby finally triumphed over the polluters' lobby" (Atlas 1990). Representative Bill Richardson (D-New Mexico), who cosponsored the House version of the clean fuels amendment, victoriously declared that "Despite Big Oil's opposition, we reached agreement on a major environmental initiative that will not only clean up the nation's air, but give credibility to the growing ethanol industry" (Atlas 1990). This infusion of "credibility" for ethanol on environmental grounds would benefit the corn ethanol industry for more than a decade.

5.7 Science vs Reformulated Gasoline

The adoption of reformulated and oxygenated fuels legislation was not well supported by scientific findings. Using oxygenates to control winter CO pollution had already begun before the clean air act was amended. However, using oxygenates as part of the larger year-round Reformulated Gasoline Program to tackle ozone pollution was problematic. In an article in *Science*, Calvert et al. (1993) questioned the value of the entire program. They asserted that oxygenates "offer negligible benefits in terms of decreasing atmospheric ozone formation. No convincing argument based on combustion or atmospheric chemistry can be made for the addition of ethanol to gasoline."

The EPA received advice from scientific research organizations concerning the benefits and costs of oxygenated and reformulated gasoline. They asked the National Science and Technology Council (NSTC) to conduct a comprehensive interagency assessment of the effects of the oxygenated fuels program. NSTC's assessment did not provide an encouraging endorsement of the oxygenated fuels program. It concluded that the EPA had overestimated the benefits of the oxygenated fuels program in reducing CO concentrations, which the NSTC estimated was a reduction of only about ten percent; that fuel oxygenates decreased emissions of benzene and 1,3-butadiene but increased emissions of aldehydes (acetaldehyde from ethanol and ETBE and formaldehyde from MTBE); that older vehicles benefited more from oxygenates than newer vehicles; and that some studies showed that NO_x emissions increased above about two percent oxygen content (NSTC 1997).

In 1995 Senator Richard Lugar (R-Indiana) asked the EPA to examine not only the *mass* of reformulated gasoline pollutants, but also the *reactivity* (i.e., ozone-forming potential) of those chemicals. The suggestion behind the study was that although ethanol oxygenate generated

greater VOC emissions due to its higher volatility, the reactivity of those emissions may be lower than the emissions from other oxygenates. The EPA arranged the study with the National Research Council, a branch of the National Academies of Science. The NRC (1999) report concluded that the contribution of the reformulated gasoline program to the historic downward trend in ozone levels was probably less than 10 percent. It also found that the "use of commonly available oxygenates in RFG has little impact on improving ozone air quality and has some disadvantages" (NRC 1999). The report explained that while oxygenates may succeed in reducing CO and VOC exhaust emissions, these benefits were offset by higher emissions of NO_x and aldehydes (formaldehyde in the case of MTBE; acetaldehyde in the case of ethanol). A key factor affecting vehicle performance and emissions was gasoline volatility, measured in units of Reid Vapor Pressure (RVP). Ethanol raised the volatility of gasoline, making it more prone to evaporative emissions. Since ethanol-oxygenate had a higher volatility than MTBE-oxygenate, "a net increase in the overall reactivity of motor-vehicle emissions (exhaust plus evaporative) would result from the use of ethanol-blended RFG (with an elevated RVP) instead of MTBE-blended RFG" (NRC 1999, 8). Thus, the study concluded, "it appears likely that the use of an ethanol-containing RFG with an RVP that is 1 psi higher than other RFG blends would be detrimental to air quality in terms of ozone" (NRC 1999, 9).

In 1997, Texas Congressman Bill Archer, Chair of the House Committee on Ways and Means, asked the General Accounting Office (GAO) to conduct a study of the effects of tax incentives for alcohol fuels such as ethanol. The GAO report concluded that MTBE dominated the oxygenate market because it was cheaper and easier to transport than ethanol, and because it had the advantage of lower volatility in warm weather. The GAO report concluded that if tax incentives were removed, ethanol would likely become uneconomical and be eliminated from

most of the market. Yet in terms of environmental effects, a return to neat gasoline instead of ethanol blends would "result in little reduction in overall air quality" (GAO 1997). The likely effect would be a slight increase in CO emissions and a slight decrease in ozone precursors (GAO 1997).

Niven (2005, 540) conducted a meta-analysis of scientific studies on ethanol-blended gasoline. The evidence he compiled found that:

> E10 produces lower total hydrocarbon, CO, benzene and particulate tailpipe emissions than E0 [gasoline], and possibly lower 1,3-butadiene emissions, but at the expense of substantially higher acetaldehyde and ethanol emissions, and higher NOx, methanol and ethylene emissions. There is mixed evidence regarding formaldehyde emissions.
>
> However, evaporative losses from E10 are substantially higher than E0 above about 16 C [60.8 F]. Unless special measures are taken to reduce the volatility of E10, many of its emission benefits (total hydrocarbons and air toxics) are reversed, and its ozone forming potential is significantly enhanced.

He concluded that E10 had "debatable air pollution merit," and "may in fact increase the production of photochemical smog" (Niven 2005). The EPA admitted in its fact sheet on the final RFS regulations that ethanol caused higher emissions of nitrogen oxides and volatile organic compounds, by as much as 5 percent for NO_x and 7 percent for VOCs (EPA 2007), yet it did not feel compelled to explain the contradiction between its stated aim of reducing ozone precursors including VOC and NO_x, and its support for ethanol as an oxygenate in the nation's fuel.

5.8 Regulatory Negotiations and the "One Pound Waiver"

Demand for MTBE had been rising since ARCO's reformulated gasoline was released in 1989, and with the passage of the CAAA, demand for both MTBE and ethanol increased

dramatically. Due to its higher transport and storage costs, ethanol was generally restricted to Midwestern cities including Chicago and Milwaukee. While the bill specifically defined the composition of reformulated gasoline, it was left to the EPA to design a practical and cost-effective set of regulations for the industries involved with reformulated gasoline. Rather than publish a notice of proposed rulemaking and await responses, the EPA took an opportunity to write regulations in a consultative process involving the key stakeholders. The requirements set by Congress needed to be managed by industries and regulated by the EPA in a cost-effective manner.

The EPA invited participants from seven interest categories – the oil industry, the auto industry, the ethanol industry, the MTBE industry, environmental and public interest groups, and government regulators at the local, state, and federal levels (Federal Register 1991). The regulatory negotiations they undertook became known as the 'reg neg' process, and hinged in large part on reaching agreement on the amounts and characteristics of oxygenate additives, and on how to ensure that oxygenate blends met or exceeded the clean air requirements under various seasonal conditions. For the ethanol lobby, a key imperative was to ensure that regulations did not restrict the amount of ethanol in the market. For example, ethanol interests sought to maintain their advantage by setting the highest possible oxygen content (Adler 1992). In terms of regulating each of the major pollutants, the ethanol lobby favored a 'credit' system in which reductions in one pollutant, such as CO, could offset increased levels of VOC and NOx emissions, but this approach was rejected by the other reg neg members (Weber 1998, 134). One detail that threatened ethanol's market share concerned volatility. Various states had set their own fuel volatility regulations, and in 1990, the EPA finalized a summertime standard for the 48 contiguous states. Evaporative emissions of ozone-forming chemicals were most acute in

summer, when temperatures were high. From May to September, the volatility of gasoline blends sold in the northern states was capped at an RVP of 9.0 pounds per square inch (psi), and for southern states, the cap was set at 7.8 psi. The ethanol lobby recognized that ethanol-oxygenated gasoline would not meet this requirement, and applied for a "one pound waiver" – to 10 psi – in order for ethanol to gain access to the market. An RVP of 10 psi meant that the fuel had a greater propensity to evaporate ozone-forming compounds. The ostensible clean air imperatives of the act seemed to have been overrun by narrow economic interests. Despite ethanol lobbyists' claims concerning the environmental benefits of ethanol, the standard which had been set by the EPA would have to be *relaxed* in order to allow ethanol access to the oxygenate market.

The EPA regulatory negotiations concluded with an 'agreement in principle' consisting of a concise (eleven page) list of guiding principles to be used in promulgating the final rules on RFG, which was signed by all parties in August 1991. The timely completion of this collaborative effort was no small achievement, given the legal disputes common to major EPA regulations (Weber and Khademian 1997). The EPA explained in their report that they had no choice but to deny the 'one pound waiver' for ethanol, noting that doing so would have "significant adverse environmental impacts" in the form of approximately 20 percent higher VOC emissions (Anderson and Rykowski 1995). The ethanol lobby responded by pulling out of the agreement and lobbying the White House and the EPA to waive the RVP requirement for ethanol (Anderson and Rykowski 1995). RFA president Eric Vaughn told reporters that the ethanol industry had thought that the regulations contained an exemption for ethanol, but when they discovered that this was not the case, they lobbied for an exemption (Swanson and Gunset 1992). The ethanol lobby argued that without the waiver, the ethanol industry would be

excluded from the oxygenate market, which contradicted what Congress had intended when the clean air legislation was written (Segal 1993). While conservation groups had been supportive of the Daschle amendment earlier, in this case the Natural Resources Defense Council and the Sierra Club were aligned with the EPA, the American Petroleum Institute, and the American Methanol Institute in criticizing the ethanol lobby for turning their back on the 'reg neg' process and for pressuring the Bush Administration to grant them a waiver that would cause damage to the environment (Segal 1993; Stikkers 2001).

At this time President Bush faced uncertain re-election prospects in key Midwestern states. He calculated that a waiver on ethanol would shore up votes without unduly alienating environmentalists and the oil industry. He ordered his staff to devise a plan to overturn the regulations that constrained oxygenate ethanol use. The matter came to a head when President Bush attended the Illinois State Fair in Springfield in August 1992. His advisors had privately formulated a compromise that would offer 100 million dollars per year in additional tax breaks to ethanol while maintaining the RVP requirements. Just hours before he was to speak at the fair, Illinois Governor Jim Edgar – a powerful ethanol proponent and vice chairman of the Governors' Ethanol Coalition – and farm groups informed the President that they were not satisfied with the concessions being offered. President Bush was said to have ripped pages from his notes and spoke only in general placatory terms about supporting ethanol (Arndt 1992).

Corn ethanol supporters had lobbied Congress and the White House for months to ensure that the EPA regulatory negotiations were favorable to ethanol, and Midwestern farmers were "incensed" at the President's apparently lackluster support for ethanol at the Illinois State Fair (Orr 1992). Governor Edgar voiced concern that if ethanol was not supported in the regulations thousands of jobs in his state would be jeopardized (Swanson and Gunset 1992). Presidents of

twelve Midwestern state Farm Bureaus pressed President Bush and EPA Administrator William Reilly to publicly declare their support for ethanol (Orr 1992). The Illinois Corn Growers Association raised their concern that "the intent of Congress, which was to make ethanol a key player in the nation's clean air strategy, is being distorted during the ongoing regulatory process. The nation and Illinois' economy in particular have too much at stake to not insure that ethanol retains its prominent role in the Clean Air Act" (Orr 1992). The National Corn Growers Association and the RFA were also active in lobbying the White House to grant an exception to ethanol (Gushee 1996).

The political pressure proved effective. Despite objections from the other 'reg neg' participants, President Bush signed an ethanol waiver at a Rose Garden ceremony on October 1, 1992, accompanied by Illinois Governor Edgar, Kansas Republican Senator Dole, Illinois Republican Congressman Michel, Tim Trotter from the National Corn Growers Association, Secretary of Agriculture Ann Veneman, and EPA Administrator William Reilly, among others. The order specified that up to 30 percent of the RFG sold would be given a 'one pound waiver' to use ethanol. The figure of 30 percent had no apparent scientific basis, though it did approximate the proportion of national gasoline consumption that would be subject to the Oxygenated Fuel Program. The effect of the waiver was estimated to double the market for ethanol (Chicago Tribune 1992; Gushee 1996). The President announced that there would be no adverse impact on the environment, but that was only because under the new regulation refineries had to produce a less volatile grade of gasoline to compensate for the higher volatility of ethanol, the higher cost of which would be passed on to consumers. The Clinton campaign denounced the move as an underhanded attempt to win farm votes. The President was lauded by ethanol advocates and accused by critics of pandering to special interests and of undermining the

clean air legislation. The scientific evidence on oxygen content and emissions that formed the basis of the EPA's regulatory negotiation process was no match for the corn ethanol industry's prerogative to gain access to the oxygenate market. In the end, the nation's pervasive urban air pollution was used as a smoke screen for a struggle between MTBE and ethanol supporters over market share for oxygenates, neither of which offered clear environmental benefits. The waiver was offered late in President Bush's term in office, but regulations governing ethanol production would change again following the election.

5.9 EPA Dissimulation

EPA representatives opposed the ethanol lobby's denunciation of the regulatory negotiations, and objected to President Bush's use of a "magic wand" (as one EPA official put it) to grant ethanol exceptional status among oxygenates (Weber 1998, 136). Since the agency had well established procedures for making changes to existing regulations, which had been usurped by the presidential waiver, it was unclear whether any part of the original 'reg neg' agreement was still valid. The EPA's reluctance to move forward with regulations containing the one pound waiver forced the dispute to continue into the next presidency and a new EPA administrator (Weber 1998). Environmental groups, the oil industry, and the methanol industry opposed the waiver. In April 1993, these groups wrote to the EPA, asking the agency to uphold the credibility of the reformulated gasoline program and the 'reg neg' agreement by "rejecting the special preferences for ethanol" (Bloomberg Business News 1993). The ethanol lobby, in the meantime, sought to turn public opinion against their chief rival by placing ads in national newspapers, including *The New York Times, The Washington Post*, and *The Wall Street Journal,* claiming that MTBE posed an environmental hazard (Bryner 1995, in Stikkers 2001). Perhaps

not surprisingly, some of the most ardent pro-ethanol legislators in Congress were also the most vocal MTBE alarmists, but some of the warnings turned out to be prophetic (Stikkers 2001). For example, Senator Grassley (R-Indiana) pointed out that MTBE posed risks to groundwater (Stikkers 2001).

The EPA was running behind schedule and under pressure from Congress to finalize the regulations on reformulated gasoline. Finally, in October 15, 1993, the president's waiver was withdrawn, and on December 15, 1993, the EPA Administrator signed the oxygenate regulations based on the original 'reg neg' agreement – that is, they did not include an ethanol waiver. The EPA's final rule, published in February 1994, justified the absence of the waiver by referring to a DOE study which found that ethanol-blended gasoline increased emissions of VOCs. Since this disadvantage could not be outweighed by other benefits (ethanol cost more and had a lower energy content than MTBE), the EPA had rejected the 30 percent waiver.

The Clinton Administration, however, would soon prove to have an even greater affinity for ethanol promotion than the previous administration. While Clinton had decried the Bush waiver as a cynical attempt to secure "farm votes," the Clinton administration initially did not seem to have any definitive or ideological antipathy to corn ethanol (Segal 1993). To the contrary, during his presidential campaign Clinton reassured Midwestern voters that he would promote corn ethanol (Stikkers 2001). While Clinton's environmental record as governor of Arkansas was poor (Ifill 1992), past Senator and new Vice President Al Gore was recognized as one of the most active environmental policy advocates in Congress. The administration sought to show that both the environment and the economy could prosper.

With reformulated gasoline the new administration had inherited one of the most controversial pieces of environmental policy. The administration worked with the EPA to

propose new rules for oxygenates that were more friendly to ethanol. The ethanol lobby had suggested that the EPA create a mandate that 30 percent of oxygenates must be renewable (i.e., ethanol from biological sources), which they called the Renewable Oxygenate Requirement (ROR). Accordingly, on December 27, 1993, the EPA announced a notice of proposed rulemaking entitled *Regulation of Fuels and Fuel Additives: Renewable Oxygenate Requirement for Reformulated Gasoline*. The new rule would require refiners to obtain 30 percent of oxygenates from renewable sources, all year round (not just in summer). Since ethanol was renewable and MTBE was not, the rule was de facto an ethanol mandate, just as ethanol supporters had wanted. In the proposed rule the agency argued that:

> Expanding the use of renewable fuels, such as ethanol, from resources such as corn, grain, wood, organic waste products, and even garbage can help clean up our air, cut dependence on foreign oil, create investment and jobs in America, reduce primary energy use by 20% or more as compared to nonrenewable oxygenates, and lower emissions of harmful greenhouse gases (EPA 1993, 3).

Evidently the EPA had replaced its raison d'être, of protecting the American public from environmental harm, with a far more complex set of economic and geopolitical objectives. Moreover, the agency's rationale for supporting ethanol had begun to resemble those that might appear on an ethanol lobby group's website or brochure. Just as they had opposed the ethanol lobby's rejection of the 'reg neg' process, oil industry, methanol industry, and environmental groups objected to the Renewable Oxygenate Requirement.

5.10 The Clinton-Gore Administration

With ethanol oxygenate recognized as a key issue, various studies were conducted to assess the impact of ethanol production on air quality and oil imports. A detailed study by

researchers at the Argonne National Research Laboratory conducted for the DOE flatly refuted the EPA's claims regarding energy independence and ethanol performance compared to other oxygenates. They found that:

> RFG requires more energy but less crude oil for its production than does conventional gasoline. The least energy-intensive of the RFG options is RFG with MTBE only. …RFG with ethanol requires nearly 6% more total energy.… Production of RFG with ethanol alone increases crude oil use by more than 9%.
>
> The specific impetus for this report was an EPA proposal that would allow RFG blended with ethanol to meet a lesser VOCs reduction standard than RFGs with other oxygenates. If implemented, the proposal would cause increased energy use of 1.8 to 2.0%, depending on the oxygen level (2.1% or 2.7%) achieved with the ethanol portion of the mixed RFG pool. Crude oil use would increase by 2.1 to 2.5% (Singh and McNutt 1993, 25).

Thus, even if ethanol production was viable without government support, blending it with gasoline for sale as RFG was uneconomical, since it required more energy and oil to produce than conventional gasoline, undermining the notion of ethanol as a means of achieving energy security or independence. The report for the DOE was published in May, and on June 20, 1994, the DOE informed Congress of its understanding of the likely impact of the mandate:

> Our initial analysis indicates that under the most likely scenario, U.S. oil use and VOC emissions are likely to increase as a result of the proposed mandate. …If ethanol production does significantly increase, ADM would still benefit, but greater gains would go to other food processors (e.g., Cargill) and corn farmers (DOE 1994).

Even the EPA admitted in Congressional hearings that there was no environmental reason for mandating ethanol over MTBE (Reichhardt 1995). It claimed that it was acting in accordance with Congress' long-standing policy of supporting ethanol production and believed it had the statutory authority to prescribe one type of oxygenate, ethanol, over another, MTBE. A federal court would soon rule otherwise.

In Congress, meanwhile, pro-ethanol legislators found innovative ways to promote ethanol over other oxygenates. On May 27, 1994, Iowa Democratic Senator Tom Harkin stood on the Senate floor before a Committee on Agriculture, Nutrition, and Forestry hearing on the environmental effects of ethanol. He presented two glasses, one containing 190-proof *Ever Clear* alcohol (chemically almost identical to ethanol, since ethanol is pure alcohol), and the other methanol, a poison. Methanol was a constituent of MTBE, and was also being tested in California as an alternative fuel. Senator Harkin challenged the other Senators, particularly methanol supporters, to step up and drink from their glass of choice. Nobody accepted his dare. Senator Harkin then sipped from the glass of ethanol (Congressional Records 1994). His eyes watered and he immediately drank several glasses of water, while jokes were bandied around. Harkin's "chemistry experiment" was a publicity stunt intended to convey the more serious notion that ethanol had superior properties to methanol. Of course, Senator Harkin would have been unlikely to drink E10, the most common ethanol fuel blend.

Against the DOE's advice, President Clinton announced on June 30, 1994, just days after receiving a donation for 100,000 dollars from ADM CEO Dwayne Andreas (Carney 1995), that a 30 percent ethanol mandate would go into effect, claiming that the measure would "create thousands of new jobs for the future" and protect "our environment, our public health, and our farmers" (Moore and Stansel 1996). Major newspapers immediately attacked Clinton's announcement. *The New York Times* reported that "What the EPA's rule will do is take money from consumers and taxpayers and hand it over to Archer Daniels Midland" (Bovard 1995). *The Washington Post* described it as a "misuse of environmental laws" (Brown 1997). *USA Today* asserted that "Nothing is more likely to provoke a round of fat-cat-happiness than an open-ended

federal rule that forces manufacturers and consumers to buy federally subsidized ethanol" (Bovard 1995).

The Clinton Administration's ethanol requirement prompted a fresh round of Congressional hearings on ethanol. Senator Bennett Johnston, a Democrat from oil-rich Louisiana, proposed Amendment 2446 to strike down the Renewable Oxygenate Requirement. Midwestern senators, including Daschle (South Dakota), Kerrey (Nebraska), Harkin (Iowa), Lugar (Indiana), and Wellstone (Minnesota) endorsed the ROR (Johnson and Libecap 2000). Senate votes were divided mainly between farm states seeking to reject Johnston's bill and 'oil states' and non-farm states supporting it. A 50-50 deadlock ensued. The tie-breaking vote came from Vice President Al Gore, who voted against Johnston's amendment. Gore used his Senate vote to support a mandate that would substantially increase the use of ethanol oxygenate, which was known to increase vehicle emissions of climate-altering gases.

5.11 Federal Court Rejects the Renewable Oxygenate Requirement

On August 2, 1994, the EPA promulgated the final rule on the ROR, reversing their February ruling by making mandatory that 30 percent of oxygenate in the RFG program come from renewables. They were surprisingly candid about their reasons for overturning the previous decision:

> In order to ensure compliance with the minimum reductions in ozone forming volatile organic compounds (VOCs) required by Congress for the RFG program, [the 1991 reg neg agreement] did not extend the volatility waiver for ethanol-blended conventional gasoline to RFG. In response, members of the ethanol industry submitted comments to EPA which expressed their concern that the proposed reformulated gasoline rules would effectively exclude ethanol from the reformulated gasoline market.

> To address [this issue]…EPA…proposed…a year-round requirement that 30 percent of the mandatory oxygen content specification for reformulated gasoline be obtained from renewable oxygenates. To ensure that the ozone benefits from the reformulated gasoline program are not adversely affected by that requirement, EPA proposed that during the VOC control period (i.e., the summer months) only renewable oxygenates that do not exhibit volatility-related commingling effects when mixed with gasoline would receive renewable oxygenate credit.
>
> EPA received over 12,000 comments in response to the renewable oxygenate proposal. The vast majority of these comments were letters supporting the proposal written by farmers, ethanol producers, and their supporters (EPA 1994).

In other words, the EPA changed their ruling on renewable fuels because the ethanol industry (and ethanol interests, and the Administration) wanted the revision, despite the environmental drawbacks. Conservation groups, including the Sierra Club and the Environmental Defense Fund, were again aligned with the oil industry in criticizing the rule as environmentally harmful because of ethanol's high volatility. The Sierra Club's A. Blakeman Early, who had participated in the 'reg neg' process, denounced the policy as illegal, claiming that "It's not the role of the Clean Air Act to make mandatory markets for ethanol" (Adler 1996). Midwestern legislators, including Iowa Democratic Senator Tom Harkin and South Dakota Democratic Senator Tom Daschle, lauded the legislation as a boon to corn growers and ethanol producers (MacLean 1993). The expected impact on the corn and ethanol industries was substantial. Department of Agriculture Secretary Mike Espy proudly declared that the ROR would increase ethanol production by as much as 60 percent (Adler 1996).

Unsuccessful in overturning the ROR in Congress, the American Petroleum Institute (API), the National Petroleum Refiners Association, and the American Methanol Institute took the EPA to federal court. The court criticized the EPA for promulgating rules that not only failed

to improve air quality, but that may actually make it worse (because ethanol-blended gasoline emitted greater amounts of volatile organic compounds). The court ruled that:

> [t]he sole purpose of the RFG program is to reduce air pollution, which it does through specific performance standards for reducing VOCs and toxic emissions. EPA admits that the [ethanol rule] will not give additional reductions for VOCs or toxics…and has even conceded that the use of ethanol might possibly make air quality worse (U.S. Court of Appeals, 1995).

Judge Stephen Williams wryly summed up the EPA's non sequitur: "It seems to me EPA is in outer space" (quoted in Farrell 1998). The court ruled that the ROR would not be effective in reducing volatile organic compounds, and that the EPA had exceeded the authority given to it under the Clean Air Act. EPA Administrator Carol Browner said that the Clinton Administration would consider "its legal options and will continue to explore other ways to promote renewable fuels like ethanol" (Brown 1997). The EPA applied for a rehearing, which the court denied.

5.12 The MTBE Groundwater Contamination Fiasco

To the denunciation of the ethanol lobby, the ruling against the ROR was a boon to MTBE, touted as the chemical with the world's fastest growing production. The original oxygenated fuel program remained intact, and refiners were free to use ethanol if they wished. The Oxygenated Fuels Program began in the winter of 1992-1993. Within months, the EPA received a deluge of complaints of exposure-related health problems, which consumers blamed on reformulated gasoline (Mayer et al. 1995; Gushee et al. 1996). Symptoms included headaches, burning eyes, dizziness, nausea, and respiratory irritation (Mayer et al. 1995; McCarthy and Tieman 2006). The media publicized a study in Italy which had found that rats exposed to high levels of MTBE had increased incidences of cancer (Mayer et al. 1995). Still,

the EPA did not seem overly perturbed by the findings. After conducting an assessment of health risks associated with MTBE, the EPA concluded that:

> There is unlikely to be a substantial risk of acute health symptoms among healthy members of the public receiving "typical" environmental exposures under temperate conditions (i.e., not subarctic temperatures). This leaves the question open about more subtle health risks, especially among susceptible subpopulations. If acute symptoms are being caused by MTBE, they appear to be mild and transient (EPA 1993b, 45).

Legislators put bills before Congress to repeal the program or suspend it until the EPA completed a public health study to show that MTBE-blended fuel was safe, but these risks were not taken seriously. The House Commerce Committee's Oversight and Investigations Subcommittee held a hearing in June 1995, and concluded that since there was a lack of evidence against the reformulated gasoline program, they were "reluctant to impose any legislative restrictions on the use of RFG" (Mayer et al. 1995).

Production of both ethanol and MTBE continued to rise. Approximately 30 percent of the gasoline sold in the U.S. used oxygenates, and MTBE held about 87 percent of the oxygenate market (McCarthy and Tiemann 2006). MTBE production more than tripled from 1990 to 1997 (EIA 2000). The disastrous rise and fall of MTBE oxygenate must rank among the most extraordinary examples of environmental legislative incompetence (McGarity 2004). It is directly relevant to ethanol in that they were the two primary competitors in the oxygenate market; the ultimate fall of MTBE was a boon for ethanol. Despite considerable experience with MTBE, the EPA was slow to act upon widespread evidence that it posed a widespread health hazard. Congress, for its part, was slow to change course after the reformulated gasoline requirements had been put in place in the CAAA.

The EPA had first approved the use of MTBE as an alternative to lead in 1979, at seven percent by volume mixed with gasoline, and this was increased to 15 percent by in 1988. In 1986, MTBE was listed in the Toxic Substances Control Act (TSCA; P.L. 99-519) as a priority health hazard, and in 1988 it was added to the EPA's Drinking Water Priority List (until 1996 the EPA was required to publish this list of potential water contaminants for future regulation). Yet there were problems with the way MTBE was studied. The EPA's familiarity with MTBE in low concentrations may have contributed to a lack of alarm, and second, the EPA associated MTBE with air quality issues, not with drinking water issues (Franklin et al. 2000). The first public outcry concerning MTBE-contaminated drinking water occurred in the 1980s, and by the time of the clean air Congressional debates in 1990, MTBE had been listed on the EPA's list of hazardous air pollutants. It was established knowledge that MTBE posed health and environmental threats, but these were essentially ignored during the 1990 debates over oxygenates. Congress was also well aware that the country's approximately two million underground storage tanks were prone to leak hazardous substances into the surrounding soil and water, and in the 1980s had established programs and designated funds to address this issue. Soon after the reformulated gasoline requirements began, public complaints about contaminated water arose in thousands of sites across the U.S., and water authorities were suddenly faced with the cost of decontaminating MTBE-contaminated water. In 1993 a social movement called OxyBusters was formed to stop MTBE use, and the issue became a focus of national public debate.

The EPA continued to support MTBE oxygenate use despite mounting evidence of its adverse impacts on drinking water and human health. It wasn't until 1997 that the EPA issued an MTBE drinking water advisory, of 20-40 parts per billion, but this had no apparent effect on

MTBE use since there were no requirements to test drinking water supplies for MTBE (except in California beginning in 1997) and the advisory was not legally enforceable. A California study found that 10,000 drinking water sites had been contaminated with MTBE in that state (Happel et al. 1998). The University of California was asked to evaluate the risks of MTBE to Californian groundwater. Its report concluded that there were "significant risks and costs associated with water contamination due to the use of MTBE" (Keller et al. 1998). It also found that there was "no significant additional air quality benefit to the use of oxygenates such as MTBE in reformulated gasoline" (Keller et al. 1998). California Governor Gray Davis issued an executive order in 1999 to remove MTBE from gasoline entirely by the end of 2002 (later delayed until 2003). This order, however, sparked an international trade dispute over fuel oxygenates. A Canadian company, Methanex Corporation – the world's largest producer of methanol, the chief constituent of MTBE – filed a law suit against the United States, claiming that Governor Davis's ban on MTBE in California violated the North American Free Trade Agreement (NAFTA). Methanex argued that when oxygenates were under review in California, Gray Davis, then a gubernatorial candidate, was flown on an ADM plane to the company's headquarters in Illinois, and that ADM then gave Davis over 200,000 dollars in campaign donations. Methanex alleged that the ban on MTBE was discriminatory, and that the governor's decision was influenced by ADM's largesse in order to shore up support for ethanol (NAFTA Chapter 11 Arbitral Tribunal 2005). The case was finally dismissed in 2005 (Mann 2005). By 2006, 19 states had enacted bans or limits on the use of MTBE (Yacobucci 2007).

Finally, in November 1998, EPA Administrator Carol Browner responded to pressure to investigate the impacts of MTBE by assigning a 'Blue Ribbon Panel' of experts to the task. The panel's report, issued in 1999, found that MTBE was detected in areas of the country that used

reformulated gasoline. It counseled that Congress and the EPA revise the RFG program immediately to ensure that a clean fuels program provides both air and water quality benefits, such as by reducing or completely removing MTBE. But the panel went further, recommending that "Congress … remove the current 2 percent oxygen requirement to ensure that adequate fuel supplies can be blended in a cost-effective manner while quickly reducing usage of MTBE" (EPA 1999). The crucial point is that the Blue Ribbon Panel suggested the immediate removal of the two percent oxygen requirement, not solely the removal of MTBE. It was then up to Congress to decide whether to drop the oxygen requirements from the CAAA, or to retain the RFG program but ban MTBE. The MTBE findings were an embarrassing indictment of the EPA's mishandling of MTBE problems, but the situation also created an exceptional opportunity for lobbyists to promote ethanol. While ethanol may not have outperformed other oxygenates in any other respect, ethanol's relatively innocuous biodegradability in soil and water compared to MTBE gave it a newfound advantage. The ethanol lobby thus wanted to retain the oxygenate requirements, but have MTBE banned, which would then essentially act as an ethanol mandate and vastly expand the ethanol market. Environmental groups and the oil industry were initially united in opposition to a complete ban on MTBE, instead advocating measures to prevent spills and clean up contaminated sites (Stikkers 2001). Once it became apparent that MTBE would no longer be supported, oil industry lobbyists sought to have the entire oxygenate requirement repealed.

5.13 A Renewable Fuels Mandate Takes Shape

In a major victory for ethanol, in March 2000, EPA Administrator Browner appeared at a press conference and proposed to amend the CAAA to authorize the EPA to phase out MTBE

and increase the use of renewable oxygenates. The administrator recognized that if Congress did not act, the EPA would be forced to use its own rule-making authority, which could get bogged down for years in legal disputes. McGarity (2004) suggested that if the EPA's case against asbestos was protracted and difficult, establishing scientific evidence of MTBE's effects on the environment and human health that would hold up in court appeals may have been even more difficult. "If we delay too long, the problem will become worse," Browner said. "The time has come to take action. Americans deserve both clean air and clean water and never one at the expense of the other" (Cone 2000). Browner denied that the EPA's decision was related to California's recent executive order against MTBE, or to boost Vice President Al Gore's election campaign (Usdin 2000).

Crucially, Browner's selective reading of the Blue Ribbon panel's recommendations included phasing out MTBE, but did not include repealing the reformulated gasoline program. She signaled that Congress needed to "amend the Clean Air Act to provide the authority to significantly reduce or eliminate the use of MTBE," to "ensure that air quality gains are not diminished," and to "replace the existing oxygen requirement contained in the Clean Air Act with a renewable fuel standard for all gasoline" (EPA 2000a). Browner presented Congress with a legislative framework for replacing the Reformulated Gasoline Program and the Oxygenated Fuel Program with a single "renewable fuel standard" – a requirement that would guarantee that all gasoline consumed in the U.S. contained a minimum quantity of renewable fuel (most of which would come from corn ethanol), not seasonally but year-round (EPA 2000a). As if to emphasize the significance of this development, administrator Browner was joined by Secretary of Agriculture, Dan Glickman. He noted that:

> Ethanol will play an important role in ensuring that we maintain the air quality gains we have achieved to date, and the renewable fuels

> standard will encourage substantial new growth in the use of ethanol and other renewable fuels across the country (EPA 2000a).

For the ethanol industry this could hardly have been more welcome news. Not only had the industry averted a potential disaster if the entire reformulated gasoline program had been repealed or put under review, but with MTBE being phased out, ethanol gained dominance in the oxygenate market.

The Renewable Fuel Standard (RFS), when it was finally made law in 2005 with the Energy Policy Act, would be the most significant ethanol policy to date, contributing to a tripling of U.S. ethanol production. From the ethanol lobby's perspective, a mandate for renewable fuels was the most lucrative of all forms of regulation. It created a market – if that is what a consumption mandate could be called – for a set volume of ethanol. There were several reasons for the delay in passing a renewable fuel standard in Congress. In California, most reformulated gasoline was made with MTBE, so when MTBE was banned this was expected to lead to a massive and costly reliance on ethanol imports. The California Air Resources Board (CARB) sent a formal request to the EPA for a waiver of the oxygen content requirement. After two years of deliberation the EPA rejected CARB's appeal, yet another boon to the ethanol industry. CARB appealed the decision and commissioned a study by the Coordinating Research Council (CRC) on the evaporative tendencies of different fuel blends. In September, 2004, the CRC issued their final report, entitled *Fuel Permeation from Automotive Systems*. Permeation refers to the propensity of fuels to diffuse through the rubber and plastic components of a vehicle and evaporate. The CRC tested three types of fuel – two percent (by weight, approximately 5.7 percent by volume) ethanol oxygenated gasoline, two percent (by weight) MTBE oxygenated gasoline, and non-oxygenated gasoline. The report concluded that, in all ten types of vehicles tested, ethanol-blended gasoline had the highest permeation, 65 percent greater than MTBE-

blended gasoline and 45 percent greater than non-oxygenated gasoline (Haskew and McClement 2004). Despite the evidence California presented against ethanol-blended gasoline, in June 2005 the EPA denied California's request for an oxygenate waiver.[20] The EPA's press release noted that:

> While EPA agrees with California's claim that an oxygen content waiver would lead to a decrease in certain vehicle emissions that contribute to the formation of smog and particulate matter, EPA concludes that the overall impact on emissions is slight (EPA 2005).

It is evident from the press release that unless a state could demonstrate that the oxygen content requirement imposed a substantial (not just a "slight") obstacle to achieving clean air, the EPA would deny any waiver request. A comparison can be drawn between California's oxygenate waiver request and, as discussed below, a 2008 request by Texas for a partial waiver of the renewable fuels mandate. Although California provided data to show that the oxygenate requirement impaired clean air, and Texas furnished data to show that the renewable fuels mandate drove up the price of corn, negatively affecting Texan livestock owners, the EPA denied both requests, not because the data were deemed incorrect, but because the impacts were not considered substantial enough to warrant a policy shift.

State and federal legislators watched the dispute in California to see how it might affect other states. Attempts to introduce a renewable fuels mandate in the 106th, 107th, and 108th Congresses failed, mostly because of irreconcilable differences between House and Senate. Meanwhile, crude oil prices rose from a low point in the late 1990s to new heights in 2004. U.S. petroleum consumption rose to over 20 million barrels per day, and was expected to increase irrevocably. Global oil demand was rising faster still, led by burgeoning economies in Asia. Oil

[20]At the same time the EPA also denied waiver requests from New York and Connecticut, both of which had banned MTBE and were thus in a similar position as California in that all oxygenation was from ethanol.

imports topped 60 percent in 2005, and the gap between imports and domestic production found a renewed urgency on the political agenda.

5.14 The Volumetric Ethanol Excise Tax Credit (VEETC)

A separate policy development during the 108th Congress resulted in a bill which became known as the American Jobs Creation Act of 2004 (P.L. 108-357). It was ostensibly designed to remove barriers to U.S. manufacturing and investment, thereby creating and retaining American jobs. It provided a great many tax breaks to businesses. One component of the bill was directly targeted at ethanol and biodiesel production, not biofuels or renewable fuels more generally. In July 2003, Iowa Republican Senator Grassley introduced S.1548, a rider co-sponsored by a strong contingent of Midwestern senators, called the Volumetric Ethanol Excise Tax Credit (VEETC).[21] Almost a year later, a provision under the same name was included in H.R. 4520, a bill introduced by California Republican Representative William Thomas covering broad business interests. Thomas' bill passed the House by a reasonable margin (251 votes to 178), passed in the Senate by voice vote, and was signed by President Bush on October 22, 2004. The VEETC essentially consolidated two older laws – the ethanol tax credit in the National Energy Act of 1978 (P.L. 95-618), and the import tariff in the Omnibus Reconciliation Act of 1980 (P.L. 96-499). Provisions were also made for cellulosic ethanol in the form of a 1.01 dollar per gallon tax credit for ethanol blenders, and an additional ten cents per gallon credit for small ethanol producers.

[21]Co-spsonsors: Baucus (D-Montana), Frist (R-Tennessee), Daschle (D-South Dakota), Domenici (R-New Mexico), Bingaman (D-New Mexico), Inhofe (R-Oklahoma), Jeffords (I-Vermont), Thomas (R-Wyoming), Voinovich (R-OH), Conrad (D-North Dakota), Lincoln (D-Arizona), Coleman (R-Minnesota), Dorgan (D- North Dakota), Bond (R-Missouri), Harkin (D-Iowa), Dayton (D-Minnesota), Durbin (D-Illinois), Talent (R-Missouri), Nelson (D-Nebraska), Brownback (R-Kansas), DeWine (R-Ohio), Cochran (R-Mississippi), Johnson, (D-South Dakota), Craig (R-Idaho), Crapo (R-Idaho), Burns (R-Montana), Murkowski (R-Alaska), Lugar (R-Indiana), Stevens (R-Alaska), Hagel (R-Nebraska), Fitzgerald (R-Illinois).

The impetus for the VEETC ostensibly related to federal budget arrangements. The original ethanol tax credit effectively meant foregone revenue to the Highway Trust Fund. Under the new bill, the revenue burden would shift to the U.S. Treasury's General Fund. This seemingly esoteric policy actually introduced the most expensive subsidy in the history of ethanol policy, and would come to dominate federal funds on renewable energy. The ethanol tax credit had begun in 1978 at 40 cents per gallon, and had fluctuated over time, reaching a high of 60 cents per gallon in 1984. VEETC would pay oil blenders 51 cents per gallon of ethanol blended with gasoline. Similarly, VEETC set a new import tariff of 54 cents per gallon. All blends of ethanol, from E10 to E85, qualified for the tax credit. Since the VEETC was based on the volume of ethanol blended, the cost of the bill was proportional to ethanol consumption. VEETC cost approximately four billion dollars in 2008 and over five billion dollars in 2009 (GAO 2009; CBO 2010).

The most notable feature of the VEETC was the relative lack of public attention it received, especially compared to calls for its repeal in 2010 and 2011. Whereas the discourse of clean air had formed the backdrop for ethanol growth in this era, the VEETC was undisguised as a bill to promote ethanol expansion. Later, when the effects of the bill were better known, opposition swelled. Antipathy to VEETC was based on three main arguments. First, critics noted that when the ethanol tax credit was first introduced in the 1970s the ethanol industry was relatively small and immature. A quarter century later, the industry had reached a level of economic and technological maturity, and should no longer need such subsidies (GAO 2009). Second, once a mandate for renewable fuel consumption was introduced in 2005 in the form of the Renewable Fuels Standard (as discussed below), ethanol production was bound to increase to the level of the mandate anyway, making the VEETC largely redundant (de Gorter and Just

2008; GAO 2009; Babcock 2010). Economists raised a key point often overlooked by ethanol advocates concerning the indirect or market effects of commodities. It was commonly assumed that an energy-equivalent volume of ethanol would displace the same volume of gasoline.[22] Yet with the renewable fuels mandate, the tax credit acted as a "gasoline consumption subsidy" – artificially bringing down the price of fuel and thereby encouraging oil consumption (de Gorter and Just 2008). Finally, the VEETC was paid to oil blenders – including major oil companies such as Shell Oil and British Petroleum – not to ethanol producers directly. It seemed wasteful and duplicitous to pay oil companies to blend ethanol, especially once they were legally obliged to do so under the renewable fuels mandate. The VEETC was reduced to 45 cents per gallon in the Food, Conservation, and Energy Act of 2008 (P.L. 110–234). In the original bill the VEETC was slated to expire at the end of 2010, but it was extended until the end of 2011. Widespread calls to repeal the VEETC included a March 2011 letter to Congressional leaders urging them to "allow the [VEETC] to sunset this year and to resist calls for spending on infrastructure for conventional biofuels," signed by major environmental groups[23] and agricultural industries negatively affected by rising corn prices, including the National Meat Association, the National Chicken Council, the National Turkey Federation, and the Milk Producers Council (ActionAid U.S. et al. 2011).

5.15 The Renewable Fuels Standard Becomes Law

Despite the political pressure of high oil prices, new national energy policy remained elusive. Then a critical moment came on May 25, 2005, when the powerful Senate Energy and

[22]The term 'energy equivalent' is used because a gallon of ethanol contains approximately two thirds of the energy of gasoline.

[23]Including Environmental Working Group, Friends of the Earth, Greenpeace USA, National Audubon Society, National Wildlife Federation, Natural Resources Defense Fund, Sierra Club, and World Wildlife Fund.

Natural Resources Committee held a full hearing on energy policy. Missouri Republican Jim Talent and South Dakota Democrat Tim Johnson proposed Amendment 819, which called for a consumption mandate that would reach eight billion gallons of renewable fuels by 2012. As expected, the amendment had strong support from Midwestern senators, and was added to the committee's energy bill.[24] The 'Talent-Johnson Amendment' was essentially the renewable fuels standard for which ethanol proponents had been lobbying for years. Opposition to the bill was led by New York Democratic Senator Chuck Schumer, who railed against the proposal on the Senate floor on June 15, 2005:

> The bottom line is this boondoggle not only hurts drivers and puts money in the pockets of the big ethanol producers, but this amendment puts a dagger in the heart of the concept of a free market. …I know the political forces here. We have coalitions. We have big industry and people from the corn-growing States on one side. But if we required every person in New Mexico or Georgia or West Virginia or Montana to buy New York milk, no matter how much it cost and whether they needed it, you would be on your feet hollering. But to require New York drivers and drivers from Maine and Florida and Texas and Arizona and California and Washington to buy Middle Western corn-based ethanol is equally outrageous (Congressional Record 2005).

When the bill passed on the Senate floor by 85 votes to 12, its authors lauded the amendment's ostensibly wide range of benefits:

> We have been debating a Renewable Fuels Standard for too long. …This amendment reflects the growth that has occurred in the industry over the last four years while the Energy bill stalled in Congress. Renewable fuels are at the crux of economic growth and jobs; at the crux of energy security; at the crux of consumer benefits; at the crux of environmental quality; and at the crux of value-added agriculture for our producers (Talent 2005).

[24]Including Senators Dorgan (D-North Dakota), Salazar (D-Colorado), Domenici (R-New Mexico), Harkin (D-Iowa), Thune (R-South Dakota), Obama (D-Illinois), Lugar (R-Indiana), Grassley (R-Indiana), Nelson (D-Nebraska), Hagel (R-Nebraska), Conrad (D-North Dakota), Bond (R-Missouri), Dayton (D-Minnesota), Coleman (R-Minnesota), and Bayh (D-Indiana), among others.

> Encouraging investment in alternative forms of clean-burning energy, like ethanol and biodiesel, is good for the environment, good for national security and energy independence, and good for job creation in rural America. …One of every three rows of corn planted in South Dakota is dedicated to ethanol production. Renewable fuels need to be part of our national energy policy (Johnson 2005).

The Senate (S10) and House (HR 6) versions of the RFS were negotiated, resulting in a slightly smaller mandate than proponents had hoped. The new Energy Policy Act of 2005 (P.L. 109-58), signed by President George W. Bush on August 8, 2005, replaced the old reformulated gasoline requirements with a mandate that gasoline sold in the U.S. contain four billion gallons of renewable fuel in 2006, increasing to 7.5 billion gallons in 2012 (the Renewable Fuels Standard). Renewable fuel was defined broadly, to include ethanol, biodiesel, and natural gas from municipal waste and sewerage treatment plants (Yacobucci 2005). The EPA negotiated with oil refiners and blenders to devise a regulatory system so that each company would blend its share of renewable fuel with gasoline. The energy act eliminated the oxygenate requirement of the CAAA, but did not ban MTBE (this was left up to states). Though oil companies sought legal immunity from lawsuits for drinking-water damages, this was denied in the law, effectively spelling the end of MTBE-blended gasoline (McCarthy and Tiemann 2006). U.S. MTBE consumption peaked in 1999, but by 2005 its use had fallen by half.

The Energy Policy Act was heavily focused on the development of domestic oil and gas production. It opened new areas for oil and gas exploration, including parts of the outer continental shelf, as well as various shale formations. President Bush's choice of location for the ceremony was significant: Sandia National Laboratory, New Mexico, was home to Manhattan Project research that resulted in the development of atomic bombs during World War II. Both Sandia and nearby Los Alamos labs more recently conducted DOE research, including work on

the development of cellulosic biofuels and defense work. Sandia thus provided a narrative link to a discourse of national security. President Bush announced that:

> The bill includes a flexible, cost-effective renewable fuel standard that will double the amount of ethanol and biodiesel in our fuel supply over the next seven years. Using ethanol and biodiesel will leave our air cleaner. And every time we use a home-grown fuel, particularly these, we're going to be helping our farmers, and at the same time, be less dependent on foreign sources of energy. …I used to like to kid, but I really wasn't kidding when I said, some day a President is going to pick up the crop report…and they're going to say we're growing a lot of corn, and -- or soybeans -- and the first thing that's going to pop in the President's mind is, we're less dependent on foreign sources of energy. It makes sense to promote ethanol and biodiesel (U.S. Department of State 2005).

The RFS spurred a massive growth in corn ethanol industry investment, so much so in fact that production in the first years of the RFS exceeded the mandated levels.

5.16 The 'Technical Feasibility' of Advanced Biofuel Expansion

As in the 1970s, a discourse of *Environmental Bureaucracy* continued to frame policy making on biofuels. Government institutions were increasingly organized and institutionalized around the idea that biofuels were a national planning and research priority. In August 1999, President Clinton signed an executive order, the Biobased Products and Bioenergy Initiative, to triple the use of biofuels in the U.S. by 2010. Congress complemented this initiative with the Biomass Research and Development Act of 2000 (P.L. 106-224), which directed the departments of Energy and Agriculture to integrate their biomass research and development efforts by establishing a Biomass Research and Development Technical Advisory Committee and a Biomass Research and Development Board. Other government departments, including Interior, Transportation, Commerce, Defense, and the Treasury, as well as the EPA, the National Science Foundation, and the Office of Science and Technology Policy, provided input. Key sites of

energy research, including the National Bioenergy Center at Oak Ridge National Laboratory (ORNL), Tennessee, and the National Renewable Energy Laboratory (NREL), Colorado, led collaborative research and knowledge sharing.

The fruits of these efforts were soon evident in the publication of detailed technical studies of the potential growth of a U.S. biofuel sector beyond corn. Each successive report appeared to reach a higher estimate of the feasible scale of bioenergy crop production. An economic analysis by Walsh et al. (1998) estimated that 1.3 *million* dry tons of biomass could be harvested annually, from non-food biofuel crops including switchgrass, poplar, and willow plantations. Similar reports in 2000 (De La Torre Ugarte et al. 2000) and 2003 (Walsh et al. 2003) estimated that cellulosic crops could provide as much as 188 million dry tons of biomass annually. A joint USDA and DOE study, which became known as the *Billion Ton Vision,* found that it was technically feasible to produce over 1.3 *billion* dry tons of biomass annually: "enough to produce biofuels to meet more than one-third of the current demand for transportation fuels" (Perlack et al. 2005). A 2006 report by ORNL's partner institution, the University of Tennessee, claimed that by 2025 America could produce 25 percent of its energy needs from renewable biomass produced on farms, forests, and ranches, including 86 billion gallons of ethanol and 1.2 billion gallons of biodiesel per year (English et al. 2006). The *Billion Ton Vision* provided the impetus behind the DOE's *30x'30 Biofuels Initiative*, with a goal of producing the equivalent of 30 percent of 2004 gasoline consumption – an estimated 60 billion gallons of ethanol – by 2030 (Foust et al. 2006). In 2009, Sandia National Laboratories, a DOE research facility, published *90-Billion Gallon Biofuel Deployment Study*. It found that "with enduring government commitment and continued technological progress," by 2030 the U.S. could produce 15 billion gallons of corn ethanol and 75 billion gallons of cellulosic ethanol (Sandia National Laboratories

2009). These technical reports were widely circulated among ethanol advocates and policymakers as evidence of the potential for industry expansion. The development of corn ethanol had demonstrated that a scaled-up domestic biofuel industry was possible. In a *Techno-Optimist* frame, the remaining step was a transition from food crops such as corn and soybeans toward 'next generation' biofuels. Yet while a large-scale cellulosic ethanol industry was keenly anticipated, the inability to break down cellulosic biomass in a cost-effective manner continued to frustrate the development of such an industry. The advanced biofuel reports were theoretical and illusory since they were built upon the notion, now three decades old, that cellulosic ethanol would soon be commercialized.

5.17 Addicted to Oil

Despite the ostensible contribution of biofuels to energy security, American oil markets continued to cause public and political disquiet. Just weeks after the Energy Policy Act of 2005 was signed, Hurricane Katrina struck the Gulf Coast, followed by Hurricane Rita. Aside from the direct human and economic devastation, both storms caused extensive damage to oil refineries and distribution systems in the region. Hurricane Katrina damaged 30 oil platforms and forced the closure of nine refineries in the Gulf Coast region. Oil imports reached their highest level ever in late 2005, at over 12 million barrels per day, some of which could not be brought ashore to be refined because of the damage. Consequently, retail gasoline prices rose to over three dollars a gallon and spiked to over five dollars in some areas, and the DOE released 30 million barrels of crude oil from its Strategic Petroleum Reserve. The troublesome situation in late 2005 suggested that federal energy policy may not have gone far enough.

Reliance on imported oil reached 66 percent in 2006 (GAO 2007a), and gasoline prices continued to rise through 2006 and 2007. A further pressure on Congressional action was

speculation that the phase-out of MTBE and shortages of ethanol were partly to blame for high gas prices (McCarthy and Tiemann 2006). Corn ethanol producers responded energetically to the combined effects of the Renewable Fuel Standard, the ethanol tax credit, and to other policies (including state level incentives) with a refinery construction boom – so much so that they exceeded the federally mandated renewable fuel volumes. By late 2007, ethanol production had increased so quickly that signs of a glut were beginning to show. Bottlenecks in the supply chain, including infrastructure to distribute ethanol from the Midwest to the coastal markets, could inhibit industry growth (Yacobucci and Schnepf 2007). This presented a problem of oversupply and falling prices, and ethanol supporters lobbied Congress for even greater renewable fuel mandates (Barrionuevo 2006; Andrews 2007).

A legacy of the G.W. Bush presidency was his attention to U.S. energy independence. For President Bush, escalating fuel imports and a growing ethanol industry were flip sides of the same issue. While in previous addresses the president had listed a range of technologies, including "clean coal" and "hydrogen-fueled cars," his 2006 and 2007 State of the Union speeches marked a high point for corn ethanol. In 2006 he announced that America was "addicted to oil," and described the role that ethanol could play in alleviating this addiction:

> We will also fund additional research in cutting-edge methods of producing ethanol, not just from corn but from wood chips and stalks or switch grass. Our goal is to make this new kind of ethanol practical and competitive within six years. Breakthroughs on this and other new technologies will help us reach another great goal: to replace more than 75 percent of our oil imports from the Middle East by 2025 (The White House 2006).

The following year, President Bush urged Congress to mandate an almost five-fold increase in the RFS, to 35 billion gallons of alternative fuels by 2017, not only from corn but "using everything from wood chips to grasses to agricultural wastes" (The White House 2007). The

President's focus on the technical feasibility of significantly reducing dependence on foreign oil by producing large quantities of biofuel from cellulosic biomass was largely built upon the ambitious national assessments made by the collaborative interagency efforts mentioned earlier (Glozer 2011). However, corn could not provide the volume of ethanol required to meet the President's goals. Hill et al. (2006) and Yacobucci (2007) estimated that even if *all* U.S. corn were used to make ethanol, it would satisfy only 12 to 17 percent, respectively, of existing gasoline demand. Even these figures were too high, once the energy inputs involved in corn and ethanol production were subtracted. However, it could not be assumed that ethanol simply replaced an energy equivalent volume of gasoline, if subsidies caused the price of ethanol-gasoline blends to change (de Gorter and Just 2008). The only way the President's targets could be met was with the large scale development of cellulosic ethanol, and no such industry existed. Thus federal biofuel policy, strongly supported by the White House, was predicated on *Techno-Optimism* – that technological breakthroughs that would realize a more abundant, more environmentally sustainable, cellulosic biofuel industry. In the meantime, the immediate beneficiary was corn ethanol.

Following the President's State of the Union Address, in February 2007 the DOE announced a plan to spend 385 million dollars over the next four years to commercialize six cellulosic ethanol pilot plants in partnership with private investors. In June it granted 375 million dollars to fund three new Bioenergy Research Centers, at Oak Ridge National Laboratory in Tennessee, Great Lakes Bioenergy Research Center in Wisconsin, and Lawrence Berkeley National Laboratory in California. The objective of these research centers was to develop technology for cellulosic ethanol and other biofuels to make them cost competitive with gasoline by 2012.

5.18 Chapter Summary

The Clean Air Act Amendments of 1990 sparked an intense and protracted political struggle over market share for reformulated gasoline oxygenates. An organized and active ethanol lobby sought to influence this process by ensuring as large a market share as possible for ethanol oxygenate. They were supported by Midwestern Congressional lawmakers, including Senators Tom Daschle (D-SD) and Bob Dole (R-KS), who spearheaded the formation of policies favorable to corn ethanol. The storyline that the ethanol lobby and their supporters in Congress offered was that gasoline reformulated with ethanol yielded air quality benefits to the American public. The scientific evidence for this claim was uncertain at the time the legislation was written in the early 1990s, and was known to be untrue by the end of the decade. Administrations, including those of Presidents G.H.W. Bush, Clinton, and G.W. Bush, saw the political value in approving of strongly supportive corn ethanol policies, despite the mounting evidence of ethanol's environmental disadvantages as a fuel oxygenate. By 2005, the narrative had shifted from clean air back to energy security, and President G.W. Bush emphasized the role of biofuels as part of a strategy for reducing oil import dependence. Evidently, Environmental Protection Agency clearly did not have the institutional autonomy to develop a scientifically-informed policy on ethanol and fuel oxygenation, free of political influence from Congress or the White House. Both discourses of clean air and energy security were predicated on a strongly administrative state and on technological improvements. The twin discourses of *Environmental Bureaucracy* and *Techno-Optimism* were on display most clearly in the technical reports produced by government researchers enthusiastically predicting that a cellulosic biofuels industry could replace at least one quarter of American fuel needs. *Environmental Bureaucracy*

reached a new highpoint in the enactment of the Renewable Fuel Standard – more reminiscent of Soviet or Chinese style central planning than of a market-based approach to energy policy.

Chapter 6 - Ethanol Policy 2007 to 2013

In the period from 2007 until 2013, two new and important discourses emerged and framed biofuel policymaking. The first of these is *Ecological Modernization* – the view that capitalist economic growth and environmental improvement can mutually reinforce, rather than antagonize, each other. The second is *Limits*, a neo-Malthusian argument against the expansion of using food crops (such as corn) for biofuels, on the grounds that it competes for a finite supply of land and starves the world's poor. *Ecological Modernization* is best understood in opposition to the notion that economic growth and industrialization are antithetical to environmental protection. *Ecological Modernization* theorizes, rather, that modernization and environmental improvement can be mutually reinforcing. Leading exponent Arthur Mol goes even further, asserting that "the only possible way out of the ecological crisis is by going further into the process of modernization" (Redclift and Woodgate 2010, 78). The term modernization implies cross-sectoral, holistic change, including of the state (including public policies and government institutions), of the economy, of culture, and of society. *Ecological Modernization* recognizes a role for both markets and an administrative state. Government bodies play an important regulatory function in guiding the economy toward greener industrial pathways, such as by setting and enforcing environmental performance standards. Private investors and firms respond by innovating more energy efficient or environmentally sustainable products and services. Consumer demand for cleaner, greener, lifestyles drives markets from less to more sustainable products and services. Like *Environmental Bureaucracy*, *Ecological Modernization* (or *Ecomodernist*) discourse relies on *Techno-Optimism*. A key distinguishing feature of *Ecological Modernization* is its affinity for capitalist economic growth. *Limits* discourse displays far less confidence in either technological innovations or free markets to solve what is seen as a problem

of competition for limited global farmland. *Limits* thinkers are more likely to look to strong government regulation, particularly at the international level, to regulate against the kind of circumstance experienced in 2008, in which rapid expansion in biofuel production appeared to be a lead cause of a global spike in food commodity prices.

6.1 Democrats Reorient Ethanol Discourse

Following the mid-term elections in 2006, the Democrats gained control of both chambers of Congress for the first time in twelve years, and launched their 'First One Hundred Hours' agenda to pass a suite of bills that included revising tax incentives for the oil and gas industries. A key feature of the change in leadership was a rhetorical shift toward climate change mitigation. In the aftermath of the 2005 hurricane season and escalation of oil prices, oil and gas companies had reaped record profits. Democrats took the opportunity to frame Republican-instigated oil and gas subsidies as unfair and undeserved, and to wed energy security and climate change as a single policy problem. New Speaker of the House Nancy Pelosi created a Select Committee on Energy Independence and Global Warming to coordinate bills in the House (Bang 2010). Democrats framed energy production in terms of environmental and technological advancement that would lead to a transition away from 'dirty' coal, oil, and gas, toward 'renewable' or 'clean' energy technologies, including wind, solar, and biofuels. For most Republicans, including the Bush Administration, the driving agenda for biofuel policy continued to be energy security and independence.

At the beginning of the 110th Congress, a bill termed the Creating Long-Term Energy Alternatives for the Nation (CLEAN) Energy Act was introduced to the House by the new chair of the Natural Resources Committee, West Virginia Democratic Congressman Nick Rahall, which had been coauthored by New York Democratic Congressman Charles Rangel, chair of the

Ways and Means Committee. Rahall characterized it as legislation that sought "to end the unwarranted tax breaks and subsidies which have been lavished on Big Oil over the last several years at a time of record prices at the gas pump and record oil industry profits" (*Congressional Digest* 2007). The act was designed to repeal a series of tax breaks and tax loopholes worth approximately 14 billion dollars to large oil companies, and to spend the revenue on 'alternative energy,' renewable energy, and energy efficiency standards (*Congressional Digest* 2007). The bill bypassed committee review and went straight to the House floor, where it was debated for a week and passed by 264 to 163 votes, mostly along party lines, on January 18, 2007. Representative Jim McDermott (D-WA) alluded to the importance of the bill for climate change mitigation:

> I bumped into some people from the National Wildlife Federation, and they gave me 30,000 signatures of people who want this bill to pass, people who care about the environment. People who care about global warming, people who believe in national security, who believe in economic security, signed this in the last three weeks. The American people obviously are way ahead of us (*Congressional Digest* 2007).

Democrats thus sought to draw a distinctly environmental rationale for energy policy, one that would foster a modern, clean energy sector, in contrast to an outdated, fossil fuel-based energy sector that Republicans had supported in 2005. House Republicans countered that oil companies used profits to invest in exploration and drilling, so burdening them with tax increases would stifle domestic oil production, increase oil prices, and lead to job losses and greater dependence on oil imports (*Congressional Digest* 2007).[25]

Having passed in the House, energy policy was then taken up in the Senate in June 2007, where several key environmental provisions were added to the RFS, primarily due to the work of

[25]Critics of HR 6 included Jim McCrery (R-Louisiana), Phil English (R-Pennsylvania), Tom Cole (R-Oklahoma), and Jerry Weller (R-Illinois).

New Mexico Democratic Senator Jeff Bingaman, who chaired the powerful Senate Energy and Natural Resources Committee. Bingaman undertook a comprehensive review of the 2005 Energy Policy Act and submitted an amendment to examine the environmental impacts of the RFS. Bingaman's proposal required the EPA to report to Congress on the impacts of biofuel mandates on air and water quality. Moreover, biofuels were defined in more specific terms than they had been in the Energy Policy Act of 2005. For example, 'advanced biofuels' must achieve at least a 50 percent reduction in life-cycle greenhouse gas emissions. The National Academies of Science would be contracted to assess the effects of increased renewable fuels on air and water quality, the quality of natural resources, land use changes in America and globally, biodiversity values, and long-term prospects for the U.S. production of biomass. Democratic support for the amendment was unanimous and ten Republicans joined them in passing Bingaman's proposal. Other aspects of the bill still had to survive negotiations between House and Senate. Democratic Senators had hoped to pass a much larger oil and gas tax bill than the House version, and to spend the 32 billion dollars in revenue on alternative energy development, but this was blocked by Senate Republicans. President Bush signed the Energy Independence and Security Act of 2007 (EISA) on December 19, 2007.

The mandated volumes of renewable fuels themselves were similar to what President Bush had called for – nine billion gallons to be blended in 2008, rising to 36 billion gallons in 2022. More than half – 21 billion gallons – had to come from advanced biofuels, including 16 billion gallons from cellulosic biofuel. EISA defined advanced biofuels to include all biofuels other than those made from corn kernels (Yacobucci and Capehart 2008). The definition was confusing because it therefore included ethanol from sugarcane – a decades-old industry. Other 'advanced' biofuels included biodiesel from soybeans, biofuels derived from algae, and

cellulosic ethanol – derived from biomass such as corn stalks, wheat stubble, prairie grasses, poplar and willow trees, forest residue, and municipal waste. The RFS2 regarded corn ethanol as 'conventional' or 'first generation' biofuel whose impressive growth had made the RFS possible, yet whose continued expansion could create environmental and economic problems. For the first time, Congress recognized that there was a limit to how much corn could be used for ethanol without unduly affecting other sectors of the economy. First-generation biofuel (i.e., corn ethanol) was capped at 15 billion gallons per year from 2015 – an amount that would likely fill the domestic E10 market – and starting in 2016, all increases in renewable fuels must come from advanced biofuels (Sissine 2008). Congress had essentially mandated the creation of an entire industry – cellulosic biofuels – from the ground up. It assured the public that 'advanced biofuels' were on the horizon, when in fact the government did not know when, or if, such an industry would materialize. No better example of *Techno-Optimism* can be shown than the government-mandated creation of a cellulosic biofuel industry.

The 2005 and 2007 acts were remarkably different energy policy documents. The first was passed by a Republican-controlled House and Senate, and strongly encouraged domestic oil and gas production. The second was passed by a Democratic-controlled House and Senate, and drew a strong link between energy and climate change. Notable features of EISA include stricter CAFE standards, new energy efficiency rules for lighting and appliances, repeal of tax breaks to the oil and gas industries, and an expanded renewable fuel standard ("RFS2"). The bifurcated logic of the revised renewable fuel standard reflected its history under both energy acts. For most Republicans, the RFS2 represented a continuation of established support for corn ethanol and its ostensible contribution to national energy security and independence. For most

Democrats, it signaled a decisive shift toward cleaner, more climate-friendly renewable fuels, especially those made from non-food plant biomass.

To qualify as a renewable fuel, EISA required corn ethanol to achieve at least a 20 percent reduction in life-cycle GHG emissions relative to life-cycle emissions from conventional gasoline. For advanced biofuels the standard was set at 50 percent, and for cellulosic biofuels (a subset of advanced biofuels), 60 percent. Life-cycle GHG emissions requirements added new meaning to biofuels as a public good, and created a new discursive space for assessing and comparing renewable fuels. Life-cycle analysis (or life-cycle assessment, LCA), often referred to as "cradle to grave" accounting, is a term for the aggregate ecological impacts involved in all steps of a commodity's production and consumption, including all energy and material inputs and processes. LCA provided a means of comparing the relative ecological impacts of different products or forms of consumption. According to the new law, the EPA was required to conduct LCA for each type of biofuel, including both the direct GHG emissions caused by growing, harvesting, transporting, refining, and ultimately burning the fuel in a motor vehicle, as well as the indirect emissions from market-based effects such as the conversion of non-farmland to biofuel production.

A further complicating feature of life-cycle assessment of biofuels was the notion of land use change. Land use change (LUC) is the conversion of land from one use to another. In the Midwest, direct LUC was observed as the market for corn ethanol expanded (GAO 2007b; Westcott 2007a). As corn prices rose in the mid-2000s, farmers planted more corn and less soybeans, wheat, and cotton. Farmers in 2007 planted more than 90 million acres of corn, the largest acreage since the Second World War. The International Panel on Climate Change (IPCC) considers land use change to be a major driver of climate change. An IPCC special report

estimated that land use change caused one-third of anthropogenic GHG emissions between 1850 and 1998 (IPCC 2000, 4).

Land use change can also be induced through markets. For example, the expansion of corn for ethanol drove up prices for other crops, such as wheat and cotton, which induced farmers to convert conservation land to grow crops (USDA 2011). In the period from 2007 to 2012, Conservation Reserve Program (CRP) acreage declined by 27 percent, from approximately 37 to 27 million acres (Stubbs 2013). The same logic of induced land use change can be applied on a global scale (Searchinger et al. 2008; see discussion section 6.5 below). The U.S. is a leading exporter of major food commodities, including corn, soybeans, and wheat. Throughout the 2000s, U.S. corn exports averaged over half of global exports (USDA 2014). The powerful influence of U.S. markets on global food commodity markets means that domestic changes – such as rapidly growing demand for corn ethanol – can trigger changes to global crop production and land use (Naylor 2007). In contrast to the direct land use changes visible in the expansion of U.S. corn acreage, indirect land use change (ILUC) refers to land use change induced by market forces (Turner et al. 2007). ILUC is fundamentally a concept of spatial-economics. A central precept in economics is the Law of One Price, which states that, transport and transaction costs notwithstanding, the price of a good will converge on a single price in all locations (Mankiw 2011, 686). This is based on the idea that if there are two markets in different locations for a single product, an arbitrageur will seek to profit from the price differential by selling more of the good in the higher-priced market, causing prices there to fall and ultimately equalize with the lower-priced market (Persson 2008). Theoretically, then, globally traded commodities like corn, soybeans, and wheat, each converge on a global price. If demand for corn ethanol raises the U.S. price of corn, this price change transmits market signals throughout the global economy.

Searchinger and associates (2008) assert that even as far from Midwestern corn fields as the Amazon region or Brazilian grasslands, higher food commodity prices induce land owners to clear land to produce more of the crops whose value have increased (see discussion section 6.5 below).

The EPA accepted that the expansion of corn ethanol domestically could indirectly trigger land use changes in distant parts of the world, and that such changes could produce undesirable climate change effects. The inclusion of ILUC in the EPA's regulatory responsibility was itself a remarkable development. The agency was, after all, responsible only for U.S. environmental protection, not global environmental or food-related problems. Moreover, the EPA had not been in the practice of regulating any domestic industry on the basis of its direct GHG emissions, yet was now expected to regulate biofuel industries based on *global* emissions.

Measuring ILUC required sophisticated econometric models which relied on dozens of key parameters about which a great deal of uncertainty persists (Edwards et al. 2012; Wicke et al. 2012). These include, for example, the yield-response of a crop price increase, the productivity of land in different world regions, the productivity of newly converted land, the substitutability of different crops and commodities, consideration of biofuel by-products such as distillers' grains, and global consumer demand for commodities (Edwards et al. 2012). The sensitivity of models to such parameters helps explain the lack of consensus among researchers on the magnitude of ILUC from biofuels, and the large margins of error in model findings (Edwards et al. 2012).

The EPA's new responsibility for measuring LCA thus placed the agency in a particularly powerful yet precarious position. If the agency determined that ILUC from growing

corn for ethanol precluded its qualification as a renewable fuel, it would jeopardize the growth of the industry, and upset many powerful members of Congress. EISA and the RFS2 had therefore launched the EPA into uncharted scientific and political territory. The inclusion of a requirement to measure indirect land use change altered the discursive landscape of biofuels by linking them to climate change. The EPA had not considered biofuel-induced land use change before, and struggled to keep abreast of the Pandora's Box of models, calculations, speculation, claims, and counter-claims which soon erupted from the scientific literature.

6.2 A Global Food versus Fuel Narrative Emerges

After more than three decades of relatively low and stable prices, food commodity costs began to rise in 2006, escalated in 2007, and peaked in 2008. *The Economist* reported that the food price index showed the highest food costs since records began in 1845 (*The Economist* 2007). The FAO's food price index rose 57 percent from March 2007 to March 2008 (FAO 2008a). Rice, soybean, and wheat prices also increased substantially. A distinction must be made between food expenditures in developing versus wealthier countries, however. In industrialized countries most food is consumed in processed form. Moreover, in the U.S. food costs constitute a relatively small proportion of most household budgets. By contrast, in developing countries, households spend a large part of their budget on food, and much of this is on unprocessed commodities (e.g., rice, wheat, corn). The impact of the sudden rise in commodity prices was devastating in much of the world. The FAO reported that an additional 80 million people joined the ranks of the world's hungry, and listed 37 "countries in crisis, requiring external assistance" because of problems caused by food insecurity (FAO 2008b).

Mass riots, violence, and political instability ensued in many regions, generating concerns about global security.[26]

The period of the 2007-8 food crisis was not the first time that a food-vs-fuel concern had arisen: in 1980 the Worldwatch Institute warned about potential food shortages from large scale conversion of cropland for energy crops (Brown 1980). Yet such fears had not been taken seriously at the policy level. To the contrary, major international organizations involved in food and agricultural policy indicated the potential benefits of expanding bioenergy, and specifically biofuel production, primarily in developing countries. In an analytical framework on bioenergy and food security, for example, the FAO noted that if managed properly, bioenergy offered many advantages over other energy sources in regions of the world with land availability and an advantageous climate for growing biomass. The report outlined several important benefits of bioenergy in developing countries, including as a source of local energy security and reducing dependence on fossil fuels, its contribution to mitigating rural poverty, providing rural employment and economic growth, its complementary contributions to food production and food security, and its contribution to environmental quality by reducing GHG emissions (FAO 2010). A report by the Global Bioenergy Partnership (GBEP), a group originally comprised of 23 countries and 13 international organizations including the FAO and the International Energy Agency (IEA), compiled a list of 24 sustainability indicators designed to inform and guide domestic policies on sustainable bioenergy production (GBEP 2011). The GBEP articulated the same potential advantages of bioenergy production as had the FAO, namely rural economic growth, climate change mitigation, and "modern energy services" (GBEP 2011). Also in 2011, the IEA, in its technology "roadmap" for biofuels, laid out a vision for biofuels that by

[26]Protests and/or violence were reported in Bolivia, Haiti, Egypt, Burkina Faso, Cameroon, Bangladesh, Indonesia, Ivory Coast, Mexico, Mozambique, Mauritania, Pakistan, Senegal, Uzbekistan, and Yemen.

midcentury would be expanded to 100 million hectares of feedstock production, provide 27 percent of transport fuel, and avoid 2.1 gigatons of CO_2 emissions (IEA 2011). The IPCC, in its special report on renewable energy sources and climate change mitigation, reiterated that renewable energy, including biofuels, can contribute to the "modernization of energy services" and achieve social, environmental, and economic benefits (IPCC 2012). The IPCC expected that technological improvements would continue to reduce the cost of biofuel production, making it more competitive with fossil fuel, and would lead to the commercialization of advanced biofuels made from plant biomass.

The FAO, GBEP, IEA, and IPCC reports demonstrate the increasing integration of biofuel discourses with issues of food, energy, and climate change. Indeed, the FAO, IEA, and IPCC had long been advocates of integrated agriculture and energy policies (Kuchler and Lener 2012). To an extent, agriculture and energy sectors have always been related. In industrialized countries, modern intensive agriculture requires large inputs of fossil fuel energy for agrochemicals, irrigation, farm machinery, food processing, and transportation. Biofuels represented a new, and what would prove to be contentious, use of land and resources not for food, feed, or fiber, but for transportation fuel.

However, the 'food crisis' exposed biofuels to increasing scrutiny and blame, particularly among international institutions concerned with agriculture, poverty, and development. In June 2008, Oxfam International published *Another Inconvenient Truth: How Biofuel Policies are Deepening Poverty and Accelerating Climate Change*, while ActionAid International USA released similarly condemnatory publications, including *Coming Clean on Hunger: The Dirty Truth about Industrial Biofuels* (2011), *Biofuels: Fueling Hunger? Threats of another Global Food Crisis* (2012), and *Fueling the Food Crisis: The Cost to Developing Countries of Corn*

Ethanol Expansion (2012). Prominent environmental activist, prolific author, and founder of the Earth Policy Institute, Lester Brown, claimed that food-based "biofuels pit the 800 million people with cars against the 800 million people with hunger problems" (Grunwald 2008). Jeffrey Sachs, director of Columbia University's Earth Institute and special adviser to the United Nations, said in *Scientific American* on 19 May 2008, that the U.S. government's corn ethanol policies were "wrong-headed," and were being driven by "an aggressive farm lobby" (Sachs 2008a, Figure 6-1). He called for an end to "misguided corn-to-ethanol subsidies" (Sachs 2008a). In the September issue of the same journal, Sachs published *The Specter of Malthus Returns* – a commentary on whether the world's growing population could continue to satiate demand for food and energy, given current rates of depletion of "natural capital" (Sachs 2008b; Figure 6-1).

Figure 6-1 Illustrations from a *Limits* perspective by Matt Collins, *Scientific American*, June and September 2008.

Speaking at the UN headquarters in New York in October, 2007, UN special rapporteur on food and human rights Jean Ziegler declared that converting farmland for biofuels constituted a "crime against humanity" and called for a five year moratorium, which, he argued, would allow time for advanced biofuels (using non-food crops) to be developed (UN 2007). The UN General Secretary Ban Ki-Moon rejected the moratorium, calling instead for a comprehensive review of biofuel policies in light of the food commodity price spikes. At the same venue in April, 2008, Bolivian president Evo Morales and Peruvian president Alan Garcia argued that land use for biofuels was making food too expensive for the poor in their countries (BBC 2008a). There seemed to be uncertainty within the UN over how urgently to respond. That month the UN General Secretary met with high level officials in Switzerland to address the food crisis.[27] The resulting communique simply recommended further research on the impacts of biofuel expansion on food production and a review of existing subsidies to food-based biofuels (UN 2008a). The head of the UN's Food and Agriculture Organization, Jacques Diouf, took a much more explicit stance than his superior, Ban Ki-Moon. At a high level conference on the global food crisis in Rome, Diouf ignored pleas from biofuel industry lobbyists not to target biofuels and publicly renounced U.S. ethanol policies for depriving 100 million tons of grain from the world's hungry, to "satisfy a thirst for fuel" (Rosenthal and Martin 2008). U.S. Secretary of Agriculture Ed Schafer sought to reassure world leaders that biofuels contributed no more than two or three percent to increased food prices (Rosenthal and Martin 2008). Yet Schafer's remarks contradicted the findings of former USDA chief economist Keith Collins. Collins' June 2008

[27]Also in attendance were Josette Sheeran, Executive Director of the UN's World Food Programme; World Bank President Robert Zoellick; Jacques Diouf, head of the Food and Agriculture Organisation (FAO); and Lennart Baage, president of the International Fund for Agriculture Development (IFAD).

report on the effect of biofuels on food prices found that corn demand for ethanol accounted for up to 60 percent of the expected increase in price over the coming year (Collins 2008).

Addressing representatives at the UN headquarters again in July, Ban Ki-Moon's position did not appear to have shifted. He warned that soaring energy and food prices were undermining the Millennium Development Goals by sending millions of people into poverty. He alluded, cryptically, to the need to balance food and biofuel production:

> Member states must reassess subsidies and tariff protection for biofuel production. It is true that biofuels will need to remain a part of the equation in our fight against climate change, but we also need to establish an international consensus and agree [to] policy guidelines on ways to balance the development of biofuels with food production priorities to ensure complementarity (UN 2008b).

Just a week before the G20 summit at which food security was to occupy center stage, a World Bank report was leaked to *The Guardian*, a British newspaper (Chakrabortty 2008).[28] It concluded "that the most important factor [in raising food prices] was the large increase in biofuels production in the U.S. and the E.U." (Mitchell 2008). The report calculated that up to 75 percent of the spike in food commodity prices was attributable to biofuel production and the related consequences of low grain stocks, large land use shifts, speculative activity and export bans (Mitchell 2008). The World Bank issued an update to this analysis in 2010, in which they revised downward their estimation of the role of biofuels on food prices, suggesting that previous estimates had been exaggerated (Baffes and Haniotis 2010). At the G8 summit in Japan, World

[28]The G20 is a group of 20 leading economies, including Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Turkey, United Kingdom, and the United States, as well as the European Union.

Bank President Robert Zoellick urged U.S. and EU leaders to reduce their production of biofuels (BBC 2008b).[29]

In May 2008, the Director General of the International Food Policy Research Institute (IFPRI), a Washington DC-based organization focused on alleviating global poverty and malnutrition, called for an immediate "emergency package" of measures to assuage the food crisis. He said that governments should "revoke biofuel subsidies and excessive blending quotas," place a "moratorium on the use of grains and oil seeds for biofuels," and support the "development of bio-energy technologies that do not rely on food crops" (von Braun 2008). The Organization for Economic Co-operation and Development (OECD) also published an economic assessment of biofuels. It concluded that corn ethanol was an inefficient and costly means of reducing GHG emissions or reducing fossil fuel dependence. Among competing feedstocks, such as sugarcane, sugar beets, and vegetable oils, corn was the least efficient at reducing GHG emissions, unlikely to gain more than a 30 percent reduction. The OECD report concluded that fossil fuel use in the transport sector was unlikely to be reduced by more than about one percent, while the cost per ton of carbon dioxide-equivalent pollution saved was extremely high – between 960 and 1700 U.S. dollars (OECD 2008). At the same time, biofuels contributed to "a range of factors that raise international prices for food commodities." The OECD recommended that governments shift their focus to more cost-effective means of reducing GHG emissions, reduce biofuel trade barriers, and advance research on more efficient feedstocks such as cellulosic biomass (OECD 2008). With the advantage of hindsight three years later, the National Research Council summarized authors' estimates of the contribution of biofuel production to food commodity price increases (NRC 2011, Table 4-4). They noted that Mitchell's estimate (of

[29]The G8 is a group of eight leading economies, including Canada, France, Germany, Italy, Japan, Russia, United Kingdom, and the United States.

75 percent) was at the high end, and that estimates had come down over time. The report acknowledged that measuring the precise effect of biofuel expansion on global food commodity prices was probably impossible, and settled on a much more modest estimate than Mitchell, of between 20 and 40 percent (NRC 2011). A 20 percent contribution implied that biofuels were one of multiple factors, and may not be the leading cause, of the global food crisis – certainly a less sensational news story. Nonetheless, it still implied an antagonistic relationship between biofuel expansion and food commodity prices.

6.3 Biofuels Attacked in the Mainstream Press

The sudden and unanticipated nature of the food commodities price spike sparked a flurry of speculation among the mass media on its immediate and proximate causes. A popular metaphor was that a '*perfect storm*,' or combination of unpredictable events affecting rising demand and falling supplies, had precipitated the food crisis (e.g., Headey et al. 2009). Analysts, for example, noted shortfalls in supply caused by poor harvests in Australia, India, and Eastern Europe, though others countered that these were not large by historical standards and that they were compensated by good harvests elsewhere (Headey et al. 2009). Others pointed to rising fertilizer and oil prices, the declining relative value of the U.S. dollar, and market speculation. On the demand side was a rise in meat consumption in the emerging economies, including China and India. In April 2008, President Bush's comments vis-à-vis India's growing appetite sparked a minor diplomatic spat. Corn prices were reaching new highs of over five dollars a bushel, while gasoline prices were about to peak in the summer before crashing at the end of 2008. Speaking at a factory in Missouri, the President rejected the idea that biofuels were the main problem, and asserted that one reason for high food prices was due to demand by

India's emerging middle class. Insulted Indian commentators retorted that per capita calorie consumption was far higher in America than in India, and accused President Bush of blaming India to divert attention away from U.S. consumption. Once commodity prices began to rise, governments of major exporters, including Argentina, China, India, Kazakhstan, Ukraine, and Vietnam, imposed policies to restrict food exports, which likely exacerbated the run up in global prices. Among all these explanations, however, U.S. biofuel policies became the subject of a high degree of denunciation.

As 2008 shaped up to earn the label of the 'year of the food crisis,' the *perfect storm* metaphor appeared inadequate for two reasons. First, a storm implies a natural inevitability and therefore that it was driven by environmental or market forces beyond the control of governments. Second, a storm implies suddenness in the onset and a temporary period of unrest; this did not fit the deeper structural issues concerning energy and agriculture. Another food crisis arose in 2011, when the food price index rose even higher than it had in 2008. Looking beyond the *perfect storm* trope, many mainstream media journalists began to point directly at biofuel policies as a leading cause of the food crisis. *The Economist* scathingly described the food crisis as the "self-inflicted result of America's reckless ethanol subsidies" (*The Economist* 2007). *The New York Times* summed up the situation as follows:

> The rise in food prices is partly because of uncontrollable forces—including rising energy costs and the growth of the middle class in China and India. This has increased demand for animal protein, which requires large amounts of grain. But the rich world is exacerbating these effects by supporting the production of biofuels. The International Monetary Fund estimates that corn ethanol production in the United States accounted for at least half the rise in world corn demand in each of the past three years (2008).

On April 7, 2008, *TIME* magazine's front cover depicted an ear of corn with hundred dollar bill husks (Figure 6-2). The author claimed that enormous investment in biofuels in the U.S. and Europe was driving Amazonian deforestation and "jacking up world food prices and endangering the hungry" (Grunwald 2008). Criticism of corn ethanol subsidies became widespread in the mass media in this period, featuring in *Bloomberg BusinessWeek* (Carey 2008), and *National Review* (Freddoso 2008), as well as broadsheets including *The New York Times* (Martin 2008), *USA Today* (Kirchhoff 2008), *The Wall Street Journal* (Hughes et al. 2008), and *The Washington Post* (Sloan 2008; Brown and Lewis 2008).

Figure 6-2 Cover of *TIME* Magazine, 7 April 2008

6.4 Food vs Fuel Becomes a Domestic Issue

While the food-vs-fuel debate was playing out on the international stage and gaining national media attention, 'feed versus fuel' issues were affecting domestic policy. In 2008 Texas Governor Rick Perry sent a request to the EPA for a 50 percent waiver of the renewable fuels

mandate because, he said, it was harming his state's livestock industries and raising food prices. Texas has long been the country's leading beef producer, and a major poultry and dairy producer, all of which rely heavily on corn feed. The governor's application was supported by a wide range of food and livestock industry groups.[30] The EPA rejected Governor Perry's request, explaining that it had the authority to waive or reduce the mandate only if states were found to be "severely economically harmed" by the RFS. From the EPA's perspective, the onus was on the state to demonstrate that among all the potential factors influencing the economy, it was solely the RFS that had caused severe harm. The Texas policy makers argued that the effect of the RFS could never be completely isolated because there were always multiple factors affecting the price of corn feed (Powers 2009). Yet the EPA maintained that it was not enough to show that the mandate had contributed to economic harm; the state must show that the mandate itself had been the direct cause of the harm (EPA 2008). In their analysis, the EPA published modeled estimates of the savings to Texas livestock industries if the waiver were granted. The results ranged from a low-end estimate of 53 million dollars to a mid-range estimate of 207 million, to a "worst case scenario" figure of 919 million dollars (which the EPA considered "highly unlikely") (EPA 2008). The agency concluded that:

> Compared to Texas's $1 trillion dollar economy, these impacts appear to be relatively small. Even looking at the cattle and poultry industry in Texas specifically, we believe $53–$207 million is a small impact compared to the over $10 billion livestock industry (EPA 2008).

The EPA's interpretation of the law was that even if estimates showed increased costs in the order of tens or even hundreds of millions of dollars, the waiver must be denied because the costs constituted a small percentage of the state's entire economy or livestock industry. The operative

[30]Including the National Cattleman's Beef Association, National Chicken Council, Campbell Soup Company, Tyson Foods, American Meat Institute, National Turkey Federation, American Bakers' Association, Dean Foods, National Pork Producers Council, Grocery Manufacturers Association, Hispanic Institute, American Beverage Association, National Restaurant Association, American Conservative Union, Kraft Foods and Pepsi Co.

word is "relatively" – the EPA did not quantify how much of a state's livestock sector or overall economy must be damaged to be considered "severe." Given this rationale, it was difficult to see how any state would demonstrate sufficient grounds for "severe economic harm," short of the entire collapse of its livestock industry (Powers 2009). Rejecting the Texas request sent an assurance to the ethanol industry that production would not be impeded by waivers, and clearly came as a relief to ethanol lobbyists. The Renewable Fuels Association had written to the EPA emphasizing the strict and limited statutory requirements for granting a waiver. RFA President Bob Dinneen then triumphantly asserted that:

> The complete failure of Governor Perry's request to meet the explicit criteria of a waiver lays bare the true motivation behind the Governor's action, which has more to do with protecting the profits of integrated oil and livestock companies than with the economic well-being of Texans and Americans around the country (RFA 2008).

The Texas case was significant because it set the standard by which subsequent cases were to be judged. In 2012 the governors of Arkansas and North Carolina requested RFS waivers. Both governors argued that the RFS had caused shortages of grain, which severely affected their states' livestock industries, including cattle, dairy, poultry, and swine. They added that widespread drought had exacerbated the problem by further driving up the cost of grain. The EPA responded by noting that it had collaborated with the departments of agriculture and energy to conduct analyses of the impacts of granting a waiver, and had found little evidence that a waiver would reduce corn, food, or fuel prices. The EPA denied the waivers.

6.5 The Searchinger Study

The neo-Malthusian notion that food and biofuels competed for limited cropland gained a significant boost in scientific authority with the publication of two articles in *Science* on

February 7, 2008.[31] In response to the publications, National Public Radio aired a feature entitled "Ethanol Worse for Climate than Gasoline" (Harris 2008), and the following day "Environmentalists Debate the Promise of Biofuels" (NPR 2008). Also on 8 February, NBC Nightly News filed a report entitled "Biofuels More Polluting than Gas," *The Washington Post* published "Studies Say Clearing Land for Biofuels Will Aid Warming" (Eilperin 2008), and *The New York Times* printed "Studies Call Biofuels a Greenhouse Threat" (Rosenthal 2008).

The studies, led by professors and environmentalists Timothy Searchinger, at Princeton University, and Joseph Fargione, at the University of Minnesota, sought to quantify the greenhouse gas emissions associated with the main types of biofuels.[32] Fargione et al. (2008) dealt only with clearing land specifically to grow biofuels. They found that when grassland or Conservation Reserve Program (CRP) land was converted to corn for ethanol production, a large "carbon debt" was incurred from the release of CO_2 from the soil and cleared vegetation. They estimated that it would take 48 years to achieve GHG neutrality on former CRP land, and 93 years on grassland in the central U.S. (Fargione et al. 2008).

Searchinger et al. (2008, hereafter the 'Searchinger study') addressed the question of *indirect* land use change (ILUC). Hitherto, scientists had only begun to consider the direct ecological effects of using land to grow biofuel crops (e.g., Fargione et al. 2008). Likewise, Searchinger and his colleagues posited that since biofuel production was land-intensive, it competed with other uses for productive agricultural land, such as for food, animal feed, and fiber production. They extended this logic to the global scale, and argued that the expansion of land used to produce biofuels could induce – via market forces – the conversion of land use

[31]The early release was published in *Science Express* on February 7, then in *Science* on February 29.
[32]Timothy Searchinger was a lawyer at Environmental Defense Fund for 17 years, and then joined the World Resources Institute. Joseph Fargione worked for The Nature Conservancy.

elsewhere on the planet. They claimed that induced, or indirect, land use change (ILUC) could have grave consequences for the life-cycle accounting of biofuels, since large quantities of greenhouse gases could be emitted in the process of land conversion. The Searchinger study found that, to meet the 15 billion gallon RFS2 ethanol mandate, 12.6 million hectares of U.S. land would be needed to grow corn, and that exports of corn, wheat, soybeans, pork, and chicken would decline sharply. They used a computer model of global emissions and energy use to estimate that these market changes would induce the conversion of 10.8 million hectares of additional cropland worldwide, including 2.8 million hectares in Brazil and 2.3 million hectares in China and India. The Searchinger team calculated that the conversion of forest, savannah, or grassland in these regions would have a much greater effect on GHG emissions than any savings obtained by using biofuels instead of gasoline for fuel. Accounting for the estimated emissions from such land use changes, they estimated that it would take 167 years before corn ethanol achieved a net reduction in GHG emissions, and concluded that with a rising global population and an increase in per capita meat consumption, competition for limited land would only intensify (Searchinger et al. 2008). They underscored the importance of switching to non-food biofuel feedstocks including municipal waste and algae, as well as crops that could be grown on "unproductive" land. These conclusions were direct and ominous for corn ethanol. If it took a century or more to balance GHG emissions, support for corn ethanol made no sense as a GHG mitigation policy.

Belying its conceptual appeal, measuring indirect land use effects of any agricultural activity was exceedingly complicated. While land use change could be directly observed, its *indirect* causes could not; they must be inferred from models. The Searchinger study employed a global-scale partial equilibrium model known as Greenhouse Gases, Regulated Emissions, and

Energy Use in Transportation (GREET), developed by Argonne National Laboratory, within the Department of Energy's Office of Energy Efficiency and Renewable Energy. Partial equilibrium models consider only one sector of the economy (in the Searchinger study it was the agricultural sector), in contrast to general equilibrium models, which model the entire economy. GREET was one of only a handful of computer models capable of modeling ILUC. Others include the model developed by the Iowa State University's Food and Agriculture Policy Research Institute (FAPRI), Iowa State University's Center for Agricultural and Rural Development model (FAPRI-CARD), Texas A&M University's Forest and Agricultural Sector Optimization Model (FASOM), and Purdue University's Global Trade Analysis Project (GTAP) model. It is noteworthy that none of these models was originally developed to quantify both U.S. and global direct and indirect GHG emissions resulting from biofuel production. For example, FASOM was developed to model domestic agriculture and forestry sectors. FAPRI was designed to model U.S. and global commodity markets. Unlike the other models, GTAP was a general equilibrium model, and therefore had the advantage of comprehensiveness, but lacked the same level of detail as the partial equilibrium models.

A disconcerting feature of life-cycle analysis and ILUC modeling is their sensitivity to a range of parameters about which great uncertainty persisted and for which empirical evidence was scarce (Wicke et al. 2012). For one thing, all of the above models assume economic equilibrium rather than market flux – a questionable supposition given the rapid onset of events that precipitated the food crisis. Some of the 'default' estimates of GHG emissions from agricultural production were gleaned from FAO and IPCC data, while land use change emissions factors were sourced from Winrock International, Woods Hole Research Institute, and Colorado State University's DAYCENT model. Long term price elasticity was also a matter of

uncertainty. Wicke et al. (2012) note that the elasticity between land use for farming and food production varied substantially between crops and over time, yet the Searchinger study and Hertel et al. (2010) used a single global elasticity average for all crops.

Another sensitive but uncertain factor was time (O'Hare 2009). Most analysts agreed that if native vegetation is cleared, there is an initial burst of GHG emissions related to the clearing or burning and soil carbon loss, followed by a gradual reduction of GHG emissions if a sequestering biofuel crop is grown. A lengthy time horizon was thus critical to account for the flow of emissions between the atmosphere and the terrestrial ecosystem. The Searchinger study used two time scales for its analysis – 100 years, with a two percent discount rate on GHG emissions, and 30 years, with no discount rate. These two scales produced very different results. The choice of time parameters, however, was empirically weak, as Searchinger (2012) admitted. O'Hare et al. (2009) argued that the Searchinger team was wrong to simply add up the emissions over the chosen time period and to apply a discount rate. Had the Searchinger study accounted properly for the initial surge of GHG emissions, estimates of corn ethanol ILUC emissions would have been even worse (O'Hare et al. 2009). Serious problems with the 100 year time horizon included the increasing fuzziness of estimates the further out they were projected, the likelihood that crop production technologies would change, and the uncertainty over how the land would be used over the entire century. The EPA focused on the year 2022 since that was the regulatory horizon of the revised renewable fuel standard. It assumed that cellulosic ethanol would be commercialized, and estimated ILUC based on essentially hypothetical production and sequestration estimates.

The Searchinger study assumed an integrated world market for agricultural commodities, and found that land use conversion would occur primarily in Brazil (26 percent of the total land

use change), the U.S. (21 percent), China (10 percent), and India (11 percent) (Villoria and Hertel 2009). Villoria and Hertel (2009) challenged this assumption, noting that the global trade of coarse grains (dominated by corn but also including oats, barley, rye, and sorghum) tended to follow historically established trade patterns. Assuming instead that coarse grains were differentiated by place of origin, were traded as differentiated commodities, and were not effortlessly substituted, Keeney and Hertel (2009) arrived at a distinctly different geographic distribution of land use change, with 56 percent occurring in the U.S. and only four percent in Brazil, six percent in China, and almost none in India. The implications were that state and bilateral trade policies were key factors in ILUC.

Aside from the operation of the models themselves, the findings of the Searchinger study generated a great deal of debate among scientists concerned with life-cycle analysis, induced land use change, and climate change (Marshall et al. 2011). Michael Wang, a scientist at Argonne National Laboratory, had developed the GREET model that Searchinger's team used. He and his colleague, Zia Haq, cautioned that the information required to equip ILUC models was inadequate, so predictions of ILUC from biofuel production would be "speculative" and "may lead to misguided biofuel policy" (Wang and Haq 2008). Searchinger countered that despite the challenges of modeling ILUC, any calculation that did *not* attempt to address ILUC would be "too incomplete to provide a basis for policy decisions" (Searchinger 2008b). Keith Kline and Kevin Dale, researchers at Oak Ridge National Laboratory, asserted that biofuel ILUC estimates were undermined by two key conditions. First, land use change was influenced by an interconnected set of factors – cultural, technological, biophysical, political, economic, and demographic – not just by crop prices (Kline and Dale 2008). Second, biofuel crops offered a stable source of income and employment, thereby reducing the use of fire to clear land. Fire was

a far greater source of GHG emissions than direct land clearing for biofuels, so its reduction could lead to a substantial reduction in GHG emissions (Kline and Dale 2008). Searchinger reiterated that among all the factors listed by Kline and Dale, economic drivers were the most important (Searchinger 2008c). While he agreed that fire was a factor, Searchinger pointed out that the vast majority of burned areas in the tropics were on annual grassland, which grew back every year and thus were essentially GHG emissions neutral. Forest clearing, on the other hand, whether by burning or logging or both, produced large GHG emissions.

Other researchers seemed intent on personally undermining Searchinger's credibility. Bruce E. Dale, a researcher at the DOE's Great Lakes Bioenergy Research Center at Michigan State University, opined that:

> As usual, Mr. Searchinger does not compare the imagined problems of biofuel production with the very real problems with continuing our oil dependence. Oil and energy prices are much more responsible for increased food prices than anything else. We are not going to make progress in dealing with our energy problems until we make reasonable and realistic comparisons between oil alternatives and the costly status quo of continuing oil dependence (Growth Energy 2011).

Dale and his colleague Seungdo Kim explained in several studies that crop management practices, including nitrogen fertilizer application levels, greatly influenced GHG emissions from agricultural land (Kim and Dale 2008). They estimated that improved cropping practices, such as no-tillage and no till plus winter cover crops reduced the duration of the GHG debt from decades to just three years if the land use change was from grassland to biofuel crops, and to just 14 years in the case of forest conversion (Kim et al. 2009). In a similar vein, Gibbs et al. (2008) calculated that clearing productive tropical ecosystems for biofuels would incur a greenhouse gas payback period of decades to centuries, while growing biofuels on degraded or already-cleared land would provide almost immediate carbon savings (Gibbs et al. 2008). The authors noted that

other factors could influence the LCA of biofuels, including technologies that improve crop yields, and the possibility that in the future biofuel LCA may compare more favorably with gasoline from unconventional sources such as tar sands. Other studies broadly corroborated the notion that ILUC was a major factor influencing the life cycle GHG emissions of biofuels (Lapola et al. 2010; Plevin et al. 2010). In 2010 a team led by Thomas Hertel, Executive Director of Purdue University's Center for Global Trade Analysis, used the GTAP model to conduct a "new, comprehensive analysis of market-mediated changes in global land use in response to the expansion of U.S.-grown maize [corn] for ethanol" (Hertel et al. 2010). Hertel's team found that biofuel-induced land use change was approximately 40 percent of the values Searchinger's team reported, and GHG emissions only 25 percent, but acknowledged that even these smaller values were a serious impediment to using corn ethanol to mitigate GHG emissions.

These studies underscore the fact that ILUC had become a focus of scientific inquiry and debate. Differences of opinion centered on the magnitude of land use change attributable to biofuels and the measurability of this phenomenon, rather than whether or not biofuels in fact induced land use effects. Even ethanol lobbyists (as discussed below) rarely challenged the plausibility of induced land use change, and instead highlighted the inadequacy of the science of measuring ILUC. Whatever its flaws, the Searchinger study led a discursive shift in the environmental assessment of biofuels – one in which biofuel performance was linked to land use and climate change.

Before the study was published, likely few outside of academic circles had heard of Timothy Searchinger or his and his colleagues' work. The Searchinger study sparked media attention that associated Searchinger's name and his research with ILUC and the hitherto

unmeasured costs of biofuel production. Searchinger described himself as a specialist in agriculture and land use, and in the challenge of sustainably feeding a growing world population without destroying native vegetation or exacerbating global climate change (Bryce 2008b). In interviews and articles in the mainstream press, as well as in scientific journals, Searchinger's focus turned toward the policy implications of biofuel-induced land use change. In July 2008, the British government commissioned a review of national biofuel policy, the centerpiece of which was the Renewable Transport Fuel Obligation, led by the chair of the British Renewable Fuels Agency, Ed Gallagher. The 'Gallagher Review' directly cited the Searchinger study as a reason for its reconsideration of biofuel policy:

> there is growing concern about the role of biofuels in rising food prices, accelerating deforestation and doubts about the climate benefits. This has led to serious questions about their sustainability and extensive campaigns against higher targets. Concern was further raised among policy makers when the paper by Searchinger asserted that U.S. biofuels production on agricultural land displaced existing agricultural production, causing land-use change leading to increased net greenhouse gas (GHG) emissions (Renewable Fuels Agency 2008).

Searchinger et al. (2009) and Khosla and Searchinger (2009) reiterated that GHG emissions accounting should include those related to ILUC resulting from the production of biofuel crops.

When global food prices rose again in early 2011, biofuels came under renewed scrutiny and Timothy Searchinger continued his attack on food-based biofuel crops (2011a and 2011b). He said that since 2004, for every additional ton of food grain produced, an equal measure had been used for biofuels (Searchinger 2011a). He argued that none of the other explanations of the food crises – from droughts in Australia and Russia, to rising food consumption in China and India – were convincing. Only biofuels had risen so quickly in such a short period of time as to disrupt markets so forcefully. To prevent exacerbating hunger, Searchinger suggested that

governments alter their policies to halt the expansion of biofuels and to encourage a switch to advanced biofuels from crop residues or marginal land which do not compete with food crops. Within weeks, *TIME* (Walsh 2011) and *The New York Times* (Rosenthal 2011) ran stories citing Searchinger and pointing to biofuels as one of the primary causes of the new rise in food prices.

6.6 The EPA's New Biofuel Regulations

The implications of the biofuel-climate change discourse extended into the realm of policy concerning climate change accounting and global food prices, yet the uncertainty in life-cycle measurements presented a thorny issue for policy makers. If ILUC estimates had been inconsequential, policy makers may have felt justified in omitting them from LCA calculations. As it was, LCA seemed to be a scientifically rigorous process at first glance, demanding cutting-edge satellite imagery and computer modeling, yet arrived at results that appeared unsatisfactorily speculative and sensitive to assumptions about factors which could only be estimated or generalized across vast geographic areas. Too little was known about how biofuels affected global land use to trust that the analyst was accurately tallying the positives and negatives. The apparently large magnitude of ILUC combined with the high degree of uncertainty regarding total effects created a degree of political disquiet as policy makers were confronted with the notion that 'renewable fuels,' such as corn ethanol, were not environmentally sustainable and did not reduce GHG emissions.

The EPA was now in the position of needing to come up with regulations that explicitly included life-cycle analyses of GHG emissions associated with each type of biofuel, including those related to ILUC. The EPA could not simply reject ILUC calculations, because the

available estimates indicated that changes were significant, and because 2007 energy act defined life-cycle GHG emissions to include them:

> The term 'life-cycle greenhouse gas emissions' means the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes), as determined by the Administrator, related to the full fuel life-cycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential (Clean Air Act 1970).

In fact, the scientific literature (at the forefront of which was the Searchinger study) suggested that biofuel ILUC was so significant that it could make all the difference between meeting and not meeting the GHG reduction requirements established in EISA (GAO 2009).

In a landmark case in 2007, the Supreme Court ruled that the Clean Air Act of 1970 (CAA) required the EPA to determine if greenhouse gases should be regulated in the same fashion as other regulated forms of pollution, such as lead or SO_2.[33] In response, the EPA concluded that GHGs were indeed air pollutants subject to the regulations of the CAA, and set about writing rules for regulating them. The EPA's legal authority to regulate GHG emissions was politically significant because it gave the Obama administration leverage in its efforts to get Congress to pass climate change legislation (discussed below; Lizza 2010).

Congress had required the EPA to finalize the RFS2 regulations within a year of the signing of the EISA (i.e., by 19 December 2008), but the agency missed the deadline, reportedly due to the complexities of the rulemaking and the volume of comments they received (EPA 2010). On 5 May 2009, the same day that President Obama announced major new funding for advanced biofuels, the EPA issued a Notice of Proposed Rulemaking, which acknowledged that

[33]In Massachusetts vs EPA 549 U.S. 497.

indirect effects were indeed a major contributor to corn ethanol life cycle greenhouse gas emissions (EPA 2009). It is evident from this document that the agency had taken the Searchinger study as its cue for regulating ILUC. The EPA rejected the notion that ILUC calculations were overly simplistic or should be shelved until the accuracy of measuring them was improved. The agency agreed with the notion that the initial conversion of land for biofuel production was a potentially major source of GHG emissions, which would be gradually 'repaid' so long as continued biofuel production achieved net emissions reductions (EPA 2009), just as the Searchinger and Fargione studies had suggested. The EPA even adopted the same time horizons and emissions discount rates for assessing biofuel life-cycle analysis as the Searchinger study: 100 years with emissions amortized at two percent per year, and 30 years with no discount rate.

The EPA found, unsurprisingly, that the emissions performance of ethanol plants powered by coal was much worse than those powered by natural gas or biomass (some facilities burn woody material for heat or power or both). According to EPA calculations, an ethanol refinery powered by coal would result in an overall *increase* in emissions of 34 percent after 30 years and 13 percent after 100 years of operation, while a natural gas-powered plant would produce an emissions increase of five percent after 30 years and achieve a 16 percent reduction after 100 years (EPA 2009b). Only biomass-powered ethanol plants had a chance of achieving the required 20 percent emissions reduction target, but not in 30 years: the percentage reductions at 30 and 100 years were 18 and 39 percent, respectively (EPA 2009b). For the 96 percent of all U.S. ethanol refineries that were powered by coal or natural gas, GHG emissions reductions were not sufficient to qualify the ethanol as an EISA-endorsed renewable fuel, and no U.S. ethanol

plant would achieve 20 percent emission reductions within the policy framework extending to 2022 (EPA 2009b).

The EPA findings clearly were not what corn ethanol producers had expected, and sparked a new struggle for discursive and political control over biofuel regulations. Biofuel industry supporters urged the EPA not to include ILUC in its calculations, arguing that the science of measuring indirect emissions was too immature and speculative to be used as the legal basis for deciding on the future of biofuel subsidies. A dozen Midwestern Senators wrote to EPA Administrator Lisa Jackson, urging the agency not to include ILUC in its calculations. The Governors' Biofuel Coalition, led by North Dakota Governor John Hoeven, urged the Obama Administration to set up an interagency panel, including the EPA, USDA, and DOE, to resolve questions concerning the life-cycle analysis of biofuels (German 2009). In contrast, environmental groups encouraged the EPA to press forward with their proposed calculations of ILUC (Lewis et al. 2008; Greene 2009).

Between the time of the EPA's proposal and its final rulemaking on February 3, 2010, the EPA made significant changes to their assessment of corn ethanol's emissions. The agency explicitly rejected the possibility of assessing the emissions from individual refineries. Such a move meant that the EPA rejected scientific evidence from researchers including Wang et al. (2007) and Liska et al. (2009), showing substantial differences in life-cycle emissions by biofuel producers in different parts of the U.S. Instead, the EPA based assessments of emissions reductions on specified pathways. In the Fact Sheet accompanying the final rule, the EPA found that:

> Ethanol produced from corn starch at a new natural gas, biomass, or biogas fired facility (or expanded capacity from such a facility) using advanced efficient technologies (ones that we expect will be most typical

> of new production facilities) will meet the 20% GHG emission reduction threshold compared to the 2005 gasoline baseline (EPA 2010).

Similarly, ethanol from sugarcane was found to comply with the 50 percent reduction threshold for advanced biofuels, and cellulosic ethanol pathways that were modeled by the EPA were found to meet the 60 percent GHG reduction threshold. The agency explained that their new conclusions were driven by improved analyses of ILUC which showed that crop yields would improve more quickly as a result of higher prices, that distillers' grains were a more efficient feed source than previously estimated, and that international pasture expansion would come more from grassland and less from forest than previously estimated. In the Final Rulemaking published in March, 2010, the EPA elaborated on how the conclusion that ethanol plants deploying "advanced efficient technologies" achieved a 20 percent emissions reduction was reached. The EPA based its assessment on an idealized hypothetical 2022 ethanol plant. Emissions from 33 types of corn ethanol facilities were evaluated, based on a range of factors such as whether the facility was powered by coal, natural gas, or biomass; whether it deployed 'combined heat and power' technology (an energy-saving process); whether a dry milling or wet milling process was used;[34] whether distillers' grains (a byproduct) were dried or wet; and whether fractionation[35] was used or not. Under optimal conditions, the EPA estimated that an ethanol plant would produce 21 percent fewer emissions than the baseline – it would achieve the statutory requirements by a single percentage point (EPA 2010, 14786). The EPA found similarly favorable results from their analyses of sugarcane ethanol and cellulosic ethanol (made

[34]In 'dry milling', the first step is to grind dry corn kernels into flour, whereas in 'wet milling,' the whole kernels are first soaked in water and acid to facilitate the separation of their constituents – corn germ, gluten, starch, and fiber. These components are made in to a variety of products including ethanol, high fructose corn syrup, corn oil, corn starch, dextrose, and wet feed.

[35]Fractionation is an additional step taken to boost ethanol production efficiency by mechanically separating corn kernels into their components.

from switchgrass): Brazilian sugarcane ethanol achieved a midpoint reduction of 61 percent, well above the required 50 percent, and emissions reductions from cellulosic ethanol easily achieved the required 60 percent reduction (the midpoint was found to be 110 percent).

The EPA then adopted a series of regulatory measures designed more to allow the ethanol industry to continue unimpeded than to assure the public that GHG emissions would be curtailed. First, all refineries operating by the time the EISA was signed on 19 December 2007, were 'grandfathered in' – exempt – from the 20 percent emissions requirement. Thus even though the EPA acknowledged that coal-fired ethanol plants would not achieve the 20 percent reductions, existing coal-fired ethanol refineries could continue to produce 'renewable fuels.' Second, any refinery that began construction in 2008 or 2009 and used natural gas or biomass to power the facility was automatically deemed to be in compliance with the 20 percent threshold. Third, the EPA reserved the authority to reduce the 20 percent requirement to 10 percent at its discretion.

The EPA ignored all but the lowest-emissions type of ethanol plant– a dry mill natural gas powered refinery producing 63 percent dry and 37 percent wet distillers' grains. Life-cycle emissions for all types of corn ethanol refineries had been calculated at three points in time: 2012, 2017, and 2022. Critics pointed out that the EPA was careful not to publicize its findings that no corn ethanol plant achieved 20 percent emissions savings in 2012, and only some in 2017 (Plevin 2010; McMahon and Witting 2011). The best emissions savings were found in 2022, and this was the only year considered in the EPA's final analysis. Richard Plevin, biofuels researcher in the Energy and Resources Group at the University of California, Berkeley, said the logic of projecting all ethanol emissions and reductions to a single point in time twelve years in the future, instead of analyzing them in the present, was "unconvincing" and analogous to the

EPA allowing a coal-powered electricity plant to emit GHGs for the next twelve years, based on a possibility that it would reduce emissions in 2022 (Plevin 2010).

The agency's new findings drew criticism from scientists and environmentalists, who challenged what they saw as manipulated data to achieve emissions compliance. Rather than use *hypothetical* 2022 data, Friends of the Earth conducted its own analysis using EPA emissions data on *existing* ethanol facilities, 156 of which used primarily natural gas (some combined natural gas and biomass) and 17 of which used coal (McMahon and Witting 2011). They concluded that corn ethanol plants would likely never achieve a 20 percent emissions reduction (McMahon and Witting 2011). The Clean Air Task Force (CATF) pointed out that corn ethanol production was likely to reach its EISA-mandated maximum of 15 billion gallons per year by 2015, not by 2022, and therefore that it was more accurate to calculate the 30-year discount period from 2015 to 2044, not from 2022 to 2051 as the EPA had done. Using EPA emissions data, and adjusting the time period, the CATF calculated that corn ethanol emissions would be *28 percent higher* than the baseline emissions from gasoline (Brick and Lewis 2013). By contrast, the Renewable Fuels Association said that the new rules were "workable," but that it was "problematic" that the EPA continued "to rely on oft-challenged and unproven theories such as international indirect land use change to penalize U.S. biofuels to the advantage of imported ethanol and petroleum" (RFA 2010). Other biofuel advocates, including Growth Energy, Clean Energy Renewable Fuels, DuPont, the National Corn Growers Association, the National Biodiesel Board, and the National Alliance of Forest Owners, voiced their support for the RFS2, and argued either that ILUC imposed an unjust penalty on the industry, or that ILUC could not adequately be quantified, or that the magnitude of ILUC had been overestimated.

Given the EPA's regulatory record, it is difficult not to be suspicious of political bias in the agency's about-turn in findings on the life-cycle emissions of biofuels. After all, in the 1990s the EPA had repeatedly reversed its proposed or actual regulations on ethanol oxygenate as a "clean fuel." The agency's final ruling highlighted incongruous aspects of their analysis. On one hand, it acknowledged that LCA, and especially ILUC, calculations presented a high degree of uncertainty, as scientific knowledge in this area was far from certain (EPA 2010, 14765). Here the EPA seemed to concur with scientific consensus, since ILUC measurement was still a matter of intense debate (Liska 2010; Melillo et al. 2009; Plevin et al. 2010). This uncertainty was reflected in the EPA's acknowledgement that ILUC was the only source of emissions with a range of values, and that the range contributed as much as half of all biofuel emissions. At the same time, however, the EPA placed enormous importance on their conclusion that corn ethanol LCA showed a one percent clearance over the 20 percent threshold, based not on existing ethanol production but on a hypothetical best-case scenario twelve years in the future. While the EPA acknowledged that their ruling would need to be updated as new information came to light, the agency appeared to foreclose the possibility that GHG emissions regulations would adversely impact the biofuel industry. The agency's ruling was essentially irreversible since their approval signaled to the ethanol industry that refinery construction and expansion, representing millions of dollars in investment, could proceed unabated (Farber 2011). Not for the first time, the EPA appeared to have undergone a remarkable, scientifically dubious, turnaround in its assessment of the GHG emissions associated with biofuels. While scientific findings are conventionally couched in cautionary and probabilistic terms, the EPA moved ahead with corn ethanol on the basis of a single percentage point clearance above the regulatory threshold based on a hypothetical best case scenario, and then buttressed their ruling by grandfathering in existing

high-emissions coal-powered ethanol plants, which by its own calculations were emissions non-compliant. Additionally, EPA data confirmed that sugarcane ethanol was far more energy efficient and far less emissions-intensive than corn ethanol. On environmental grounds then, it is unclear why the EPA did not recommend the use of sugarcane ethanol instead of corn ethanol.

Aside from the EPA's questionable use of data to support the emissions-reductions benefits of biofuels, there were remarkable discrepancies in how and where advanced biofuels were supposed to be produced to meet the RFS2 mandate. Among the three leading government branches charged with implementing biofuel policies – DOE, EPA, and USDA – the only consistent prediction was, not surprisingly, that corn ethanol would likely reach the 15 billion gallon mandate for conventional biofuel (Keeler et al. 2013). For advanced biofuels, the EPA predicted the largest contribution to come from perennial grasses such as switchgrass, the USDA expected the largest supply to come from annual energy crops such as sweet sorghum, and the DOE anticipated the largest contribution from forest and crop residues. The EPA anticipated a large contribution from municipal waste and imported biofuel, whereas the DOE and USDA predicted no contribution from these sources. In terms of acreage and spatial extent, the USDA predicted that over 55 million acres of land, primarily in the Midwest, would provide corn stover (the residual stalks, leaves, husks, and cobs of corn plants after the kernels have been harvested), whereas the DOE and EPA anticipated only about 30 million acres for corn stover. Complicating the issue of cellulosic ethanol from corn stover, research by Liska et al. (2014) suggest that the removal of crop residues from Midwestern corn fields to produce cellulosic ethanol reduces soil carbon and increases GHG emissions. Unlike the other two government branches, the EPA predicted no corn stover harvest from Minnesota or Wisconsin. The DOE's projections of perennial grass production included over one million acres each from Kansas,

Oklahoma, and Texas. The EPA's projection of perennial grass production was geographically broader, including over one million acres from Kansas, Oklahoma, Texas, Arkansas, and Missouri. The USDA's projection of perennial grass production spread further north and east, including over one million acres from Kansas, Missouri, Kentucky, Iowa, and North Dakota (Keeler et al. 2013). In terms of land use change, the three government branches also differed in their projections of how much land would remain enrolled in the Conservation Reserve Program (CRP). The USDA expected 9.5 million acres of CRP land to be displaced by perennial biofuel crops, the EPA predicted that 5.3 million CRP acres would be converted to cropland, and the DOE did not allow for any CRP acreage reduction (Keeler et al. 2013). Overall, the acreage needed to meet the RFS2 mandate was estimated by the EPA to increase U.S. cropland by 8.1 million acres, while the USDA predicted that 27 million acres of cropland would be needed, and the DOE estimated that 47 million acres of cropland and 9 million acres of perennial grasses and woody crops would be used (Keeler et al. 2013). These wide discrepancies reinforced the notion that advanced biofuels remained an experimental and undeveloped commercial enterprise.

6.7 Biofuels on the Defensive

Since 2007, potentially disastrous allegations had been aimed at biofuels. The industry had been accused of inducing tropical rainforest and grassland destruction, jacking up global food prices, and starving the poor. There was also a growing body of research critical of corn ethanol's effects on regional water use (NRC 2008; Dominguez-Faus et al. 2009), water quality (Donner and Kucharik 2008; Thomas et al. 2009), soil conservation (Piñeiro et al. 2009), air quality (Crutzen et al. 2008; Hill et al. 2009), and wildlife habitat (Groom et al. 2008) in the U.S.

Biofuel industry promoters naturally did not accept these claims without offering counter arguments of their own. These took several forms. Lobbyists refuted the connection between biofuel production and food prices, pointing to other factors which they claimed more greatly influenced food costs, such as the high price of oil and market speculation (e.g., RFA 2011). They pointed out that biofuels constituted a minute proportion of global farmland, and that a valuable co-product of corn ethanol production was distillers' grains, which could be fed to livestock, partially offsetting high feed costs for livestock owners. Major corporations including ADM, Du Pont, John Deere, and Monsanto, as well as the RFA, formed a new lobby group called Alliance for Abundant Food and Energy (Cameron 2008) to counter the food versus fuel narrative. Coverage of the debate over "food vs fuel" deserves closer attention because it featured an exchange between biofuel critics and one of its chief proponents, former South Dakota Senator Tom Daschle. The clash of ideas between Daschle and professors of applied economics C. Ford Runge, Director of the Center for International Food and Agricultural Policy at the University of Minnesota, and Benjamin Senauer, Co-director of the Food Industry Center at the University of Minnesota, received widespread coverage in the mainstream American press (Thompson 2012). In the May/June 2007 edition of *Foreign Affairs*, Runge and Senauer argued that government policies gave rise to the massive expansion of the U.S. ethanol industry, which drove up global food prices to levels beyond reach of the poor. One statement, in particular, seemed to capture the essence of their argument. The authors claimed that filling a 25 gallon Sports Utility Vehicle (SUV) tank with pure ethanol would require approximately 450 pounds of corn, enough to feed a person for a year (Runge and Senauer 2007). This widely quoted calculation originated with Lester Brown, environmental activist and founder of the Earth Policy Institute (Brown 2006).

Former Senator Daschle responded in *Foreign Affairs'* September/October issue. He argued that 'food versus fuel' was a myth that had been rebutted repeatedly (Daschle 2007). Rising corn prices, he said, do not contribute much to rising food costs because only five percent of the U.S. corn crop goes directly to human consumption. Most of the remaining 95 percent was used to feed livestock. Also, ruminants such as cattle got more nutritional value out of distillers' grains than out of other feed. The recent rise in corn prices was a short-term effect, but in the long term markets adjust by encouraging farmers to plant more corn. Induced by higher prices, corn productivity would also be improved. In the future, thanks in part to forward looking Congressional policies, feedstocks other than corn would become more important. This was already evident in the expansion of *jatropha*, a non-food plant that grows on marginal soil that is used to produce biodiesel in parts of Africa, India, and the Caribbean. It is innovations such as jatropha and cellulosic biofuels, Daschle argued, that will help reduce our carbon footprint and confront the energy and climate crises.

Runge and Senauer disagreed with Daschle on four key points. First, they said, while most corn is used as feed, people consume "chicken, eggs, pork, steak; drink milk; and consume foods containing cornmeal, corn oil, and corn sweeteners" (Runge and Senauer 2007). When more land is used to grow corn, less land is available for a whole suite of other crops, from alfalfa to green beans. Thus a rise in corn prices has market-based effects across the food sector. Second, most of the world's poor were either subsistence farmers or urban slum dwellers, both of whom are harmed, not helped, by rising global food prices. Third, even if the entire U.S. corn crop were devoted to ethanol, it "would meet only 12-15 percent of the country's transportation fuel needs." Finally, Runge and Senauer argued, the notion that corn ethanol would provide a stepping stone to cellulosic biofuels was spurious. After three decades of devoted lobbying to

lawmakers such as Senator Daschle, why would the corn ethanol industry simply step aside? Moreover, which farmers were going to start planting cellulosic crops when corn prices are at record highs? If the development of advanced biofuels really is a priority, then removing policies that favor corn ethanol would be a step in the right direction. Corn ethanol subsidies, they concluded, was a "textbook example" of agricultural lobbyists gaining special favors in Congress (Runge and Senauer, 2007). This exchange encapsulated the complexity and rancor of the 'food versus fuel' debate. The complex integration of so many factors that affect food prices, including energy costs, competing land uses, market speculation, consumer preferences, weather, and trade policies, make the task of delineating the effect of any one of these difficult.

Ethanol lobbyists also sought to discredit the findings of the Searchinger study. RFA president Bob Dinneen responded to Searchinger's *Washington Post* op-ed with arguments similar to Daschle's earlier comments in *Foreign Affairs*:

> The production of ethanol in the United States uses just 3 percent of the world's grain supply on a net basis and none of staples such as wheat and rice. In 2010, world supplies of grain were off from record volumes by less than 1 percent. Moreover, the demand created by U.S. ethanol production has been the catalyst for more productive farming practices. ...Most studies of 2008 food price increases demonstrated far greater impact by high oil prices and hedge fund speculators than by ethanol. …Chicken Little scenarios propagated by Mr. Searchinger and others do nothing to address issues of food supply, world hunger or America's unsustainable reliance on imported oil (Dinneen 2009).

RFA spokespeople sought to undermine Searchinger's legitimacy, accusing him of being "disingenuous" and far from an expert on biofuels (Hartwig 2011). Growth Energy, a biofuel lobby and trade group formed in 2008 by America's largest ethanol producer, POET, released a statement on its website describing Searchinger's article as an "intellectually-bankrupt attack on

farmers and renewable, clean-burning biofuels" (Growth Energy 2011).[36] Growth Energy CEO Tom Buis complained that a "well-funded and highly orchestrated campaign of misinformation" was fabricating the link between food prices and biofuels (Walsh 2011). Seeming not to understand Searchinger's point regarding market-induced land use change, Buis pointed out that ethanol uses "No. 2 yellow corn," not the grade used for human consumption (indeed, the vast majority of U.S. corn production is feed-grade, not food-grade).

Former House Speaker Newt Gingrich was paid by Growth Energy to promote ethanol, and was the keynote speaker at the Iowa Renewable Fuels Association Summit in Des Moines in 2011. He used the occasion to attack a *Wall Street Journal* article blaming corn ethanol for rising food prices, noting that "Obviously big urban newspapers want to kill [ethanol policies] because it's working, and you wonder, 'What are their values?'" (*Biofuel Digest* 2011). The *Wall Street Journal* (2011) shot back that Gingrich was "pandering" to Iowa voters in the upcoming presidential election. In fact, Growth Energy formed after a split in the Renewable Fuels Association, the group that had hitherto led promotion of renewable fuels. As a major ethanol producer, ADM had long dominated the RFA. However, ADM also produced high fructose corn syrup (used in a myriad of food products) and was a member of the Grocery Manufacturers' Association (GMA), which opposed corn ethanol's expansion on the grounds that it drove up food prices (Holland 2012). The GMA was among the list of over 100 organizations calling on Congress to repeal the ethanol tax credit (ActionAid USA et al. 2010).

The split between Growth Energy and the Renewable Fuels Association was indicative of a deeper division between groups focused on corn and advocates of advanced biofuels. For example, Growth Energy was receptive to the idea raised by Minnesota Democratic

[36]POET surpassed ADM to become the largest ethanol producer in 2007.

Representative Collin Peterson of replacing the VEETC with investment in ethanol infrastructure, such as pipelines and E85 fuel pumps at service stations. Corn growers' associations and the RFA opposed the measure, presumably because they benefited more from the status quo ethanol tax credit. As another example, in April 2013 the RFA surprised and angered advanced biofuel supporters when it urged the EPA to reduce the RFS2 advanced biofuel mandate. In the past, the RFA had argued the exact opposite – that the EPA should send a "strong policy signal" to incentivize the growth of advanced biofuels. Although not stated, the RFA's likely motivation was concern that a large volume of Brazilian sugarcane ethanol would be imported to make up the deficit in the advanced biofuel mandate (the EPA counted sugarcane ethanol as an 'advanced biofuel'). Ardent ethanol supporter Iowa Republican Chuck Grassley candidly summed up the risks of an internally divided biofuels industry lobby:

> When it was Big Oil fighting biofuels, I don't think there was a problem. But when you have Big Oil, Big Food, environmental groups, some ag groups up against biofuels, it's pretty common sense that you can't have much division in biofuels or you're in trouble. Or in more trouble, I should say (*The Economist* 2012).

In July, 2011, California Democratic Senator Dianne Feinstein introduced a bill to repeal the 45 cents per gallon ethanol credit (the VEETC), which was largely redundant since the RFS2 mandated ethanol consumption, anyway (GAO 2011; De Gorter and Just 2012). The VEETC was likened to paying drivers for not exceeding the speed limit, rather than just penalizing drivers for speeding (Moore et al. 2010). Congress came under pressure from "business associations, hunger and development organizations, taxpayer advocates, agricultural groups, religious organizations, environmental groups, budget hawks, and public interest organizations" to allow the VEETC to expire (ActionAid U.S. et al. 2010). Senator Feinstein argued before the vote that:

> Ethanol is the only industry I know of that receives a triple crown of government support: its use is mandated by law, it enjoys protective tariffs and oil companies receive federal subsidies to use it. These flawed policies, which cost taxpayers nearly $6 billion a year, must be changed (Feinstein, 2011).

The Senate voted (73 to 27) to discontinue the VEETC. The vote was more symbolic than concrete, as Congress adjourned at the end of the year without extending the VEETC or the 54 cents per gallon ethanol import tariff, allowing both to expire on 31 December. This policy shift precipitated a steep decline in federal payments for biofuels, as the VEETC had been paid in proportion to the volume of ethanol produced and was by far the largest expenditure. The removal of the import tariff also had little impact, because Brazilian demand for ethanol had risen above what the country could produce domestically, and so Brazil was actually *importing* (a modest amount of) subsidized corn ethanol from the U.S.

In March 2013, the EPA announced the most significant changes to vehicle emissions standards since the 1990 Clean Air Act Amendments (Wald 2013). The proposal aimed primarily to reduce sulfur emissions from vehicles, as well as emissions of NO_x, VOCs, CO, and particulate matter. It contained a potentially significant new provision for ethanol: the EPA would allow automakers to begin testing a new 'high octane' ethanol blend – E30 – and begin redesigning vehicles to optimize the use of such fuel. The EPA acknowledged that one reason for its new E30 regulation was that the RFS2 demanded greater volumes of ethanol than what the existing E10 market allowed. The term 'blend wall' was coined in the industry to refer to the saturation of the domestic fuel market with ethanol, which was largely determined by the volume of E10 sold (consumption of the other mix, E85, was greatly limited by the lack of fuel stations that sold it). Thus, unless a higher blend of ethanol could be marketed, the blend wall was approximately ten percent of national gasoline consumption.

6.8 'Advanced Biofuels' Fail to Advance

Conventional corn ethanol production continued to expand, reaching 10.9 billion gallons in 2009, 13.3 billion gallons in 2010, and 13.9 billion gallons in 2011, approaching the 15 billion gallon limit. However, a Midwestern drought in 2012 cut corn output and drove prices up to over eight dollars per bushel, pushing ethanol production back down to 2010 levels (13.2 billion gallons). Meanwhile, despite the massive influx of federal funding through the DOE and USDA, the next generation of biofuels had failed to materialize as expected. It became increasingly apparent that the RFS2 standards for cellulosic ethanol were astronomically unrealistic. The National Research Council soberly noted that the 16 billion gallon cellulosic ethanol mandate was "unlikely to be met in 2022," since technological innovation had not brought production costs down to a competitive level with petroleum-based fuels (NRC 2011, 2). The failure of the RFS2 to produce the intended growth in advanced biofuels forced the EPA to drastically downgrade the mandate for cellulosic ethanol production for every year since the RFS2 came into effect (Table 6-1). While the RFS2 had established mandatory biofuel consumption levels each year through 2022, Congress had added a contingency plan in case, for whatever reason, the mandates were unlikely to be met. The law empowered the EPA to set the mandate at the "projected volume of cellulosic biofuel production" for each calendar year, to be made no later than 30 November of the prior year, based on an estimate of the Energy Information Administration (P.L. 110-140, Table 6-1). It was the EPA's responsibility to gather all the relevant information, including production capacity and total fuel consumption trends, and determine a realistic mandate level. Discrepancies between the RFS2 mandates, the EPA's annually adjusted mandates, and the actual production of cellulosic biofuel grew more alarming

with each passing year, and revealed how spectacularly unrealistic the original mandates were (Table 6-1).

In February 2010, the EPA revised the original (i.e., legislated in the RFS2) mandate of 100 million gallons of cellulosic biofuel down to just 6.5 million gallons, but even this amount was not produced. In November 2010, the EPA revised their 2011 mandate down from the original volume of 250 million gallons to 6.6 million gallons. Again, none was produced. Neither of the previous years' errors deterred the EPA from increasing its 2012 mandate to 8.65 million gallons. No real cellulosic ethanol was produced in 2012, but just over 20,000 gallons of sugarcane ethanol was counted toward the mandate. All of it was exported, and within months the refinery (Western Biomass Energy, in Upton, Wyoming) filed for bankruptcy.

Table 6-1 Cellulosic ethanol mandates and actual production (million gallons)

Year	RFS2 cellulosic ethanol mandate	EIA estimate of cellulosic ethanol production	EPA-adjusted cellulosic biofuel mandate	Actual cellulosic biofuel production
2010	100	5.04	6.50	0
2011	250	3.94	6.60	0
2012	500	6.90	8.65	0.02
2013	1000	4.00-9.60	6.00-14.00	unknown

The American Petroleum Institute (API) sued the EPA for inaccurately inflating RFS2 mandates to promote biofuel industry growth. In January 2013, the U.S. Court of Appeals for the District of Columbia Circuit agreed with API that the Environmental Protection Agency had overstepped its authority by systematically overestimating the projected volume of advanced biofuel in order to encourage industry growth (U.S. Court of Appeals 2013). The EPA argued that:

> While the cellulosic biofuel standard that we set should be within the range of what can be attained based on projected domestic production and import potential, the standard that we set helps drive the production of volumes that will be made available. . . . Thus while any standard we set for cellulosic biofuel standard for 2012 will have some uncertainty in terms of actual attainment, our intention is to balance such uncertainty with the objective of promoting growth in the industry (EPA 2012, 1325).

The court, however, ruled that the EPA should have provided an accurate estimate of the potential volume of cellulosic biofuel production in the following year, not an inflated volume based on seeking to promote the growth of the industry. The mandated volume of cellulosic biofuel placed oil refiners in the nonsensical position of having to pay fines for not blending a fuel which didn't exist. In 2011, blenders paid fines of 6.8 million dollars, and expected to pay more in 2012 (Wald 2012). Oil companies pilloried cellulosic ethanol as "phantom fuel" (Kish 2013).

Yet less than a week after being reprimanded by the DC Circuit and told that its 2012 mandate was exaggerated, the EPA announced an even higher mandate for 2013: 14 million gallons. This amount was even more out of step with EIA data, which estimated that 9.6 million gallons could be produced if cellulosic ethanol plants came into full production (Table 6-1). The EPA (and the EIA) claimed to have based their 2013 volume primarily on production estimates from two refineries – KiOR in Mississippi and Ineos Bio in Florida. Since neither KiOR nor Ineos Bio produced any cellulosic biofuel in 2012 (or if they did, they did not reveal publicly how much), the EPA seemed overly credulous in accepting the 2013 estimates at face value, especially when it had made the same mistake before. Louisiana Senator David Vitter, the leading Republican on the Environment and Public Works Committee, lamented:

> The EPA continues to make up unicorn-like standards in this area of renewable fuels production, and clearly are ignoring last week's appellate court ruling. EPA has been getting away with mandating exaggerated fuel standards based on a pie in the sky wish, and even after last week's embarrassing loss, they persevere in ignoring the cold hard facts. Increasing the standard after their 2012 requirements were vacated is beyond ludicrous, and they continue to force refiners to either purchase even more gallons of product that doesn't exist or pay a fine (Environment and Public Works 2013).

The EPA (and by extension, the Obama Administration) appeared to be deliberately dismissive of the court findings as it pressed ahead with cellulosic biofuel mandates, ignoring the reality of the dearth of production. For the fourth time in four years, the EPA's cellulosic biofuel expectations were about to prove comically misplaced. On 8 May 2013, the EIA Director of Petroleum, Natural Gas, and Biofuels Analysis wrote to the EPA Director of Transportation and Air Quality to report that the EIA had revised their estimate of 2013 cellulosic biofuel production, from 9.6 to just four million gallons. This was because "the two commercial-scale facilities [KiOR and Ineos Bio] have experienced delays in realized operations over the past six

months relative to EIA's earlier expectations" (Schaal 2013; Table 6-1). Chastened, perhaps, the EPA followed suit by downgrading its mandate from 14 to six million gallons, explaining in its final ruling in August that:

> The approach to determining the cellulosic biofuel standard for 2013 is consistent with a ruling in January 2013 by the U.S. Court of Appeals for the D.C. Circuit, and we believe the sum of the volumes expected by the specific companies noted in the rule is a reasonable representation of expected production (EPA, 2013).

If the EPA had used a more discerning and conservative approach – adjusting for overly optimistic estimates from ethanol producers – it may have arrived at a figure closer to six million, or more accurately closer to zero, from the outset. The Obama Administration was wed to a narrative of developing a green economy – creating jobs in renewable energy and cleantech industries. Ethanol fit the *Ecomodernist* discourse too well to be sidelined by its shortcomings. Through a narrative of green technological advancement, the challenge of converting cellulosic biomass into ethanol was turned into a research and development opportunity. The Obama Administration seemed determined to believe that advanced biofuels would come of age, despite all evidence to the contrary.

A rather different obstacle to the success of the RFS2 lay at the downstream end, where fuel blends were used in vehicles. The limit of ten percent ethanol mixed with gasoline had been in place since the Energy Tax Act of 1978 (higher blends for flex-fuel vehicles notwithstanding). When EISA was signed in 2007, lawmakers had surmised that national fuel consumption would continue to rise, thus that biofuels would corner a share of an ever expanding market. Instead, fuel consumption flattened with the economic downturn that started in late 2007. Corn ethanol saturated the U.S. gasoline market with E10, yet the RFS2 required much greater volumes of biofuels to be blended into the national fuel supply. Advocates recognized the market problem

caused by the blend wall and lobbied to raise the E10 blend limit. In 2009 a large group of ethanol producers, led by Growth Energy, petitioned the EPA to grant a partial waver for the commercial use of E15 (containing 15 percent ethanol). A five percent volume increase may seem minor, but it represented a 50 percent increase in the domestic ethanol market. Following tests conducted by the DOE, the EPA announced in 2011 that E15 could be sold to the public for light-duty vehicles built in 2001 or later. E15 was not approved for older vehicles; motorbikes; heavy vehicles; off-road vehicles, including boats and snowmobiles; or for equipment such as lawnmowers, chainsaws and 'weed-eaters.'

The EPA issued its final rule on the sale and use of E15 in July 2011. Opposition to E15 came from stakeholders who had little in common with environmentalists opposed to E10; not surprisingly, opposition came from oil refiners, led by American Petroleum Institute and the American Fuel and Petrochemical Manufacturers. The API funded advertisements in television, print, and on radio, warning consumers of potential mechanical dangers of using E15. In one, the ad's narrator was a mechanic, ready to roll underneath a car, who was only too pleased to accept the extra work he got from working on E15-damaged vehicles. Auto-makers and the American Automobile Association (AAA) similarly claimed that E15 could damage even 2001 or newer vehicles, and warned that several automakers' warranties would not cover fuel-related damage caused by E15. The third group was food producers, led by the Grocery Manufacturers' Association (including Tyson Foods and Coca-Cola), which argued that E15 consumption would drive up the cost of food. The three trade associations (oil companies, automakers, and food retailers) petitioned the U.S. District Court of Appeals for the DC Circuit to review the EPA's decision to grant Growth Energy and others a waiver to use E15. However, the court dismissed the case. In August 2012, the judges found that the plaintiffs' legal challenges to E15 lacked

standing – they did not sufficiently convince the court that they would be harmed directly by the use of E15. Several bills were proposed in the 113th Congress to either suspend E15 sales pending further study of their effects on motor engines (HR875), restrict sales of ethanol to no more than E10 (S. 344), reform the RFS2 to include only advanced biofuels (H.R. 1462), freeze the RFS2 at existing ethanol production levels (H.R. 1469), or repeal the entire renewable fuels standard (H.R. 1461, S. 1195). Each of these was referred to their respective committee, but at the time of this writing had not passed into law.

Consumption of E15 has been limited. Fuel stations are not required to sell it, and very few stations installed E15 pumps. Since E15 was approved for some engines but not others, there was a risk of misfueling. The EPA therefore enforced 'misfueling mitigation conditions,' which meant that fuel stations had to clearly label E15 pumps and follow certain documentation and compliance procedures. Negative publicity doubtless persuaded some consumers to be wary of the higher blend. Finally, though the EPA found that E15 would not damage 2001 or newer vehicles, it did not grant E15 the same waiver that E10 received to exceed the set limits of Reid Vapor Pressure during the summer months. E10 had already shown to be problematic for certain pollutants, and E15 was likely to be worse. To compensate, oil companies had to use a more refined (more expensive) gasoline blend to mix with E15 during the hottest time of the year.

In June 2013, the EIA Administrator, Adam Sieminski, testified before the House Subcommittee on Energy and Power (within the Committee on Energy and Power). Sieminski provided a succinct and timely reality check on biofuels and America's energy outlook – a counterweight to the Biofuels Interagency Working Group's wishful *Growing America's Fuel* report and the bungled RFS2 cellulosic biofuel mandates. As the statistical arm of the DOE, the EIA had some measure of autonomy from Congress and even from the rest of the DOE. The

same could not be said of the USDA, and especially not the EPA, as the Biofuels Interagency Working Group and the RFS2 regulations demonstrated.

Sieminski acknowledged that the RFS2 mandates had failed to stimulate the expected industry in advanced biofuels, and hence the original mandate of 36 billion gallons of renewable fuel by 2022 would not be achieved (Sieminski 2013). The premise of the RFS2 – that advanced biofuels would be commercially viable in large quantities within a few years – did not materialize (Sieminski 2013). Second, existing U.S. biofuel consumption was restricted to low-blend mixtures such as E10. Absent a market for much higher percentage blends, or for some other type of renewable fuel (such as biobutanol), biofuel use would be limited to ethanol's role as an octane-enhancer to gasoline. Sieminski made a key point concerning consumer behavior vis-à-vis fuel consumption. A ten percent blend of ethanol (E10) has only a minor impact on energy content of the fuel (a loss of about three percent). But higher blends have much more noticeably lower energy content – thus fewer vehicle miles driven per gallon – since ethanol has only about two-thirds the energy content of gasoline (76,100 BTUs per gallon of pure ethanol versus 114,000 BTUs per gallon of gasoline). Experience from Brazil showed that consumers pay attention to the ratio of cost to energy, and do not simply buy the cheapest fuel. High-blend fuels would therefore need to be priced appropriately to gain a foothold in the American market.

Since EIA estimates of allowable biofuel volumes were based on overall gasoline consumption, the later essentially determined the size of the domestic biofuel market. In 2007, the EIA had forecast 2014 gasoline consumption of 154 billion gallons, but by 2013 they lowered the estimate to 133 billion gallons, a 14 percent decline. In 2013, the EIA projected gasoline consumption to gradually decline from a peak of close to 140 billion gallons in 2007 to approximately 111 billion gallons by 2040 (the limit of the forecast period). The EIA attributed

this primarily to improved CAFE standards combined with sluggish growth in vehicle miles travelled (EIA 2013c).

In November 2013, for the first time, the EPA proposed a smaller RFS2 mandate, reducing the total renewable fuels volume from 16.55 billion gallons in 2013 to 15.21 billion gallons in 2014 (the original RFS2 mandate was 18.15 billion gallons). The corn ethanol mandate would drop from 14.40 billion gallons in 2013 to 13.01 billion gallons in 2014. The overall 'advanced biofuels' volume was reduced from 2.75 to 2.20 billion gallons; yet, astonishingly, the cellulosic biofuel mandate was raised even higher than in 2013, from six to 17 million gallons (Table 6-1). Even this ambitious figure was less than one percent of the original RFS2 mandate of 1.75 billion gallons. The agency justified its new mandates based on the practical limits of the blend wall (saturation of the E10 market) and the lack of progress in developing advanced biofuels. Implicitly then, the agency acknowledged that the approval of E15 had not succeeded in overcoming the blend wall. As expected, ethanol advocates were outraged at the EPA's decision, while corn-consuming industries including dairy, livestock, and poultry producers applauded the decision, and oil companies said that the agency should have cut the mandate even further, or scrapped it altogether.

6.9 Obama and the Ecomodernist Promise

Climate policy stalled under the George W. Bush Administration. In 2001, Senators overwhelmingly voted (95 to 0) against ratification of the Kyoto Protocol, and the president rejected the protocol on the grounds that it would harm the U.S. economy and give developing countries, such as China, an unfair advantage. President Bush asserted that there was an "incomplete state of scientific knowledge of the causes of, and solutions to, global climate

change" (Jehl and Revkin 2001, 1), and that "no one can say with any certainty what constitutes a dangerous level of warming, and therefore what level must be avoided" (*The New York Times* 2001). Yet the issues of anthropogenic climate change and energy security continued to dominate public discourse, and the 2008 presidential election focused to an unusually large degree on energy and environmental issues. A contributing factor, no doubt, was the record high fuel prices in the summer of 2008 (Kenski et al. 2009).

The principal presidential candidates of the 2008 campaign, Illinois Democratic Senator Barack Obama (Figure 6-3) and Republican Senator John McCain, both sought to disassociate themselves from the unpopular incumbent's position on climate change and energy. Senator McCain broke with many in his own party by affirming the importance of addressing climate change. Both candidates highlighted the importance of energy security, but one clear difference between them was on ethanol policy. Senator McCain was an outspoken critic of corn ethanol subsidies and the import tariff, and supported market-based approaches to energy policy (Birger 2006; Bryce 2008c). By contrast, as a senator from one of the biggest corn and ethanol producing states, Barack Obama had a strong political incentive to publicly endorse corn ethanol. Senator Obama had cosponsored a bill entitled Biofuels Security Act of 2007 (H.R. 559; S. 23) with fellow biofuel supporters Senators Tom Harkin (D-Iowa), Richard Lugar (R-Indiana), Byron Dorgan (D-North Dakota), and Joe Biden (D-Delaware). The bill would have expanded the renewable fuels mandate to 10 billion gallons of renewable fuels by 2010, 30 billion by 2020, and 60 billion by 2030. Senator Obama also cosponsored the American Fuels Act of 2007 (S. 133), ostensibly to promote alternative fuels and new technologies for reducing American oil dependence and improving energy security. While neither bill passed, they reveal Obama's policy orientation with respect to biofuels. Senator Obama's leading energy policy advisor was

lawyer Jason Grumet, who also led the National Commission on Energy Policy. This commission was incorporated into the Bipartisan Policy Center, co-founded by former senators and ardent biofuel proponents, Bob Dole and Tom Daschle. During the 2008 election campaign, Obama's national co-chairman was former senator Tom Daschle. Presidential candidate Obama's advocacy of ethanol subsidies won the endorsement of corn ethanol interest groups, including the American Corn Growers Association and the Renewable Fuels Association (D'Agostino 2009).

Figure 6-3 Senator Obama campaigning in Adel, Iowa, in July, 2007 (Neibergall/Associated Press, *The New York Times*, June 23, 2008).

President Obama promoted an active role for the national government in fostering strong investment in renewable fuel technologies. Presidential candidate Obama laid out a vision for energy policy that would achieve both energy independence and mitigation of climate change. He pledged to help create five million 'green' jobs over the coming decade. The thrust of new biofuel policy would be on technologically advanced, resource-efficient biofuels such as cellulosic ethanol. While President Bush had overseen the largest expansion of biofuels in history, and the EPA already had orders to continue expanding biofuels through 2022, Obama

had even more far-reaching plans. He promised to dramatically expand the RFS2 mandate, almost tripling the target of 21 billion gallons of advanced biofuels by 2022 to 60 billion gallons by 2030 (New Energy for America 2008), just as he had proposed in the Biofuels Security Act of 2007. It is worth recalling that cellulosic ethanol still was not being produced on a commercial scale. Despite the striking incongruity between policy and reality, biofuels – especially advanced biofuels – fit the President's "green economy" agenda.

The Democratic takeover in the 110th Congress initiated the convergence of climate change and energy policies. The election of Obama as president reinforced the discourse of *Ecological Modernization* by emphasizing on one hand the urgency of mitigating climate change, and on the other the opportunities for moving away from fossil fuel dependence and toward a "green economy." Solar panels – literally and as an emblem of green technology – were reinstalled at the White House. Whereas political leaders acknowledged the need for economic sacrifice for environmental goals in the energy crisis-ridden decade of the 1970s, Obama sought to show that economic prosperity and environmental benefits could be advanced together.

The new administration vowed to be guided by scientific research and to make climate change a priority. On the day of his inauguration, President Obama called for the expansion of renewable energy to meet the challenges of energy security and climate change. He envisioned a nation which would "harness the sun and the winds and the soil to fuel our cars and run our factories" (Obama 2009). Addressing a joint session of Congress some weeks later, President Obama stated that, "We know the country that harnesses the power of clean, renewable energy will lead the twenty-first century" (Obama 2009b). He also signaled to Congress a clear departure from his predecessor's positions on energy independence and climate change policy:

"Rigid ideology has overruled sound science. Special interests have overshadowed common sense. …The days of Washington dragging its heels are over. My administration will not deny facts. We will be guided by them" (Obama 2009a).

As evidence of his commitment to science-directed policy, President Obama was credited for appointing scientists instead of Washington insiders to top positions in his administration (Bomberg and Super 2009; Schenkel 2010). These included environmental policy professor John Holdren as Assistant to the President for Science and Technology and co-chair of the President's revived Council of Advisors on Science and Technology; Nobel laureate and physicist Steven Chu as secretary of the DOE; former EPA administrator Carol Browner as White House Coordinator of Energy and Climate Policy; and chemical engineer Lisa Jackson as the new head of the EPA.

Prior to Obama's election, the U.S. entered what the International Monetary Fund described as "the largest financial shock since the Great Depression" (IMF 2008) in late 2007 and deepening in 2008. As the crisis worsened, Congress passed a stimulus package known as the American Recovery and Reinvestment Act of 2009 (ARRA; P.L. 111-5). ARRA contained funding for clean technologies and renewable energy that made it the largest energy bill in U.S. history, totaling approximately 80 billion dollars (*The New York Times* 2009). President Obama took the opportunity to use stimulus bill funding on programs that would strengthen domestic production of renewables and create green American jobs. On May 5, 2009, President Obama announced that 786.5 million dollars in stimulus funding would be spent by the DOE on research and development of advanced biofuels and for expanding commercial biorefineries (White House 2009). Most of the money would go toward building pilot and demonstration refineries, with almost a quarter on "commercial-scale biorefinery projects." He also announced the

formation of a Biofuels Interagency Working Group (BIWG), jointly run by the heads of the DOE, EPA, and USDA, ostensibly to coordinate and develop the policy, infrastructure, and marketing needs of advanced biofuels (White House 2009). The BIWG's first report – *Growing America's Fuel* – was released the in March, 2010. It enthusiastically endorsed the biofuel industry:

> First-generation corn grain ethanol is a critically important renewable fuel source that is lowering our reliance on foreign petroleum dependent fuels, and cellulosic ethanol will soon be contributing as well. Advanced next generation biofuels will be one of the nation's most important industries in the 21st century (BIWG 2010).

The report's timing could hardly have been more incongruous, and its content more wistful. Cellulosic ethanol volume requirements had already fallen precipitously behind the mandated level of 100 million gallons in 2010, forcing the EPA to reduce the mandate to a mere 6.5 million gallons, from a few pilot and experimental plants, and even this target was not achieved (Table 6-1). The USDA admitted that the capital investment cost of producing cellulosic ethanol was still at least three to four times that of corn ethanol (Coyle 2010, 11). The BIWG report suggested that the failure to produce cellulosic ethanol was due to a lack of financial investment, which the economic downturn greatly exacerbated, as well as inadequate coordination and inventiveness:

> If we are to reach our targets, we will need a more strategic approach that in a new way unleashes the creativity and skills of people in government, in college laboratories, in the garages of aspiring entrepreneurs, and in the R&D facilities of the private sector (BIWG 2010).

It strains credulity to imagine that this up-beat report could have been co-authored by the same Environmental Protection Agency that issued the proposed rulemaking of the previous May. The interagency report simply wallpapered over all the recent issues associated with

biofuels, from land use change, greenhouse gas emissions, global food commodity prices, and environmental costs associated with corn ethanol production, to the fact that cellulosic ethanol still had not reached a commercial scale despite more than three decades and millions of dollars spent on research and development efforts. Under the new administration and the heads of Agriculture, Energy, and Environmental Protection, biofuels were being pushed ahead. Rhetorically, a transition from corn ethanol to more efficient, non-food crops was confidently assured, as it had been in previous decades, yet on the ground corn ethanol continued to supply the vast majority of U.S. biofuel.

6.10 Congress and the Climate Change Agenda

With Democratic majorities in both houses of Congress, a Democrat in the White House, and the Copenhagen climate summit at the end of the year, 2009 appeared to open a window of opportunity for major policy on climate change. In May, California Democratic Representative Henry Waxman and Massachusetts Democratic Representative Edward Markey sponsored a bill in the House known as the American Clean Energy and Security act of 2009 (ACES, H.R. 2454). At the heart of the bill was a cap-and-trade program intended to reduce U.S. carbon emissions by 17 percent below 2005 levels by 2020 and by 83 percent by 2050. The program would set a limit on emissions and force carbon-intensive industries to trade carbon credits, creating a market for pollution abatement. In June, House Republicans put forward their own bill, which proposed to expand America's nuclear power industry and open the Arctic National Wildlife Refuge to oil drilling (Broder 2009). The 'Waxman-Markey' bill, meanwhile, underwent "hundreds of hours of public hearings and committee deliberations" (Broder 2009), accumulating over one thousand pages of concessions and compromises. Representative Collin Peterson (D-Minnesota), House

Agriculture Chairman, convinced Waxman and Markey to prevent the EPA from considering the ILUC of biofuels, especially deforestation, in the bill. House leaders compromised in order to gain Peterson and others' votes for the bill. Peterson introduced a provision which would block the EPA from considering ILUC in their regulations for five years. Peterson's measure would also shift responsibility for analysis of the biofuels life-cycle from exclusively EPA's remit to a responsibility shared with the USDA. In the end, buried in the miscellaneous section at the end of the Waxman-Markey bill was a key provision which directed the EPA Administrator to "exclude emissions from indirect land use changes outside the renewable fuel's feedstock's country of origin" for at least six years (GPO 2009, 1419-1424). It was ironic that the bill was touted to the public as promoting clean energy, yet contained a loophole which overrode EISA's directive to analyze both direct and indirect emissions of biofuel crops. The Waxman-Markey bill squeaked by in the House, by 219 votes to 212, with only eight Republicans voting in favor and 44 Democrats against it.

The Waxman-Markey bill had its detractors outside of Congress. Oil companies spent millions of dollars on efforts to publicly discredit it as another tax on American workers (Lizza 2010). House Congressmen and Congresswomen were surprised by the level of opposition voiced by 'Tea Party' activists, members of a newly-formed movement with primarily libertarian aims (Williamson et al. 2012). The notion of climate change policy violated Tea Partiers' core values against taxation and intrusive government regulation.

The Senate took up the cap-and-trade debate in July, led by Senator John Kerry (D-Massachusetts) and Senator Barbara Boxer (D-California), who sponsored the Clean Energy Jobs and American Power Act (S. 1733). As Representative Peterson had inserted the ILUC-loophole in the House, farm-state senators ensured that a similar provision was inserted in the Senate bill.

Iowa Democratic Senator Tom Harkin, chairman of the Senate Agriculture Committee, asserted that:

> At this time, the data and analytic methodologies for credibly calculating international indirect land-use change emissions do not exist. Because of this, including these international emissions in the EPA's rule would put an unjust burden on the biofuels industry….To put it bluntly, including international indirect emissions at this time is bad policy (Laws 2009).

Senators Ben Nelson (D-Nebraska) and Charles Grassley (R-Iowa) made similar public comments in defense of the biofuel industry. Senator Grassley asserted that:

> The model the EPA cobbled together to measure indirect land use is far from scientific, it's controversial and isn't supported by the facts. …It defies common sense that the EPA would try to blame an Iowa farmer for the actions of Brazilian farmers and developers (Laws 2009).

Senator Harkin and six other Midwestern senators[37] introduced an amendment in a separate bill that would bar the EPA from spending funds on the determination of ILUC from biofuels.[38] EPA Administrator Lisa Jackson then wrote to Senator Harkin, stating that "it is important to take into account indirect emissions from biofuels when looking at the life-cycle emissions as required by EISA," but assuring him that the EPA would consider and try to quantify the uncertainty in calculating ILUC and promising to delay regulation of ILUC until 2010 (German 2009). Reportedly persuaded by Jackson's letter, Senator Harkin withdrew his amendment. Environmental groups, meanwhile, wrote to Senators Bingaman, Boxer, and Harkin, urging them not to undermine biofuel life-cycle analyses.

The 'Kerry-Boxer' bill, as it became known, drew strong opposition from Senate Republicans, who boycotted the vote in the Senate Committee on Environment and Public Works on November 5. Committee Democrats voted anyway, and the bill passed by 11 votes to

[37]Senators Ben Nelson (Nebraska), Tim Johnson (South Dakota), Chuck Grassley (Iowa), John Thune (South Dakota), Kit Bond (Missouri) and Mike Johanns (Nebraska).

[38]H.R.2996, the Senate Interior, Environment, and Related Agencies Appropriations Act, 2010.

one. However, the bill failed to achieve policy consensus for American representatives to take to the global climate conference in Copenhagen. Senators from states with major agricultural industries expressed concern that regulations affecting agriculture and forestry should be handled by the USDA, not by the EPA, and supported proposals that would shift authority to the USDA and limit the authority of the EPA over GHG regulation.[39] At the same time, Senator Kerry began working on what he said was a more broadly appealing, bipartisan climate bill with Republican South Carolina Senator Lindsay Graham and Connecticut Independent Joseph Lieberman (Sheppard 2009; Lizza 2010). Inside the beltway, this climate-policymaking team became known as 'KGL' (Lizza 2010). For a climate bill to succeed in the Senate, KGL needed support from a diverse array of interests, including the energy sector, transport industries, environmental groups, free-market advocacy groups, and the voting public. Democrats held a majority, but Senators from states which relied heavily on coal for electricity were reluctant to support climate policy if it entailed tighter regulations on coal emissions. A 'Gang of Ten' alliance of coal-dependent state senators formed to ensure that any climate legislation would not unduly affect jobs and industries in their states.[40]

Senators Kerry and Graham coauthored an opinion piece in *The New York Times* in October 2009, highlighting the bipartisan nature of their efforts to develop wind, solar, and nuclear power, and asserting that even climate change skeptics must recognize the benefits these bring for energy independence (Kerry and Graham 2009). KGL made considerable

[39]For example, Senators John Thune (R-South Dakota), Chuck Grassley (R-Iowa), and Mike Johanns (R-Nebraska) were all outspoken critics of the EPA regulations.

[40]Dependence on coal for electric power is low (less than 20 percent of the total mix of all energy sources) in New England and Pacific coastal states, and high (over 50 percent) in the Midwest and parts of the Rocky Mountains and the Southeast (EIA, 2011). The 'Gang of 10' included Senators Debbie Stabenow (D-Michigan), Brown (D-Ohio), John D. Rockefeller IV (D-West Virginia), Carl Levin (D-Michigan), Blanche Lincoln (D-Arkansas), Mark Pryor (D-Arkansas), Jim Webb (D-Virginia), Evan Bayh (D-Indiana), Claire McCaskill (D-Missouri), and Ben Nelson (D-Nebraska). Other members joined later.

compromises with energy industry groups and others to gain support, and relabeled cap-and-trade as "pollution reduction and reinvestment" to make it sound more appealing and less like a tax. However, Senator Graham came under attack from fellow Republicans and within his home state for betraying the party and for introducing a 'gas tax,' and ultimately withdrew his support.

On April 20, the BP-owned Deepwater Horizon oil rig exploded, leaking millions of liters of crude oil into the Gulf of Mexico. The leakage of oil into the gulf was not halted until almost three months later, by which stage the spill had superseded the Exxon Valdez disaster as the worst oil spill in U.S. history (*TIME* 2010). The great irony was that while the BP/Deepwater Horizon oil disaster should have generated a wave of public support for climate and energy policy, KGL's bill had offered so many incentives to oil companies, including for offshore drilling, that the bill appeared to be on the wrong side of the issue. As *The New York Times* put it, "Kerry and Lieberman were left sponsoring a bill with a sweeping expansion of offshore drilling at a moment when the newspapers were filled with photographs of birds soaking in oil" (Lizza 2010). Without Senator Graham's support, the climate bill was effectively doomed. In late July, Senate Majority Leader Harry Reid (D-Nevada) admitted that Democrats didn't have the votes to carry climate legislation, and dropped it. As *The Economist* described it, the cap-and-trade bill on "carbon emissions died with barely the bathos of a whimper" (Grieder 2010). Once Republicans regained control of the House in November, 2010, the opportunity to pass a climate bill was effectively closed.

The United Nations Copenhagen summit was supposed to broker a new international treaty on climate change, an update of the Kyoto Protocol of 1997. A high level delegation of Americans attended the conference, including President Obama, Speaker Nancy Pelosi (D-California), and Senator John Kerry (D-Massachusetts), yet unlike for most other state leaders,

the U.S. political system prevented the President from declaring a policy commitment on behalf of the government. Without a bill passed in the Senate, President Obama was only able to pledge U.S. efforts that were basically the same as what the House of Representatives had passed earlier in the year, for a 17 percent reduction in emissions compared to 2005 levels by 2020. Ultimately, however, the Copenhagen conference failed to achieve a legally binding plan for reducing GHG emissions. A major rift had formed between developing and industrialized countries, with the former expecting greater commitments and concessions than what the latter were willing to accept.

On December 7, 2009, the opening day of the Copenhagen summit, EPA Administrator Lisa Jackson signed an "endangerment and cause or contribute findings" on GHGs under the Clean Air Act. The findings officially recognized that six greenhouse gases – CO_2, CH_4, N_2O, hydroflourocarbons (HFCs), perflourocarbons (PFCs), and sulfur hexafluoride (SF_6) – endangered public health and welfare of current and future generations by causing climate change. Motor vehicle emissions were recognized as causing or contributing to those GHGs, and therefore to the endangerment of public health and welfare. This ruling was quite significant because it paved a legal pathway for the EPA to proceed to regulate all types of industries which emitted GHGs, not just biofuels.

The EPA administrator's ruling immediately drew sharp criticism from Republican lawmakers. More than a dozen appeals and lawsuits were filed to challenge the ruling, mostly from emissions-intensive industries and climate change skeptics, as well as the Competitive Enterprise Institute, FreedomWorks (a group affiliated with Tea Party ideals), the Chamber of Commerce, and the state of Texas. By taking an uncompromising stance in favor of GHG regulation, the EPA had challenged Congressional lawmakers to either pass climate change

policy or consent to EPA regulations under the authority of the Clean Air Act. This was high stakes politics, since regulating GHGs would be the greatest extent of environmental authority the agency had ever exercised. The issue of the EPA's regulation of biofuel ILUC was a very small part of a much larger debate over climate change and the EPA's regulation of GHG emissions. In addition to legal challenges the EPA came under intense political pressure to alter its stance.

Early in 2010, Senator Lisa Murkowski, from mineral-rich Alaska and the senior Republican on energy concerns, led Republican efforts to undo the EPA's authority to regulate GHGs. She put forward a joint 'disapproval resolution' (S.J. 26) that would overturn the EPA's finding that GHGs posed a threat to human health and wellbeing, cosponsored by Senators Blanche Lincoln (D-Arkansas), Mary Landrieu (D-Louisiana) and Ben Nelson (D-Nebraska). The central argument put forward by Senator Murkowski's supporters was that Congress, not the EPA, should be the venue for regulating GHG emissions. The EPA, they claimed, was overreaching its authority, and its regulatory ambitions would wreak havoc on an already weak economy by requiring thousands of companies to curb or pay for their emissions. Murkowski argued in the Senate that the EPA's regulations "would amount to an unprecedented power grab, ceding Congress' responsibilities to unelected bureaucrats and move a very, very important debate, a critical debate, from our open halls to behind an agency's closed doors" (Glass 2010, 1). So-called 'coal-state Democrats' such as West Virginia's Jay Rockefeller, proposed a similar resolution to Murkowski's, as did Representative Earl Pomeroy from North Dakota, a state with a booming oil and gas industry.

On February 2, 2010, the White House Office of Management and Budget completed its own review of EPA life-cycle analysis of biofuels and gave it their approval, clearing the way for

the EPA to proceed. On the same day, Minnesota Representative Collin Peterson (D) and Missouri Representatives Ike Skelton (D) and Jo Ann Emerson (R) introduced a new bill in the House designed to prevent the EPA from including any indirect land use change outside the U.S. in its biofuel life-cycle analysis. The bill would also do what Senator Murkowski had proposed in the Senate: strip the EPA of its authority to regulate GHG emissions based on the effects of climate change. Representative Peterson, a prominent supporter of agricultural interests, asserted that:

> Americans know we're way too dependent on foreign oil and fossil fuels in this country — and I've worked hard to develop practical solutions to that problem — but Congress should be making these types of decisions, not unelected bureaucrats at the EPA (Sheppard 2010, 1).

The rhetoric advanced by Murkowski, Peterson, and others was primarily that regulating GHG emissions from U.S. industries was a matter of such importance that it should be handled by Congress, not controlled by "unelected bureaucrats" working "behind closed doors." A counter-argument might suggest that EPA bureaucrats are tasked with environmental protection for the good of the public at large, whereas elected members of Congress all too often served only the most powerful interests in their state.

In hearings before Senate and House committees in February, 2010, Jackson reiterated that the science of climate change unequivocally showed that human activity causes climate change. Senate Republicans, including Senator James Inhofe, a leading climate change skeptic from oil-rich Oklahoma,[41] argued that the EPA relied on information from the Intergovernmental Panel on Climate Change, which had recently been shown to contain mistakes or misleading data. Inhofe was referring to recent media coverage of a series of emails among colleagues at the

[41]In 2012 Inhofe published a book about climate change entitled *The Greatest Hoax*.

Climate Research Unit at the University of East Anglia that were reportedly hacked. Fragments of the emails were widely publicized, especially among conservative media, where they were interpreted as exposing collusion among climate scientists intent on hiding or fabricating global climate data. Stories on the emails and their implications for climate science were featured in the *New York Times* and the *Wall Street Journal*, and on National Public Radio. The timing of the hacked emails, dubbed the 'Climategate' controversy, was propitious for climate change skeptics and deniers as it provided a media focus in the build up to the Copenhagen talks. However, subsequent investigations found no evidence of scientific malfeasance; EPA Administrator Lisa Jackson and most other scientists remained unconvinced that the hacked British scientists' emails amounted to a refutation of climate change science. More than 1,800 U.S. scientists signed a petition, and 32 environmental groups wrote a letter calling on senators to reject the Murkowski bill, claiming that it would "ignore worldwide scientific consensus that carbon dioxide is a pollutant that threatens public health and welfare, block Clean Air Act protections, and delay the move to clean, American-made energy" (Bravender and Samuelsohn 2009).

Environmental groups, including the National Wildlife Federation, posted billboards in Senator Blanche Lincoln's home state of Arkansas and Senator Murkowski's home state of Alaska.[42] They decried the resolution as a "Dirty Air Act" (Mulkern 2010). In contrast, many industry and free market groups expressed support for the bill, including the Competitive Enterprise Institute and the American Conservative Union (Bravender 2010). The EPA came under intense pressure from lawmakers and industries to adjust its policy on GHG regulations, and particularly to revise its consideration of biofuel-induced land use change. On February 3, at

[42]It was rumored that Senator Lincoln had informed a fellow senator that she wanted to protect Murphy Oil, a large oil company based in Arkansas, from climate regulations (Lizza, 2010).

a White House press conference, EPA Administrator Jackson spoke with reporters and assured them that:

> EPA has found that [corn ethanol production] is indeed 20 percent less gas-emitting than gasoline, and therefore the amount of growth in the ethanol market, the corn-based ethanol market, will be dependent on market investment. …The only caveat there, I'll say, is that to get to that kind of level compared to gasoline, you have to be smart. You have to be energy efficient in how you produce the corn-based ethanol (SolveClimate Staff 2010).

This signaled a remarkable shift in policy since the proposed rulemaking of less than a year earlier. Suspecting political manipulation, journalists questioned whether the EPA's turnaround had been driven by political and industry leaders. Jackson specifically denied this, and explained that previous assumptions and data had been corrected or updated. Biofuel industry leaders and pro-biofuel lawmakers shared mixed feelings on Jackson's comments. They would have preferred that the ILUC requirement was abolished altogether, but felt relieved that corn ethanol now qualified as a "renewable fuel."

The Murkowski bill came to a floor vote on 10 June 2010. All 41 Republicans voted in favor, as well as six Democrats, mostly from mineral-rich states.[43] Fifty-three Senators voted against. The failure of the Murkowski bill enabled the EPA's regulation of GHGs to proceed. The EPA also came under legal challenge in Congress. In March, 2011 Michigan Republican Representative and Energy and Commerce Committee Chairman, Fred Upton, introduced a bill in the House entitled Energy Tax Prevention Act of 2011 (H.R. 910). The bill was specifically designed to overturn the earlier Supreme Court ruling on GHG emissions and to stop the EPA from enacting climate change regulation under the authority of the Clean Air Act. A vocal

[43]The six Senate Democrats who voted in favor of Murkowski's bill were Ben Nelson (Nebraska), Mary Landrieu (Louisiana), Evan Bayh (Indiana), Blanche Lincoln (Arkansas), Mark Pryor (Arkansas), and Jay Rockefeller (West Virginia).

proponent and co-sponsor of the bill, Oklahoma Republican James Inhofe, reiterated his view that scientific evidence concerning anthropogenic climate change was unclear, and concluded that "we have to run this machine called America, and we can't do it now without fossil fuels" (Greenspan 2011). The bill passed in the House of Representatives by 255 votes to 172, mostly along party lines (with Republicans in favor), but died in the Senate.

6.11 The Rise and Fall of Cleantech Investment in Biofuels

> *The field of greentech could be the largest economic opportunity in the twenty-first century. There's never been a better time than now to start or accelerate a greentech venture.* – Silicon Valley venture capitalist John Doerr, 2006

President Bush oversaw the 2005 and 2007 energy bills, which not only mandated biofuels but included financial incentives and regulations for other forms of renewable energy. Presidential-candidate Senator Obama pledged to spend billions on a clean-technology economy that would create millions of 'green jobs.' His rival Senator McCain similarly promised to invest in clean technologies. Discursively and politically, biofuels were one industry within a broader sector of 'alternative,' 'renewable,' 'clean,' or 'green' energy technologies. The term 'cleantech' – a portmanteau of 'clean technology' – came to symbolize a network of industries and companies using technologies that promised environmental benefits. While this ranged from 'smart grids' and energy efficiency to biotechnology, the most prominent sector was renewable energy technology. Though none of these industries was especially new – wind, solar, biofuels, and batteries had been around for decades – cleantech promised to bring fresh ideas and new technologies that would lower costs and enhance production. In the biofuels sector,

breakthroughs were hoped for in 'advanced' or 'second generation' biofuels, including ethanol from cellulosic biomass and algae.

The authors of *The Clean Tech Revolution: The Next Big Growth and Investment Opportunity* argued that in the 1970s clean technology was associated with "altruistic environmentalists" and back-to-the-landers, or with government-funded researchers (Pernick and Wilder 2007, 3). The "revolution" of the early 21st century, by contrast, was driven by "major multinationals, well-heeled venture capitalists, and savvy individual investors" who embraced "capital, business, and technological innovation" (Pernick and Wilder 2007, 18). Many of the same investors who fueled the internet boom in the 1990s were turning to cleantech. By mid-decade, renewable cleantech industries caught the attention of private investors and entrepreneurs, and venture capitalists began pouring money into the sector. Rising oil prices (through mid-2008) seemed to affirm projections of major growth for the cleantech sector.

Iconic Silicon Valley venture capital firm Kleiner Perkins Caufield & Byers, of which former Vice President Al Gore was a partner, invested 500 million dollars in a green growth fund in 2008, to help fund dozens of cleantech startups in biofuels, wind, solar, geothermal, and energy efficiency. Indian-born Vinod Khosla made his fortune as co-founder and head of Sun Microsystems, before joining Kleiner Perkins Caufield & Byers. In 2004 he established his own venture capital firm, Khosla Ventures, and began to invest heavily in cleantech. Khosla Ventures spent over one billion U.S. dollars financing biofuel refineries, including Coskata in Illinois, KiOR in Mississippi, and Range Fuels in Georgia. Khosla was also a generous donor to the Democratic Party and a close ally of President Obama, hosting the president at his California home, visiting him at the White House, and serving on the President's India policy team during the 2008 campaign. In 2012, Khosla donated one million dollars to Priorities USA Action,

which supported Obama's re-election. In a 2008 interview Khosla described himself as "one of those Republicans who is for Obama" (Cook 2008). He reasoned that "I think Obama will be much stronger for clean tech" (Cook 2008). While investors raced to cleantech, some of the largest backers were oil companies, including British Petroleum, Royal Dutch Shell, Exxon Mobil, Chevron, and Valero, as well as agro-industrial giants such as ADM, DuPont, and Dow Chemical (Swartz 2011; Ling 2014). One *New York Times* journalist claimed that this signified a "paradigm shift" as big oil companies had switched from opposing fuel alternatives to embracing them (Howell 2009).

However, the exuberant wave of cleantech investment sparked speculation akin to the 'dot com bubble' of a decade earlier (i.e., overinvestment in internet startup companies, *Bloomberg BusinessWeek* 2006; Eilperin 2009; Fischetti 2010; Mitchell 2011). Private investment in cleantech fell from 4.1 billion dollars in 2008 (when it constituted almost twenty percent of all U.S. venture capital) to 2.5 billion in 2009 (Galbraith 2009; Eilperin 2012). Second, the economic downturn began to squeeze the capital available to firms to invest in cleantech companies. The weak economy forced the federal government into a period of fiscal austerity and of heightened scrutiny of government spending. American Recovery and Reinvestment Act (ARRA) stimulus funding surged in 2009 and 2010, but by 2012 news media warned of an impending 'fiscal cliff' in government spending for cleantech industries. A report entitled *Beyond Boom and Bust: Putting Clean Tech on a Path to Subsidy Independence* showed that federal funding for cleantech was undergoing a dramatic fall, from a peak of 44.3 billion dollars in 2009 to just 11 billion by 2014 (Jenkins et al. 2012). The rise and decline of U.S. cleantech investment largely matched the global scenario. Bloomberg New Energy Finance (BNEF) reported that global investment (by governments and businesses combined) rose from

3.7 billion dollars in 2004 to a peak of 28.2 billion dollars in 2007, but then declined almost as dramatically, falling to 5.0 billion dollars in 2012 (BNEF 2013).[44] In 2013 Bloomberg media reported that the major oil companies had begun to withdraw their investment in advanced biofuels. Executives of British Petroleum and Royal Dutch Shell noted that cellulosic ethanol technology would probably not become economical "until 2020 or beyond" (Downing and Gismatullin 2013). U.S. oil companies, including Exxon Mobil and Chevron, had likewise scaled back advanced biofuel investments. The head of the International Energy Agency, Maria van der Hoeven, admitted that the deployment of advanced biofuel technologies had been slower than expected (Downing and Gismatullin 2013).

The Obama Administration had staked its environmental and economic credentials to an *Ecomodernist* discourse which promised green jobs and expanding cleantech industries. The success or failure of cleantech companies carried political risks, since failed cleantech startups drew widespread media coverage and gave ammunition to fiscal conservatives and critics of government subsidies. One such case was Solyndra. The California-based solar array maker won approval from Congress for up to 535 million dollars in federal loan guarantee money as part of the 2009 ARRA stimulus funding, as well as tax breaks from the state of California. The company used copper-indium-gallium-selenide instead of silicone for their photovoltaic arrays, and developed tubular arrays instead of flat sheets. However, the costs of production proved prohibitive, while the cost of silicon fell. Solyndra filed for bankruptcy in September 2011. Part of the blame was attributed to competition from Chinese solar panel manufacturers. Solyndra's failure was an embarrassment to the Obama Administration, a point presidential candidate Mitt

[44]BNEF, a market analysis firm, is commissioned by the UN Environment Programme to report annually on the state of global renewable energy investment, and claims to have the "world's most comprehensive database of investors, projects, and transactions in clean energy" (BNEF, 2013:9).

Romney reiterated when he campaigned outside the defunct Solyndra factory in 2012, asserting that its failure was an example of President Obama's mismanagement of the economy (Parker 2012; Figure 6-4).

Figure 6-4 Presidential candidate Mitt Romney outside Solyndra headquarters in Fremont, California, 31 March 2012 (Justin Sullivan/Getty Images)

A second example of squandered taxpayers' money pertained to the Range Fuels cellulosic refinery in the 'million pines city' of Soperton, Georgia. The DOE had committed funding to support the construction of at least six cellulosic commercial-scale ethanol plants by 2012. One of these was Range Fuels, which had financial backing from Khosla Ventures. The facility was intended to produce 40 million gallons of ethanol per year from pine chips, and become a showcase large-scale cellulosic ethanol facility. In the final days of President Bush's term, Range Fuels was approved for a 76 million dollar DOE grant, an 80 million dollar USDA loan guarantee, six million dollars in state funding, and county tax incentives worth 33 million dollars, plus about 100 acres of land. Yet the plant made headlines when it defaulted on its loans in January, 2011, filed for bankruptcy in September, and shut down in December. The facility

reportedly ran into technical problems, and never produced a drop of cellulosic ethanol. By 2012, Khosla's various investments in advanced biofuel development research and refineries, including the defunct Range Fuels, had drawn an estimated 600 million dollars in federal and state government funding (Chapman, 2012). In the media exposure that followed Range Fuels' closure, critics and journalists linked it to Solyndra and other cleantech failures, and questioned how much risk the government should be taking with taxpayers' money (e.g., Duncan 2011; *The Wall Street Journal* 2011b).

6.12 Ecological Modernization Attacked from the Libertarian Right

The failure of Range Fuels and other cellulosic biofuel investments did nothing to help the cause of the *Ecomodernist* promise by the Obama Administration. An organized political backlash to the Administration's policies came from the Libertarian right, spearheaded by oil industry moguls, Charles and David Koch. Their company, Koch Industries, was among America's largest private companies. It was a conglomerate of over a dozen companies worldwide, generating over 100 billion dollars in annual revenue, primarily from oil and gas but also from chemicals, minerals, timber, paper products, and other products and activities. The brothers described themselves as libertarians (Mayer 2010), committed to minimal government involvement in individual's lives or in markets. Charles Koch co-founded the Cato Institute in 1977, America's first major libertarian think tank (Monbiot 2010; Fisher 2012). David Koch ran for vice president on the libertarian ticket in the 1980 elections, but after poor results, turned to other means of effecting political change. Since then, the billionaires Charles and David Koch have become among America's most prominent political donors. They spent millions of dollars funding libertarian and conservative think tanks, including the Cato Institute, Heritage

Foundation, Manhattan Institute, Heartland Institute, Mercatus Center, and the American Enterprise Institute.

Koch-funded think tanks were among the most trenchant critics of government subsidies for cleantech and biofuels. In *Running on Empty: Why Corn-Based Ethanol Isn't the Solution*, Hoover Institution's analysts accused politicians of being "drunk on the prospect of corn-derived ethanol," and corn farmers and ethanol refiners of being "ecstatic" about the artificial boom that subsidies created (Miller and Carter 2008). They blamed policy makers for failing to apply "science and sound economics" to energy policy, which was already proving to be an "expensive and dangerous experiment for the rest of us" (Miller and Carter 2008). In *The Ethanol Boondoggle*, Cato energy policy experts likened corn ethanol to a religion rather than a rational proposition (Taylor and Van Doren 2008). The authors argued that, on a per gallon basis, corn ethanol received vastly more in government subsidies than petroleum, and that without subsidies the industry would not have attracted Wall Street investment and would likely not exist (Taylor and Van Doren 2008). In *Corn-Based Ethanol: A Case Study in the Law of Unintended Consequences*, the Competitive Enterprise Institute concluded that corn ethanol is far from the "magic bullet" that powerful agribusiness interest groups claim, that "mandates, subsidies, tax credits, grants, loans, and import restrictions" should be repealed, and that market forces should be allowed to operate (Smith 2007).

The Manhattan Institute's energy expert, Robert Bryce, published similar findings in *The Wall Street Journal* in an opinion piece entitled "So Much for 'Energy Independence'" (Bryce 2009). Bryce cited a report by the U.S. Energy Information Administration which compared federal subsidies to various energy sectors on an energy-equivalent basis. It showed that ethanol and biofuels received subsidies of 5.72 dollars per million BTUs, compared to just 0.03 dollars

per million BTUs for natural gas and petroleum liquids. Bryce further noted that while biofuels and ethanol contributed barely one percent of 2007 fuel energy consumption, they received 3.25 billion dollars in subsidies, compared to 1.92 billion for natural gas and liquid petroleum. He pointed out that oil was used for many products besides gasoline, including asphalt, diesel, jet fuel, naphtha, and liquefied petroleum gas, and that domestic ethanol production did not reduce demand for these products (Bryce 2010).

The Heritage Foundation's senior policy analyst on energy and the environment, Ben Lieberman, wrote in April 2008 that the expansion of corn ethanol had exposed its drawbacks, and that the government's misguided ethanol policies had created an industry that drove the cost of fuel up, not down. The high cost of ethanol, Lieberman argued, was precisely why ethanol consumption had to be government mandated. Ethanol's expansion led inevitably to higher global food costs, but also resulted in a split among U.S. farm lobbies. The "poultry, hog, beef, and dairy producers who buy corn" had begun to oppose corn ethanol subsidies (Lieberman 2008). The motto "Ethanol for Energy Independence" should be replaced with "Ethanol: Drink It, Don't Drive It" jibed Kenneth P. Green at the American Enterprise Institute in an article in the *Pittsburgh Post-Gazette* and on the institute's website (Green 2008).

The Koch brothers sought to influence politics not only through think tanks but also via direct political donations and by funding a diverse portfolio of advocacy groups, amounting to over 400 million dollars in the 2012 elections (Carrk 2011). They donated directly to most Republicans in their freshman term in Congress (Carrk 2011), and especially to members of the House Energy and Commerce Committee (Hamburger et. al. 2011). Charles and David Koch also funded so-called Tea Party groups, including Citizens for a Sound Economy and its offshoots, FreedomWorks and Americans for Prosperity (AFP), to promote libertarian causes

(Monbiot 2010; Rich 2010; Carrk 2011). AFP chapters in many states have persuaded Republican Congress members to sign a "no climate tax pledge," meaning that they will "oppose legislation relating to climate change that includes a net increase in federal revenue" (Holmberg and Campbell 2013). Prominent and likely presidential candidates, including senators Rand Paul, Ted Cruz, and Marco Rubio, signed the pledge (Toobin 2014).

Charles and David Koch and the organizations they helped fund generally promoted a *Free Markets* discourse. Koch Industries had the distinction of being one of America's most heavily fined companies for a long list of oil and chemical related environmental violations.[45] The Koch brothers' *Free Markets* discourse thus may have been less ideological than it was aimed at advancing their company's interests to undermine the regulatory power of the EPA. While under the Obama Administration the EPA had sought to move forward with regulation of GHG emissions; at about the same time, an investigation by Greenpeace[46] accused Koch Industries of funding groups to promote its agenda of undermining climate and fossil fuel regulations (Vidal 2010; Dunlap and McCright 2011, 149). Oil giant Exxon Mobil similarly donated to conservative and libertarian think tanks to promote less stringent environmental policies (Dunlap and McCright 2011, 149). The direct political involvement of wealthy oil sector industrialists wielded significant influence on biofuel-related environmental policy. The

[45]In January 2000, Koch Industries paid a record 30 million dollars in civil penalties to "to resolve claims related to more than 300 oil spills from its pipelines and oil facilities in six states" (EPA, 2000). One case involved a spill of over 100,000 gallons, which created a 12 mile long oil slick in the Gulf of Mexico (EPA, 2000). In March 2000, Koch Industries admitted to negligently discharging aviation fuel into a wetland in Minnesota, and paid six million dollars in criminal charges and two million dollars in clean-up costs (EPA, 2000b). In April 2001 Koch Industries pleaded guilty to Clean Air Act violations and was fined ten million dollars, and would pay another ten million dollars for environmental reparation near Corpus Christi, Texas (EPA, 2001). In April 2009, a Koch company was charged 1.7 million dollars and would spend an estimated 500 million dollars to remedy over 680 environmental violations from facilities in seven states (DOJ, 2009a). In May 2009, the EPA announced that a Koch company would spend an estimated 13 million dollars to clean up a 'superfund' site near the Kalamazoo River in Michigan (DOJ, 2009b).[45] In February 2013, a Koch company agreed to pay 380,000 dollars for violating the Clean Air Act at pipeline facilities in Iowa and Kansas (EPA 2013b). In March 2014, a Koch company was fined 350,000 dollars for Clean Air Act violations at a chemical plant in Port Arthur, Texas (EPA, 2014b).

[46]The 2010 Greenpeace report is titled *Koch Industries Secretly Funding the Climate Denial Machine*.

Koch-backed Tea Party forced moderate Republican leaders further to the conservative right, making biofuel subsidies more at odds with Tea Party commitments to lower taxes and reduce government spending (Grieder 2012; Friedersdorf 2012). The ethanol tax credit was allowed to expire at the end of 2011, indicative of a turning point in the Senate's affinity for expenditure on biofuels (*Congressional Digest* 2011). The decisive factor appears to have been a discourse of fiscal austerity and government cutbacks, rather than the other emerging 'anti-biofuel' discourses concerned with food prices and impacts on the environment. The Koch brothers supported and allegedly helped organize the Energy Tax Prevention bill of 2011 (Lewis et al. 2013), which, had it passed, would have prevented the EPA from ever regulating GHG emissions to address climate change.

6.13 Energy Renaissance

As recently as 2007, credible projections of energy markets painted a grim picture for the U.S., with indications of irrevocably greater fuel demand, greater oil import dependence, greater emissions of harmful GHGs, and dwindling domestic oil production. However, over the ensuing five years, a remarkable shift in energy outlook took hold, reversing all of those trends. The driving force behind the transformation was the combination of two technological innovations – hydraulic fracturing ('fracking') and horizontal drilling. The significance of this extraction technique can hardly be overstated – it propelled the U.S. to the world's fastest growing oil producing region in the 2010s (EIA 2013c). Fracking had existed for decades, but in combination with horizontal drilling and newer chemical cocktails, it amounted to a technological change. These advances enabled a "significant increase in onshore crude oil production, particularly from shale and other tight formations" (EIA 2013c). Enormous onshore

mineral resources that had been too costly to access were found to be profitably retrievable by drilling horizontally underground and injecting chemicals and water into rock layers to release oil and gas. The oil- and gas-bearing shale formations are distributed widely in the U.S., including the Bakken in Montana and North Dakota, the Marcellus and Utica in the Northeast, the Barnett and Eagle Ford in Texas, the Fayetteville in Arkansas, the Haynesville in Texas, Arkansas, and Louisiana, and the Monterey in California.

Energy experts had not foreseen this new energy outlook. In 2007 the EIA had predicted that liquid-fuel import dependence would remain well above 50 percent for the foreseeable future, but by 2012 it had fallen to 41 percent, and was projected to fall to 34 percent by 2019, and only increase to 37 percent by 2040 (EIA 2013c). After many years of declining production, domestic crude oil production rose every year since 2008, from 5.0 million barrels (MMbbl) per day to over 7.0 MMbbl. If this trend continues, the U.S. will overtake Saudi Arabia to become the world's largest oil producer (IEA 2012). While part of this is attributable to the stagnation in U.S. demand during the economic crisis, much of it is due to the phenomenal growth in domestic production. Natural gas production also increased beyond expectations. In October, 2013, the Energy Information Administration published figures which showed that the U.S. would overtake Russia as the world's preeminent natural gas producer that year (EIA 2013b). The EIA projected 1.3 percent production growth through 2040, and that by 2019 the U.S. would be a net exporter for the first time in decades (EIA 2013b). The result was that natural gas prices declined sharply, making it more competitive with other energy sources, including coal and renewables. Natural gas eroded coal's share of electricity generation, from 50 percent in 2005 to 34 percent in 2012, while in the same period natural gas-powered electricity rose from 19 percent to over 30 percent. In 2012, for the first time ever, natural gas and coal generated roughly equal

amounts of electricity (EIA 2013b). Natural gas was expected to continue to displace coal's share of the energy market, though as demand for natural gas increases, its price may rise. It's worth noting that while the U.S. energy market has been shifting in favor of natural gas, rising coal consumption in China is driving exports of coal from the U.S. and elsewhere. Cheap natural gas drove down electricity prices and fueled demand for natural gas-powered factories and vehicles. Natural gas for industry became the cheapest in the world in Canada and the U.S., far cheaper than in Europe or Asia.

The shift from coal to natural gas had major effects on GHG emissions. Electricity generation was responsible for about one-third of total U.S. emissions. Burning natural gas is not only more energy-efficient than coal (in kilowatts of energy per unit of mass burned), but it produces substantially fewer GHG pollutants than coal (in particular) or oil. EPA data shows that at an electricity-generating power plant, burning natural gas emits half the CO_2, less than one third the nitrogen oxides, and one percent of the sulfur oxides, as coal (EPA 2014). In 2012, the EIA reported that CO_2 emissions from energy demand had fallen to their lowest point in twenty years, and predicted that they would remain below their 2005 peak until at least 2040 (EIA 2013c). The coal-natural gas shift has been the driving force behind the sharpest decline in GHG emissions by any industrialized country. U.S. emissions fell even faster than in Europe, which had set strict emissions-reductions targets and banked heavily on renewables.

The "energy renaissance" had profound political effects. The Obama Administration presided over the most impressive declines in oil and gas imports in decades, and likely would see the U.S. emerge as the global leader in oil and gas production. The natural gas boom and the sluggish economy to made a major contribution toward President Obama's Copenhagen promise of reducing GHG emissions by 17 percent by 2020. However, the President had based his

energy policy on the *Ecomodernist* idea of a transition toward renewables and the expansion of "green jobs." In an address to the joint houses of Congress in early 2009, the newly elected president lamented that America had fallen behind Germany, Japan, South Korea, and China in cleantech innovation and investment, and urged Congress to pass legislation to drive "the production of more renewable energy in America," including "wind power and solar power, advanced biofuels" and "clean coal" (Obama 2009). In his 2011 State of the Union Address, President Obama depicted fossil fuels as antiquated and environmentally costly, in contrast to advanced cleantech solutions:

> With more research and incentives, we can break our dependence on oil with biofuels and become the first country to have a million electric vehicles on the road by 2015. We need to get behind this innovation. And to help pay for it, I'm asking Congress to eliminate the billions in taxpayer dollars we currently give to oil companies. I don't know if you've noticed, but they're doing just fine on their own. *So instead of subsidizing yesterday's energy, let's invest in tomorrow's* (The White House 2011, emphasis added).

For the Obama Administration then, a dilemma was how to reconcile their avowed commitment to renewables and climate change mitigation with the boom in fossil fuel energy. Awkwardly for the White House, very little, if any, of the credit for the energy boom could be taken by Democrats or by the Obama Administration. It was Republican leadership which had focused so intently on domestic fossil fuel production in the Energy Policy Act of 2005. In his 2012 State of the Union Address, President Obama emphasized the importance of government in helping "new energy ideas" (such as fracking for natural gas) become a commercial success – ideas which would presumably include advanced biofuels:

> The development of natural gas will create jobs and power trucks and factories that are cleaner and cheaper, proving that we don't have to choose between our environment and our economy. *And by the way, it was public research dollars, over the course of 30 years, that helped develop the technologies to extract all this natural gas out of shale rock –*

> reminding us that government support is critical in helping businesses get new energy ideas off the ground.
>
> Our experience with shale gas, our experience with natural gas, shows us that the payoffs on these public investments don't always come right away. Some technologies don't pan out; some companies fail. But I will not walk away from the promise of clean energy (Obama 2012, emphasis added).

At the same podium two years later, President Obama declared that his "all-of-the-above energy strategy" was succeeding, and that natural gas provided a "bridge fuel that can power our economy with less of the carbon pollution that causes climate change" (The White House 2014).

The Obama Administration had seemingly turned their commitment to renewables and climate change from a potential political liability to an asset by emphasizing that natural gas – a fossil fuel but cleaner than coal – was a transitional energy source on the path to an emerging green economy. President Obama sought to appease his environmentalist supporters by pointing to the steps he has taken toward climate change mitigation by encouraging the displacement of coal with natural gas, to his continued efforts toward renewables, and to reducing fossil fuel consumption by such measures as improving the energy efficiency of cars and buildings. The rise of natural gas had, for example, enabled the Administration to direct the EPA to implement stricter new GHG emissions regulations on power plants (McCarthy 2013). However, as environmentalists pointed out, natural gas is a non-renewable fossil fuel, and may be far less environmentally benign than official estimates suggested. Critics claim that fracking contaminates water supplies with harmful chemicals and pollutes the air (IOM 2014). A study in *Science* suggests that the life-cycle GHG emissions from natural gas depended on the leakage of methane from wells and pipes, which appears to be greater than previous EPA estimates,

potentially diminishing the GHG benefits of burning natural gas instead of other fossil fuels (Brandt et al. 2014).

Despite reassurances by the Obama Administration, the transition to a green economy may prove illusory. The journal *Nature* published a study which modeled the global market-driven effects of natural gas production on GHG emissions (McJeon et al. 2014). The researchers made two key points. First, the more cheaply and efficiently natural gas can be extracted, the greater it is likely to be consumed; a phenomenon known in economics as Jevons paradox. Lower gas prices and increasing gas consumption encourage economic activity, which tends to drive GHG emissions up, not down. Second, cheap natural gas competes not only with dirtier coal, but also with renewables, and dampens the incentive to invest in clean technologies (McJeon et al. 2014). Recall that in the 1980s low oil prices dampened investment in renewables. It is more difficult for politicians to promote renewables in a market rich in low-cost oil and natural gas, *especially* if environmental or climate change arguments are undermined by the apparently superior environmental performance of natural gas vis-à-vis coal. By mid-century, the researchers predicted, the overall effect of increased use of natural gas would be almost no reduction in GHG emissions, or possibly a slight increase (McJeon et al. 2014). Given these considerations, it is uncertain whether the eco-transition President Obama touted will materialize soon, or ever.

6.14 Chapter Summary

In the 110th Congress, Democrats legislatively tied energy policy to climate policy. Biofuels were part of a broader discourse of clean, renewable, energy technologies, and the Renewable Fuel Standard was revised and expanded to reflect the new emphasis on advanced,

non-food biofuels and GHG emissions reductions. A wave of enthusiasm and private investment swept the "cleantech" sector. The Obama Administration built on and bolstered a discourse of *Ecological Modernization*, to which cleantech was central, and promised the growth of millions of "green jobs."

Several key challenges to *Ecomodernist* logic emerged. The Searchinger study produced a scientific narrative blaming corn ethanol for indirectly causing massive GHG emissions in other parts of the world, via land use change. A global spike in food commodity prices seemed to vindicate Searchinger et al.'s findings, and strengthened the (*Limits*) argument brought by the FAO, World Bank, Oxfam International, ActionAid, and others to end food-based biofuel subsidies. Second, the U.S. economy itself sank into recession and emerged only slowly and haltingly, undermining the notion of *Ecological Modernization* as a driver of green economic growth. Stimulus funds were distributed, and as government payments for biofuel subsidies mounted, *Free Markets* critics argued that corn ethanol represented a case of special interest politics, that subsidies should be terminated, and that unregulated markets should be the mechanism by which energy investments succeed or fail. The most ardent *Free Markets* opposition to the Administration's policies and to EPA regulations came from major fossil fuel industries, which funded like-minded think tanks and political organizations. Third, several high profile bankruptcies by government-funded cleantech startups, including Solyndra and Range Fuels, brought attention to potential government overreach – the Obama Administration may have promised a faster, more profitable transition to a green economy than was technologically feasible.

Finally, fracking dramatically altered the U.S. energy outlook. The Obama Administration struggled to clarify how it had supported, or would support, the oil and gas

industry. A transition narrative was used to emphasize an ostensible shift from coal and other "dirty" fossil resources to (cleaner burning) natural gas and renewable energy. This transitional element of *Ecological Modernization* was also problematic, as natural gas was not necessarily any cleaner than coal in the long term, and may dampen investment in renewables, prolonging dependence on fossil energy.

Chapter 7 - Discussion

7.1 Summary of Principle Ethanol Discourses

Over the previous three chapters, I organized biofuel policy discourses according to broad historical policymaking eras: 1) geopolitical upheaval and energy insecurity in the 1970s, followed by a turn to free markets and small government in the 1980s; 2) heightened concern over air quality and vehicle emissions in the 1990s, which merged with renewed energy and geopolitical concerns in the early 2000s; 3) the entwining, and potential unraveling, of energy, clean technology, and climate problems from about 2007 onward. Now it is possible to draw out some essential commonalities and differences among the discourses. Table 7-1 lists the four major discourses encountered in the analysis – *Environmental Bureaucracy*, *Ecological Modernization*, *Free Markets*, and *Limits*. The first three of these share a confidence in science and technology (i.e., *Techno-Optimism*) for solving environmental and energy problems. *Limits* discourse, by contrast, has little confidence that technological innovations will resolve the mounting issue of biofuels' competition with food crops for arable land, and generally looks to government authorities to restrict the exploitation of land for fuel. The second major divide is the level of trust placed in governments and the regulations they devise. *Free Markets* discourse is notably mistrustful of government regulations and places much greater confidence in markets

for solving environmental problems. *Environmental Bureaucracy*, by contrast, inherently assumes that markets have failed to achieve the desired result, necessitating government intervention. *Ecological Modernization* lies somewhere between the extremes of *Environmental Bureaucracy* and *Free Markets*. It proposes that capitalism and environmental protection can function in unison. Environmental regulations, such as the renewable fuels mandate in combination with a life-cycle assessment of GHG emissions from biofuels (i.e., the RFS2), provides a driving force for innovation in the energy market, incentivizing the development of advanced technologies such as cellulosic ethanol. The lines drawn in Table 7-1 should not be construed to mean that all discourses are unmistakably distinct and that there are no areas of overlap. As discussed below, *Ecological Modernization* discourse ranges between a close resemblance to *Environmental Bureaucracy* and to *Free Markets* discourses.

Table 7-1 Discursive support for or opposition to ethanol policy since 1973.

	Trust in science and technology	Trust in government regulations	Trust in free markets
Environmental Bureaucracy	Strong	Strong	Weak
Free Markets	Strong	Weak	Strong
Ecological Modernization	Strong	Medium	Medium
Limits	Weak	Strong	Weak

In my research methods chapter I described a series of questions I sought to answer concerning biofuel policy. These included an examination of the literature to find and describe: 1) the key knowledge brokers, 2) the main discourse coalitions, 3) the influence of the knowledge brokers and discourse coalitions, 4) the rhetorical arguments or storylines (or political narratives) used, 5) how understandings of biofuels changed over time, and 6) what discourses dominated biofuel policy. My answers are summarized in Table 7-2 below. In the following sections I examine why these discourses dominated biofuel policy in different historical periods.

Table 7-2 Dominant Ethanol Policy Discourses since 1973.

Era	Dominant Discourse	Knowledge Brokers	Discourse Coalitions	Storylines/ Political Narratives	Metaphors	Major policy outcomes	Legislation
1973-1980	*Environmental Bureaucracy*	President Nixon, President Ford, President Carter, Dwayne Andreas, Senator Bob Dole	Corn growers, ethanol producers, 'corn state' Congress members, agribusinesses, Renewable Fuels Association, National Corn Growers Association, American Farm Bureau Federation	Corn ethanol improves national energy security by alleviating the problem of foreign oil dependence.	Manhattan Project; Apollo program; moral equivalent of war	Department of Energy established, Strategic Petroleum Reserve established, CAFE standards, ethanol subsidy, ethanol import tariff, windfall tax on oil, national gasohol production plan, funding for energy R&D	Energy Policy and Conservation Act of 1975 (PL 94-63), National Energy Act of 1978 (PL 95-617 to 95-621), Crude Oil Windfall Profit Tax Act of 1980 (PL 96-223), Energy Security Act of 1980 (PL 96-294), Omnibus Reconciliation Act of 1980 (PL 96-499)
1981-1988	*Free Markets*	President Reagan	Free market advocates and advisers	Let open markets and competition determine which fuels Americans consume.	Government is the problem	abolished gasoline price controls, reduced CAFE standards, reduced EPA funding, reduced energy R&D funding, repealed windfall profits tax	Alternative Motor Fuels Act of 1988 (PL 100-494)

1989-2006	*Environmental Bureaucracy*	President G.H.W. Bush, President Clinton, President G.W. Bush, Sen. Tom Daschle, Sen. Tom Harkin, Sen. Chuck Grassley, Rep. Jim Talent, Rep. Tim Johnson, Rep. Collin Peterson, Gov. Jim Edgar, Newt Gingrich	Corn growers, ethanol producers, 'corn state' Congress members, agribusinesses, Renewable Fuels Association, National Corn Growers Association, Alliance for Abundant Fuel and Energy, Government experts & scientists who wrote technical reports including the Billion Ton Vision and the 30x'30 Biofuels Initiative	Corn ethanol improves national energy security by alleviating the problem of foreign oil dependence. Ethanol-oxygenated gasoline improves air quality. MTBE poses a health hazard and should be banned.	One-pound waiver, Sen. Harkin's chemistry experiment, Billion Ton Vision, addicted to oil	reformulated gasoline program, MTBE banned in many states, Renewable Fuel Standard, Volumetric Ethanol Excise Tax Credit	Clean Air Act Amendments of 1990 (PL 101-549), Energy Policy Act of 1992 (PL 102-486), Biomass Research and Development Act of 2000 (PL 106-224), American Jobs Creation Act of 2004 (PL 108-357), Energy Policy Act of 2005 (PL 109-58)
2007-	*Ecological Modernization*	Amory Lovins Vinod Khosla, Former Vice President Al Gore, President Obama, Senator John Kerry, Senator Barbara Boxer	corn growers, ethanol producers, 'corn state' Congress members, agribusinesses, Renewable Fuels Association, National Corn Growers Association, cleantech companies, venture capitalists, Growth Energy, POET, Alliance for Abundant Food & Energy, Advanced Biofuels USA, National Biodiesel Board	Ethanol-blended gasoline helps mitigate climate change. Cleantech investment helps build a green economy.	Transition to a green economy, Solyndra & Range Fuels	Revised Renewable Fuel Standard (RFS2), Supreme Court ruling on air pollutants, stimulus package spending on cleantech, EPA approval of E15, EPA regulation of GHG emissions	Energy Independence and Security Act of 2007 (PL 110-140), American Recovery and Reinvestment Act (PL 111–5)

2008-	*Limits*	Jean Ziegler, Jacques Diouf, Robert Zoellick, Timothy Searchinger, Joseph Fargione, Lester Brown, C. Ford Runge, Benjamin Senauer, Jeffrey Sachs	United Nations, Food and Agriculture Organization, World Bank, Oxfam International, ActionAid USA, Earth Policy Institute, Earth Institute, Grocery Manufacturers Association, livestock, poultry, & dairy producers	Biofuel crops drive up food prices. Biofuel crops induce GHG emissions through global land use change. Corn ethanol has a negligible effect on energy security & independence.	A year's worth of corn used to fill an SUV tank	EPA regulation of ILUC, Failed appeals by Texas, North Carolina, and Arkansas for partial RFS waiver.	
2008-	*Free Markets*	Charles Koch, David Koch	Cato Institute, Manhattan Institute, Heritage Foundation, Heartland Institute, Mercatus Center, American Enterprise Institute, Competitive Enterprise Institute, Hoover Institution, American Petroleum Institute, Koch Industries, Americans For Prosperity, Tea Party, FreedomWorks	Let open markets and competition determine which fuels Americans consume. Fracking signals an oil and gas boom.	Energy revolution	repeal of VEETC, reduction in RFS2 mandate volumes,	

7.2 Environmental Bureaucracy

A discourse of *Environmental Bureaucracy* has dominated the periods in which the most pro-ethanol policies have taken shape, especially from 1978 to 1980, in the early 1990s, and in 2005. Several features of this discourse are noteworthy, and help explain its influence. First, it fosters a concentration of power and decision making in the central, administrative state. The effect this had on corn ethanol is that it amplified a regional industry to the national policy arena. "Corn state" Congress members enthusiastically lauded corn ethanol's energy security and environmental benefits at the national level. Second, *Environmental Bureaucracy* operates independently of market logic. In fact, it implicitly assumes that government intervention is necessary to correct a market failure, which is invariably described as a public good – national energy security, urban clean air, climate change mitigation. Third, and consistent with Dryzek's (2013) expression – "leave it to the experts" – *Environmental Bureaucracy* imagines the solutions to environmental problems coming from the government, not from the public or from companies. It follows that government experts – scientists, economists, and administrators – espouse a discourse of *Techno-Optimism*, to reassure the public that innovative solutions will be found. Cellulosic ethanol production was the *sine qua non* of renewable, innovative, technological solutions, and the discourse became institutionalized in the multi-million dollar cellulosic biofuels research facilities. These centers of scientific knowledge optimistically theorized that a substantial portion of gasoline demand could be replaced with cellulosic ethanol. The technical reports in which these ideas were couched found a receptive audience in federal policymakers, and in the White House, where biofuel expansion became part of the G.W. Bush Administration's political narrative of energy security.

To sum up, corn ethanol was rarely, if ever, competitive with gasoline, and more costly than Brazilian sugarcane ethanol. Nonetheless, agricultural and farm interest groups succeeded in convincing lawmakers, particularly from Midwestern states, that ethanol represented an innovative energy source that fostered energy security and independence. A combination of centralized administration and technological confidence provided an ideal political narrative for the corn ethanol industry. Congress obliged with a tax exemption for gasohol, an ethanol import tariff, and incentives for refinery construction. Ethanol lobbyists further convinced lawmakers to provide support for ethanol as a fuel oxygenate in the Clean Air Act Amendments. The CAAA marked a turning point in the discursive politics of ethanol, in which narrow agricultural and corporate interests succeeded in harnessing corn ethanol production to the public interest in clean air. When MTBE was banned, the use of ethanol grew even further. The Renewable Fuel Standard exemplified discourses of *Environmental Bureaucracy* and *Techno-Optimism*, with a consumption mandate which marked the very antithesis of market-based approaches. Despite supposedly stark differences in political ideology between the Carter and the G. W. Bush Administrations, the RFS bore a striking discursive resemblance to the energy policies of the Carter years. In both cases high oil prices and geopolitical tensions with the Middle East contributed to a sense of political urgency. The imperative of national energy security was upheld to justify special government programs to foster biofuel's growth. The Bush Administration became the most ardent supporter of the narrative that national security benefits justified ethanol subsidies, an appealing storyline in a post-9/11 energy-insecure political environment.

7.3 Free Markets

Free Markets discourse is not directly opposed to biofuel production, but rests on the premise that free market capitalism is the best way to organize society and the economy. It opposes government regulation of the economy, and therefore opposes subsidies and mandates for renewable energy. In this worldview, markets send price signals to producers and consumers when resources experience a shift in supply or demand. Firms innovate new technologies and undertake enterprising activity to compete for profits and market share. Scarcity of a resource generates the incentive for firms to find innovative ways of producing it more efficiently or of finding alternatives. *Free Marketers* rail against government attempts to "pick winners" in the energy sector, such as by the vast subsidies, incentives, import tariff, and consumption mandate for biofuels. While *Free Marketers* see efficiency and impartiality in unregulated markets, and are scathing of the inefficiency and ineptitude of an overweening welfare state, this worldview offers little hope or explanation for dealing with such "negative externalities" as health-impairing urban vehicle pollution, climate-altering GHG emissions, or the BP/Deepwater Horizon oil spill. The abolition of the EPA, as some on the conservative and libertarian spectrum recommend, might suit agribusiness corporations and oil and gas giants, but it is surely not in the public interest to lose the only regulatory body capable of interceding to stem the worst excesses of capitalism's indifference to environmental quality.

Nevertheless, is ironic that the U.S. is on track to become the world's largest producer of oil and gas at the same time that its emissions have fallen faster than any other industrialized country. If *Free Marketers* needed further proof of the triumph of human ingenuity and capitalist dynamics over energy and environmental challenges, fracking was it. In fact, oil industry analyst Robert A. Hefner III (2014) argued that the oil and gas boom was driven by a

uniquely American *Free Markets* capitalist logic. Unlike in other countries, the U.S. has a legal system which guarantees private ownership of land and minerals, and a relatively compliant regulatory system that enables thousands of oil and gas companies to compete for exploration and extraction (Hefner III 2014). The oil and gas boom undermined the apparent national security imperative for developing biofuels – newly 'fracked' oil wells have provided far more energy than what corn ethanol had done. It is too early to say with any certainty what the environmental ramifications of fracking are, but the early signs point to the importance of upholding clean air and clean water regulations.

7.4 Limits

Limits thinkers see a world of finite resources and increasing material consumption. So long as existing trends of human population growth and increased demand for resources, such as food and energy, continue, ever greater pressure will be put on the world's cropland. Food producers will be compelled to either exploit existing land more intensively or find new cropland. Technological advances, such as crop improvements, only temporarily forestall the problem. Thus *Limits* thinkers point to the need to change the course of resource depletion to avoid an impending crisis.

The revised Renewable Fuel Standard (RFS2) was signed into law before the 'scientific community' had established whether biofuels did indeed satisfy the EPA's GHG emissions requirements. The ink on the 2007 energy act had barely dried before it was confronted by an opposing narrative, in the midst of a global food crisis, which blamed biofuels for driving up food prices. Key knowledge brokers of the food versus fuel narrative included high-level United Nations officials Jean Ziegler and Jacques Diouf, and World Bank President Robert Zoellick, who drew an explicit link from biofuel production to rising global food commodity prices. NGOs including Oxfam and ActionAid voiced the same sentiment and called for a global ban on biofuel subsidies in the interests of the global poor. But it was the landmark Searchinger et al. (2008) study which made the crucial link between biofuels, food, and climate change. Searchinger's team refuted the notion that biofuels mitigated climate change, and asserted that biofuels drove competition for limited cropland, directly and indirectly, which pushed up food commodity prices and fostered land clearing. The food commodity price spike of 2008 seemed to confirm that biofuels were exerting additional pressure on the world's limited arable land, pushing millions toward starvation. The Searchinger study thus provided a powerful scientific

narrative to assertions that food-based biofuels were to blame for starving the poor. The food crisis became a media focus, which heightened attention and alarm over the likely causes of rising food commodity prices. The most iconic metaphor was of the calculation made by Lester Brown (2006) that an SUV tank full of ethanol deprived a poor person of a year's worth of corn.

The policy impact of the *Limits* discourse, however, was relatively subdued in the U.S., though in the United Kingdom the Searchinger study was directly quoted in the Gallagher Review, a document which Palmer (2010) claims led to shift toward a more precautionary approach to British biofuel policy. The acme of *Limits* policy in the U.S. was in the EPA adoption of ILUC regulation. However, ILUC (and the Searchinger study) immediately came under scrutiny and attack from other commentators, and the EPA made a suspiciously political shift in its calculations to announce that corn ethanol, sugarcane ethanol, and cellulosic ethanol had all met the GHG emissions reductions requirements. If the EPA had announced instead that corn ethanol did not meet the emission reduction requirement (say, a 19 percent reduction instead of 21 percent), a furor would have erupted among ethanol supporters. As in the early 1990s in the case of the "one pound waiver," the ethanol lobby may have simply circumvented the EPA and gone straight to the White House and Congress to get the problem fixed. The EPA's bungled handling of renewable oxygenate requirements and MTBE in the 1990s suggests that the agency is too easily manipulated by powerful political actors.

Second, the EPA was not on solid conceptual ground regulating ILUC. The notion of induced land use change is at least as old as when Myers (1981) argued that the North American appetite for fast food was driving rainforest clearing for cattle ranches in Central America. The notion of ILUC can be applied to many other resource-based industries or sectors. Morris (2008) and Parish et al. (2013) noted that the oil and gas industry also has land use impacts. The

BP/Deepwater Horizon oil spill damaged hundreds of miles of coastline; environmental violations by Koch Industries resulted in polluted stretches of the Kalamazoo River; and surface mining of oil sands in Alberta, Canada, damages native boreal forest. As global oil and gas production turns increasingly from conventional to unconventional extraction, such land use effects seem likely to increase (Morris, 2008). Consequently, the baseline of 2005 gasoline emissions used as the standard against which biofuels are held is arbitrary and should be replaced by one that reflects the changing impacts of the oil and gas industry.

More significantly, however, the notion of quantifying and regulating the specific environmental effects of each component of global trade is problematic. There are far too many variables that can only be inferred or estimated, and which are extremely difficult to validate. For example, if corn ethanol is regulated according to its effects on ILUC, why not regulate corn used to feed cattle or corn used to make high fructose corn syrup (De Gorter and Just 2009)? Global livestock production produces greater GHG emissions than the global transportation sector (FAO 2006; IPCC 2007). To be consistent, then, the EPA should regulate meat, dairy, and poultry industries according to their contribution to GHG emissions. Additionally, land is not the only resource used in biofuel production. The National Research Council and others have pointed out that intensive corn farming contributes to greater rates of fertilizer runoff into waterways and thus to a marine hypoxic zone in the Gulf of Mexico (NRC 2008; Dominguez-Faus et al. 2009; Donner and Kucharik 2008). In as much as hypoxia damages other uses of the water, such as seafood and tourism industries, it induces a resource cost attributable to ethanol which, according to the logic adopted by the EPA, should be counted in the lifecycle assessment.

A second major problem for the EPA concerned the empirical measurement of ILUC. Ideally, the EPA would have a model capable of quantifying the effect of any change in U.S.

land use on all other countries' land use. But as is evident from the breadth of corn ethanol ILUC calculations by researchers after Searchinger's groundbreaking study, the results of modeling induced land use change are inconsistent. Even using the most sophisticated models available, ILUC calculations remained vexed by their sensitivity to data, about which great uncertainty persists (Meyfroidt et al. 2013). Moreover, critics of the Searchinger study pointed to various other factors affecting ILUC, including historic trade patterns, government import and export policies, land use practices, and agricultural technologies. Even if ILUC could be measured it would not be static – it would reflect the dynamics of the factors that determine it. The EPA dodged the issue for the time being by declaring that corn ethanol met the 20 percent lifecycle GHG emissions reduction target and by grandfathering in existing non-compliant ethanol refineries. But sooner or later Congress, the EPA, and/or the courts will be confronted by the inconsistency of the EPA's regulation of ILUC. The test-case of biofuels suggests that this will be an extremely controversial and politically heated debate.

7.5 Ecological Modernization

As a theory of environmental change, *Ecological Modernization* continues to suffer from a lack of clarity on the relative importance of the state, markets, businesses, and society, noted over a decade ago by Buttel (2000). Mol and Jänicke (2009) describe *Ecological Modernization* as operating within the parameters of the modern market economy and the modern welfare state, gradually transforming these along ecological lines. Most *Ecomodernists* attribute a role for the state primarily in setting environmental performance and pollution reduction standards for the private sector (e.g., Huber 2009). Christoff (1996) draws a distinction between weak *Ecological Modernization*, which is technocratic, corporatist, nationalistic, economistic, hegemonic, and instrumental, and strong – democratic, deliberative, international, ecological, diverse, and communicative. Though in Table 7-1 I use the term 'medium' to describe *Ecological Modernization's* discursive trust in government regulation and free markets, variation exists, as discussed below.

Ecomodernist discourse is most associated with the Obama Administration, although it began earlier, when Democrats in the 110th Congress fused climate and energy policies. The revised Renewable Fuel Standard (RFS2) formalized the notion that a new cellulosic biofuel industry would contribute substantially to energy security, but also to America's commitment to reduce GHG emissions. President Obama laid out a vision for a "Green New Deal" (Friedman 2007) – for a systematic and far-sighted reorientation of government and industry toward a greening of the economy. He pledged to increase investment in clean technologies, and envisioned an immense expansion of cellulosic biofuels. To this end, he put the Energy Secretary, Agriculture Secretary, and Environmental Protection Administrator together to champion the growth of biofuels, which they did.

A defining feature of *Ecomodernist* discourse is its embrace of capitalist political and economic logic (Dryzek 2013, 174). Even as billions of dollars in federal stimulus funding poured into the cleantech sector, the discourse remained steadfastly one of capitalism, markets, and competition (Caprotti 2012). A consequence of *Ecological Modernization's* embrace of capitalism is that it is bereft of any association with radical environmentalism. If in the 1970s the environmental movement was associated with 'alternative,' utopian, or altruistic lifestyles (Pernick and Wilder 2007), today's *ecomodernists* are business-friendly technophiles. Whereas President Carter beseeched the American people to turn down the thermostat and put on a sweater, the ecomodernist message reassures the public that being green does not demand sacrifices to consumerism, nor drastic lifestyle change. In essence, through technology, being modern and being green are becoming one and the same thing.

Knowledge brokers who exemplified the *Ecomodernist* worldview included former Vice President Al Gore and billionaire venture capitalist Vinod Khosla. Al Gore was a prominent cleantech investor and wielded global influence in discursively linking climate change and clean technologies. He was one of the most prominent environmentalists of the early twenty-first century. In 1992 he published *Earth in the Balance*, which argued, along *Ecomodernist* lines, that the U.S. could lead an "environmental revolution" that would produce new green technologies and boost the economy. In 2006 an Oscar and Academy Award winning documentary featuring Gore, *An Inconvenient Truth,* was released. He and the Intergovernmental Panel on Climate Change (IPCC) won the 2007 Nobel Peace Prize, "for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change" (Nobel Foundation 2007). The documentary alluded to the possibility that solutions to climate change

lay in renewable technologies, including biofuels. But in 2010, Gore offered a remarkably frank insight into the discursive politics of ethanol when he spoke to a reporter at an energy conference: "It is not a good policy to have these massive subsidies for first-generation ethanol. First-generation ethanol, I think, was a mistake. The energy conversion ratios are at best very small" (Reuters 2010). When asked why he had supported corn ethanol policy, Gore admitted simply that "It's hard once such a program is put in place to deal with the lobbies that keep it going," and that "One of the reasons I made that mistake is that I paid particular attention to the farmers in my home state of Tennessee, and I had a certain fondness for the farmers in the state of Iowa because I was about to run for president" (Reuters 2010). Indeed, Congressional representatives' "fondness" for the farmers in their home states was indeed a driving force behind ethanol policy. Gore acknowledged that corn ethanol demand had driven up global food prices, but continued to support the development of advanced biofuels: "I do think second- and third-generation that don't compete with food prices will play an increasing role, certainly with aviation fuels" (Reuters 2010). Al Gore's candid admission that corn ethanol policy had been at least partly driven by narrow political interest rather environmental benefit may have undermined the credibility of his message on the urgency of addressing the climate crisis.

Ecomodernist discourse rests heavily on *Techno-Optimism* (Hannigan 1995). A significant challenge to the *Ecomodernist* view of biofuels was the lack of progress in commercializing advanced biofuels, such as from cellulose or algae. The technological optimism for advanced biofuels projected by venture capitalists and other investors was not based on tangible results. The Department of Energy had set of goal of commercializing cellulosic ethanol by 2012, but by the end of 2013, it still had not reached commercial production, and according to energy experts and big oil company investors, may not become

viable for another decade or more (Downing and Gismatullin 2013). The decline of public and private investment in biofuels and the failure of cellulosic ethanol to develop on schedule were a blow to the Obama Administration's *Ecomodernist* ambitions. Even within the three branches of government most involved in biofuels development – the EPA, USDA, and DOE – there , there were wide discrepancies over where, and by whom, cellulosic ethanol was to be produced. In the absence of a mature industry, it was speculative whether cellulosic ethanol crops would have a greater or smaller effect on ILUC than corn ethanol. A basic, though uncertain, premise of much of the research on cellulosic ethanol was that the market value of the feedstock (e.g., switchgrass) would be high enough to induce farmers to plant it on marginal or degraded land, but not so high as to compete with food crops (on productive farmland).

The discursive affinity of *Ecological Modernization* with capitalism, and the aforementioned influence of Al Gore, help explain the equivocal role of environmental NGOs in ethanol policy development. While plainly aware of the unsustainability of American reliance on fossil fuels, these groups were drawn into the debate primarily in response to the notion that biofuels represented a renewable alternative. Regarding the 1990 Clean Air Act Amendments, the Sierra Club, the Natural Resources Defense Council, the Environmental Defense Fund, the National Wildlife Federation, and the National Audubon Society and others advocated for the federal imposition of a mandate for renewable oxygenates in gasoline, a position which allied them with the corn ethanol industry. Later, the same environmental groups often found themselves in the awkward position of standing in the same discursive camp with big oil companies in their criticism of the ethanol lobby once it became apparent that ethanol oxygenation did not provide the environmental benefits promised.

The major conservation groups did not have a uniform view of biofuels as a fuel alternative or climate change mitigation strategy. The Natural Resources Defense Council remained an enduring advocate of ethanol as a means of promoting energy independence (NRDC, 2004, 2005, 2006, 2007, 2008). In 2006 they conducted a review of available research and concluded that both corn ethanol and cellulosic ethanol "return renewable energy on their fossil energy investments," but that (theoretically) cellulosic ethanol was more energy efficient. Looking to the future, the NRDC remained optimistic that "the corn ethanol industry is the foundation from which a much larger biofuels economy will grow" (2006). The Environmental Defense Fund gives corn ethanol and other biofuels credit for helping to reduce "global warming," but in a 2007 case study voiced concern that expansion of corn ethanol production into the Great Plains would exacerbate the depletion of groundwater supplies (Roberts et al. 2007). By contrast, the Sierra Club's policy statement on ethanol, issued in 2006 and updated in 2009 and in 2011, unequivocally "opposes further deployment of corn-based ethanol based on its extremely dubious net carbon benefits and unresolved direct and indirect environmental impacts," even opposing the use of "agricultural waste and residue products…without rigorous evidence that the material being used is surplus to the needs of soil health and fertility" (Sierra Club 2006).

As power companies began using more natural gas instead of coal, they averted a great deal of emissions. This strengthened the Obama Administration's political narrative of tackling climate change, but jeopardized the future of biofuels and possibly slowed the adoption of renewables. While the administration maintains its commitment to promoting a green economy, which embraces advanced biofuels, the head of the Energy Information Administration – who seems to have a greater degree of autonomy than the EPA Administrator – admitted that the

RFS2 was no longer viable because it had failed to inspire a cellulosic ethanol industry. He predicted that the corn ethanol industry, meanwhile, would likely continue the role it had played for decades – as a low-blend gasoline oxygenate.

Chapter 8 - Conclusions

This dissertation examined a period of significant policy change with respect to biofuels, primarily corn ethanol, but also advanced biofuels. It began with the premise that discourse analysis is fundamentally distinct from positivist analysis in the way it examines and understands public policy making. I set out to show that a focus on power and knowledge was integral to a fuller understanding of U.S. biofuel policy. In this final chapter I highlight the contributions this research has made and the manner in which it has built upon discourse analysis literatures.

8.1 Discourse Analysis as a Policy Research Tool

Discourse analysis enables scholars and researchers to identify and examine key shifts in policy debates and to explain why certain policy solutions appear more desirable than others. A primary contribution of this work is in its emphasis of discursive context as of the utmost importance to the policy process. The material advantages of corn ethanol did not simply speak for themselves, such that a majority in Congress could not fail to see its benefits. On the contrary, one of the remarkable features of biofuel policy is the endurance of supportive arguments, despite the lack of conclusive evidence that corn ethanol achieved any of its reputed benefits: enhancing energy security, reducing air pollution, or reducing GHG emissions. Notwithstanding the steady accumulation of evidence that corn ethanol is expensive, environmentally damaging, and an ineffective substitute for gasoline, the allure of these discourses by government is the principal reason for ethanol's expansion and policy support. Environmental and economic (i.e., science-based) arguments against the expansion of corn ethanol as a national fuel existed from the beginning of national biofuel policy development, and were publicly available at the time that major biofuel policies were enacted. It was no secret, for

example, that corn is a very chemical and water intensive crop, so corn acreage expansion would likely have negative ecological impacts. Chapter 5 described scientific studies of the harmful effects of using ethanol-oxygenated gasoline, and Chapter 6 described the cost of corn ethanol expansion to livestock-producing states, but policy proceeded as if these issues weren't real or didn't matter. This confirms what was premised at the outset of this research – that discourse is integral to the policy process and that knowledge-based power rightly views Congress and the White House as arenas of discursive struggle. It is noteworthy, for example, that the direct ecological costs of corn ethanol production have never been a pivotal matter of discussion in Congress or the White House. Such considerations have been overshadowed by weightier discourses concerning energy security and independence as well as national (air pollution) and global (climate change) environmental concerns. Arguments in favor of energy independence, however illusive, were politically appealing, as was the *Ecomodernist* promise that biofuels were integral to America's clean technology future.

Two particular periods illustrate the importance of discursive context. The first of these was from 1978 to 1980 – a time when many of the most enduring ethanol policies were enacted, and a plan initiated to expand biofuels to meet ten percent of national gasoline demand. The Carter Administration's policy approach stemmed from a discourse which placed a great deal of trust in government institutions to solve the country's social, environmental, and economic problems. Oil prices, however, tripled, the economy stagnated, and geopolitical strife in the Middle East did not abate. Voters elected a new administration which offered a more optimistic picture of American prosperity, based on tax cuts, smaller government, and growth in the private sector. The Reagan victory appeared to stem in part from populist mistrust of large institutions.

President Reagan ushered in a period of deregulation and free markets, which though not inimical to corn ethanol per se, exposed the industry's reliance on government subsidies.

Second, after five years of debate and delay, 2005 marked a victorious year for ethanol proponents when the Renewable Fuel Standard finally became law. Given that Republicans controlled both chambers of Congress and the White House, it would be difficult to explain the passage of the RFS (and other biofuel-related policies) in the Energy Policy Act of 2005, except with recourse to the political advantages of a narrative of energy security and independence. The inconsistency between Republican principles of low taxes and free markets and the centralized bureaucracy of the RFS became more apparent later, when rising Tea Party candidates challenged incumbent Republicans on the logic of spending taxpayers' money on biofuel subsidies. When Democrats swept to power in the 2006 midterms, they shifted the narrative to clean technology. The revised RFS retained its support for corn ethanol, but incorporated a new mandate for advanced biofuel expansion and set GHG emissions requirements.

These two examples underscore the idea that energy policy tends to be crisis-driven. Energy policy slides up and down on the political agenda, depending on such energy-related events as the OPEC oil embargo of 1973, the Iranian Revolution in 1979, the Exxon Valdez oil spill in 1989, rolling blackouts in California in 2000 and 2001, the terrorist attacks of September 2001, hurricanes Katrina and Rita in 2005, and the BP/Deepwater Horizon oil spill in 2011. Conversely, when oil prices are low, such as in the mid-1980s and late 1990s, energy policy recedes from the policy limelight. Crises seem to create an opportunity for concerted action on energy policy, but policy responses are too often either a call for greater fossil fuel extraction or a renewed urgency to find sustainable energy sources. In either case, crisis-led policy-making

seems to result in policies which are reflexive, reactionary, and fragmentary, rather than deliberative, practical, and comprehensive.

8.2 Discourse and Science

The second contribution of this research is that it underscores that there is no straightforward method for understanding the relationship between discursive power and scientific knowledge. Science is often invoked as an apolitical means of assessing the benefits and costs of public policy, and in many cases the natural sciences impart a powerful legitimizing discourse in environmental policy making. This case study, however, highlights the fact that scientific knowledge was at times deliberately ignored, at times opposing interests contested discursively ambiguous concepts, and at times scientific knowledge was manipulated in order to mask hidden agendas. It would be a gravely flawed conceptualization of biofuel policy to suggest that it unfolded by a process of scientific discovery and consensus leading to political consensus (Litfin 1994, 5).

Scientific knowledge was completely ignored in the case of the one pound waiver, the renewable oxygenate requirement, and the MTBE fiasco. It other times, scientific knowledge was manipulated by narrow political interests, as Senator Daschle demonstrated in his amendment that required the highest possible oxygen content in reformulated gasoline. The RFS2 provided a striking insight into the role of science in policy. Legislators mandated the creation of a cellulosic ethanol industry, based on the knowledge that it was technically possible to produce ethanol from plant biomass. The term I used for this overconfidence in innovation was *Techno-Optimism*. It is not surprising that *Techno-Optimism* is an enduringly popular discourse, despite the risk the government takes to its credibility each time it makes a promise

that doesn't eventuate. Technological innovation provides an alluring third way between the hard choices imposed by the limits of the scientific frontier, which in current times means continuing to rely deeply on fossil fuels, or justifying costly measures to reduce consumption or promote alternatives.

The legitimizing power of scientific discourse is best illustrated in the Searchinger study. Using sophisticated computer models, the researchers calculated the global land use – and thereby the GHG emissions – effects of U.S. corn ethanol expansion. The results, however, looked suspiciously like the assumptions and input data used to populate the model. Other scientists pointed out that many of the factors were empirically questionable, ran models with different assumptions and data, and produced substantially different results. Not surprisingly, biofuel backers sought to undermine the scientific credibility of ILUC modeling. The EPA jumped prematurely into the ILUC debate and then spent a year backpedaling from its own proposed legislation. Ultimately the EPA built a thin veneer of scientific legitimacy – complete with imaginary data and grandfathering clauses – as a façade in front of its reassurance to the corn ethanol industry that they would not be affected by meddlesome environmental regulations.

The set of ideas and storylines that constitute a discourse need not be scientific at all; they can be mythological in nature. Analogously, the notions of *Free Markets, Limits, and Ecological Modernization* do not stem from empirical testing, but grew out of theoretical concepts and assumptions. To return to an example from Chapter 2, Dixon and Hapke (1996) investigated competing discourses of American agriculture: notions of family farming and modern agri-businesses were invoked by promoters of a "safety net" for farmers or advocates of freeing farming from big government, respectively. The almost science-fictional idea of supplying American fuel demand from forestry and crop residues beguiled policy makers and scientists,

who transformed it into a serious research agenda. Technical feasibility studies suggested that cellulosic ethanol could become a commercial reality, if certain conditions were met. They weren't, but such was the allure of the notion of a large scale cellulosic ethanol industry that politicians accepted and promoted it as though its development was almost inevitable.

8.3 Biofuels and Environmental Discourse

This research began with the idea that energy policy is inexorably environmental policy, since the list of possible energy sources to support range from environmentally harmful fossil fuels to clean technologies and renewables. A third contribution of this study is a deeper understanding of the complex and uncertain relationship between environmental discourse and biofuel policies. Biofuel policies cast a fascinating lens on differences within the complex and multifaceted American environmental movement. One strand of environmentalism is that symbolized by Former Vice President Al Gore and venture capitalist Vinod Khosla – one which looks to technological innovations and market economies. By contrast, *Limits-oriented* environmental scientists such as Lester Brown, Timothy Searchinger, and Jeffrey Sachs opposed food-based biofuels based arguments about global resource limits. The large, reform-oriented conservation groups, including the Sierra Club and the Natural Resources Defense Council, had little political or discursive room to maneuver between supporting the development of petroleum-alternatives, which placed them in a pro-ethanol camp, and opposing corn ethanol expansion primarily because of its ecological costs, placing them in league with the petroleum industry. Making a nuanced distinction between corn ethanol and advanced (non-food crop) biofuels may have been scientifically relevant, but was a political dead end once the Energy Independence and Security Act of 2007 promised that advanced biofuels would soon dominate

the industry anyway. It was only toward the end of this analysis that critics grew vocal in pointing out that the mandated growth of advanced biofuels had failed (see chapter 6.8). There seemed to be little that environmental groups could do, even with access to scientific knowledge of corn ethanol's environmental costs, to alter the well-entrenched discourse of biofuels as a renewable or clean energy source.

The RFS2 raises a key point about the effects of *Ecomodernist* discourse on environmental policy. An important feature of *Ecological Modernization* is the notion of transition – that modern society is undertaking a series of incremental steps toward sustainability. The transition metaphor is powerful because it evokes the notion that the existing corn ethanol industry, while it has dominated the biofuels industry for over three decades, is merely temporary, and will soon be replaced. The effect of a transition narrative is that even if existing corn ethanol production has direct ecological costs, such as not meeting the required 20 percent reduction in GHG emissions, such problems are not worth dwelling on because the industry is about to change anyway.

8.4 Geographical Scale

A fourth key point to be drawn from this research is the need to analyze how discourses operate at particular geographic scales, and what effects this has in particular places. Clearly my focus was at the national level. Equally, other studies focus on the various U.S. state laws on biofuels, or on other world regions, such as Europe or Brazil. In terms of the connectivity of discourse and scale, a key point is that corn ethanol was elevated from a regional industry to a national one because it was insinuated with national political narratives such as energy security and energy independence. These narratives imply a nationalist ambition, in which the U.S.

competes with other countries to advance its own interests. But biofuels were also implicated with climate policy, which is inherently global in scale. As discussed below, climate policy proceeds from a perspective of cooperation – in other words, advancing a global interest in mitigating the negative effects of climate change. The case study of biofuels has revealed tensions between national and global discourses. Biofuels were politically attractive partly because they represented a "home grown" solution, thus furthering nationalist goals. As corn ethanol production expanded, so did scrutiny of its ecological costs. The discursive and political link between biofuels and climate change expanded the policy arena to the global level, and the food crisis drew international attention to U.S. biofuel policies. Most of the opposition to corn ethanol expansion based on its supposed competition with food crops came from international organizations (e.g., World Bank, FAO, UN) and from internationally oriented NGOs (e.g., Oxfam, ActionAid, Earth Policy Institute, Earth Institute). Unlike Congress, these organizations were not so obviously composed of delegates responsive to narrow economic interests in their constituencies.

In Chapter 2 I reviewed discourse analyses of wind power by Stevenson (2009). He also found that environmental discourses function at different geographic scales. Welsh environmental groups sought to mobilize a global discourse of climate change to promote wind farms, but this proved an ineffective driver of local wind development projects. Tensions between American national and global interests were evident when not a single Senator voted to ratify the Kyoto Protocol, reportedly because it would cost American jobs and give major polluters like China and India an unfair advantage. Frictions between American and global interests complicate responses to international environmental problems, as researchers articulated

with respect to the Montreal Protocol (Litfin 1994; Litfin 1995; Gareau 2013), and which continues to impact climate policy.

Through biofuel legislation written in the Energy Independence and Security Act of 2007, the EPA made an unprecedented foray into the realm of global GHG emissions life-cycle accounting, but ran up against computational, scientific, and legal limits. The fundamental notion of economic globalization – of a growing economic integration across borders and regions – is uncontroversial and is a common theme in geography textbooks. But it is another matter entirely to pinpoint ecological damage in one part of the world and hold responsible a culprit on a distant continent, as the EPA tried to do. If Midwestern farmers can be held to account for their global land use effects and GHG emissions damage, this implies that there can be, at least theoretically, a global accounting of environmental responsibility for *every* economic activity. Perhaps the closest realization of the notion of global accountability is in fair trade and certification schemes. Fair trade programs market goods ostensibly produced in an environmentally conscious manner by producers (usually in developing countries) who purportedly experience superior working conditions and better returns on their efforts. Similarly, the Forest Stewardship Council International runs a certification scheme to ensure that forest products traded internationally comply with sustainability criteria and principles. However, fair trade and forest product certification only link producers and consumers via specific commodity supply chains (e.g., coffee, bananas, handicrafts, lumber), not across sectors, as does the EPA's attempted regulation of ILUC. Moreover, participation is voluntary, not enforced by law. The extraordinary complexity involved in linking one specific activity to others globally is not likely to become a well-established feature of EPA regulation without a great deal of Congressional debate. It seems more likely that a cap-and-trade program, as was proposed in Congress in 2009,

or a carbon tax, might be enacted at the national level to more fully reflect the environmental costs of using fossil fuels (in fact, all energy sources).

Scale therefore presents a problematic and undermining feature of *Ecological Modernization* as a theory of environmental change. If one accepts that the costs and benefits of economic activity can occur in different places, such as through global commodity supply chains, then it is meaningless to find evidence of *Ecological Modernization* in just one place or region. Economic globalization enables products to be produced in parts of the world with weakly enforced environmental regulations and exported to consumers in countries with stricter environmental standards. The only scale at which an assessment of *Ecological Modernization* is appropriate is global, since this incorporates the effects of modernization not only for a minority in wealthy countries, but includes local, regional, and global environmental costs.

8.5 Discourse and Climate Change

The first four contributions of this research, concerning discursive context, scientific knowledge, environmental discourse, and scale, have particular implications for a fifth: the closely related issue of climate policy. In Chapter 1, I argued that biofuels are emblematic of broader social and environmental issues of our time. Climate change is *the* singularly global environmental issue of our time, irrevocably embedded as it is in issues of energy production and consumption, and implicated in every aspect of economic activity. International climate policy is led by the United Nations, and its information branch is headed by the International Panel on Climate Change (IPCC). In discursive terms, the IPCC climate scientists are very powerful knowledge brokers, since their primary role is as an integrator of cutting edge scientific knowledge on how the climate is changing and what must be done about it. The latest IPCC

report on climate change, issued in March 2014, warned that "business as usual" is not an option, and that the worst is yet to come in terms of extreme weather, sea level rise, and biodiversity loss. The United Nations Framework Convention on Climate Change (UNFCC) – a non-binding treaty established in 1992, which provides a framework for periodic updates or "protocols" – set a common goal of limiting global atmospheric temperature increase to two degrees Celsius, or approximately 450 parts per million of CO_2 equivalent, by the end of the century (Friedman 2010).

The discourse of the UN and IPCC is one of *Limits* – they warn governments that drastic measures must be taken to curb emissions to avoid catastrophic climate change. The discourse is also strongly scientific – using models, statistics, and projections to describe the probabilities of various scenarios. The UN's climate policy approach is also precautionary, meaning that it does not condone waiting until a more complete picture of climate change is available before taking action. A potentially serious problem with the UN's *Limits* approach is that people may grow weary of hearing that they must change behavior to avoid a looming doomsday scenario. The IPCC and other science organizations, however, are not the only knowledge brokers on climate change. Governments of advanced capitalist economies, including the U.S. and European Union, have generally adopted an *Ecomodernist* perspective on climate change, which largely accommodates "business as usual" – including capitalist expansion and industrialization – while seeking regulatory and technological solutions to reform society along ecological lines. In other words, urgent calls for cooperative action at the international level do not readily translate into policy at the national level. "American style" *Ecological Modernization*, say Schlosberg and Rinfret (2008), is especially oriented toward "national security and blatant consumerism." Compared to a stern warning on *Limits*, the *Ecomodernist* perspective offers a more sanguine

message of incrementally greening modern lifestyles. Yet leading critics feel that the pace of *Ecomodernist* reforms are not enough to drive the kind of policy change needed to curb emissions to avoid dramatic and costly climate change (Schellenberger and Norhaus 2004; Klein 2014). As befits a *Limits* perspective, the UN takes a legalistic and "command and control" type of approach to regulating emissions. It convenes meetings for its member state representatives on a regular basis, where consensus is sought on new, legally-binding treaties on emissions reductions. An undermining weakness of this approach is that international agreements risk backfiring if any of the larger member states refuse to participate, as occurred when the U.S. refused to ratify the Kyoto Protocol (Eckersley 2012).

As with biofuels, a feature of climate science in the public arena is that people largely rely on mass media to interpret scientific information. This leaves the public vulnerable to ambiguous or contrarian climate discourses, despite the overwhelming scientific evidence pointing to the existence of anthropogenic climate change, and the likelihood that some level of uncertainty will persist. The mass media's influence on the way climate change is framed and presented is well documented by researchers employing similar discursive tools of analysis (Carvalho 2005; Boykoff and Boykoff 2007; Boykoff 2008; Boykoff and Goodman 2009; Doulton and Brown 2009). We have already seen the discursive influence that oil companies (such as Koch Industries) can exert over think tanks and citizen action groups to influence environmental and political outcomes. Organized climate denial has become a feature of the U.S. political arena (McCright and Dunlap 2010; Oreskes and Conway 2010; Dunlap and McCright 2011). As with ethanol policy, the staunchest opposition to climate policy comes from the fossil energy sector. However, the issue is clouded by the fact that oil companies have also

invested in ethanol and other renewables, and engage in 'greenwash' discourses.[47] However, whereas ethanol policy was garnered and opposed largely along geographical lines, U.S. public – and especially political views – on climate change have become increasingly politically polarized. Conservative ideology is deeply distrustful of the kind of (global or national) government intervention that seems to be what the IPCC and scientists imply is necessary to coordinate mitigation efforts (Klein 2011).

Dunlap and McCright (2008) identified a growing political split in public opinion on climate change since 1997, in which Republicans grew increasingly skeptical of whether climate change existed, became increasingly sure that the media were exaggerating the seriousness of climate change, were far less likely than Democrats to agree that there was consensus among scientists on climate change, grew increasingly skeptical that climate change was caused by humans, and were much less likely than Democrats to view climate change as a serious threat. The same authors identified four methods by which the conservative movement undermines U.S. climate policy: manipulation of scientific knowledge, attacks on scientists, assertions of media bias, and the use of the political system to obstruct climate policy (McCright and Dunlap 2010). Parallels can be seen here with corn ethanol, for example in the manipulation of scientific knowledge concerning reformulated gasoline, efforts to delegitimize findings on biofuels' effects on food prices, assertions of media bias by pro-ethanol Former House Speaker Newt Gingrich, and in the political arena, Congressman Peterson and Senator Harkin's rider in the cap-and-trade bill that would have barred the EPA from regulating biofuels based on ILUC.

President Obama has continued to make energy a policy priority, and the 2016 elections may be in part a referendum on the success or failure of his Administration's *Ecomodernist*

[47]For example, British Petroleum's 'Beyond Petroleum' rebranding, Shell's sponsorship of the *Countdown to Copenhage*n report, and Chevron's "we agree" add campaign.

agenda concerning cleantech and green jobs. If cellulosic ethanol had been commercialized during President Obama's time in office, one can imagine that this would have bolstered the Administration's *Ecomodernist* agenda. The President would have emphasized, perhaps at stump speeches at bustling cellulosic ethanol refineries such as Range Fuels in Georgia, KiOR in Mississippi, and Ineos Bio in Florida, that American ingenuity had succeeded in producing a fuel that spelled the end of the dominance of fossil fuels, and which would usher in a truly green economy. In 2016, Republicans are likely to highlight the notion that the oil and gas boom do more to satisfy energy security than renewables, and make government subsidies for the latter unnecessary. Democratic candidates will likely point to progress in cleantech as evidence of a shift toward a green economy.

These differences notwithstanding, there are areas of overlap between *Ecomodernist* and *Free Market* environmental discourses, notably in the high level of confidence in science and technology. Just as ethanol was envisioned as a solution to energy crises, eco-friendly technologies are promoted as solutions to climate change. A survey conducted by the Yale Project on Climate Change Communication and the George Mason University Center for Climate Change Communication, *Politics and Global Warming* (Leiserowitz et al. 2011), surveyed public climate change perspectives and political affiliations, and found stark differences between self-identified Tea Party affiliates and the three mainstream groups: Democrats, Republicans, and Independents. Tea Partiers were far less likely than others to believe that "global warming" is happening, and were more likely than any other group to say that there is disagreement among scientists on global warming. Just over half of Tea Party affiliates say they are "not at all worried" about global warming, and the same proportion think that it "will never harm people in the United States." Notably, however, the study found that a

majority of all four political affiliations, including 74 percent of all Tea Party members, said they would "somewhat support" or "strongly support" funding "more research into renewable energy sources, such as solar and wind power" (Leiserowitz et al. 2011). Surprisingly, the study also found that a majority of all political persuasions, including 66 percent of Tea Partiers, either "somewhat" or "strongly" supported providing "tax rebates for people who purchase energy-efficient vehicles or solar panels," although a quarter (24 percent) of all Tea Partiers "strongly opposed" such a measure (Leiserowitz et al. 2011).

These responses appear to confirm widespread public support for techno-scientific eco-friendly innovations across all major political persuasions. Powering homes with solar panels potentially appeals to *Free Market* values of self-initiative, personal freedom, and entrepreneurship, while appealing to *Ecomodernists'* technologically advanced, enlightened green lifestyle. Contemporary with the rapid rise of corn ethanol, U.S. sales of hybrid-electric vehicles began in 1999 and now constitute some three percent of the auto market (Cobb 2014). Hybrids should appeal to a broad spectrum of Americans as a source of energy security, and to *Ecomodernists* as a source of eco-efficiency. However, surveys of hybrid consumers suggest that it their motivation to buy a hybrid is related to the symbolic statement hybrids make about the owner as a socially and environmentally conscious consumer (Heffner et al. 2005; Heffner et al. 2007; Griskevicius et al. 2010). In *The Rise of the Neo-Greens*, Pink (2006) described what he saw as a growing affinity for eco-friendly consumer style driven by "a new constituency in the marketplace: Prius-driving, solar panel-installing, Sierra Club-donating, look-at-me environmentalists." Yet an *Ecomodernist* discourse which relies too heavily on technological innovations and on a minority of "green citizen-consumers" is likely to have only a marginal influence on the political economy and emissions of the country as a whole (Schlosberg and

Rinfret 2008). Policymakers have implemented a plethora of transport fuel regulations in the name of energy security and environmental improvement, including corporate average fuel efficiency standards, ethanol tax exemptions and consumption mandates, tax credits for hybrids, and subsidies for replacing old, fuel inefficient vehicles with newer, more fuel efficient vehicles (the "cash for clunkers" program). Yet these *Environmental Bureaucratic* and *Ecomodernist* interventions may remain relatively weak and expensive compared to the effect of increasing the cost of driving, such as by imposing an emissions tax or "energy security tax" on fuel. In the short term this option would certainly face powerful political opposition, though it likely offers the best chance of reducing the transport sector's contribution to GHG emissions (Morrow et al. 2010; Kay et al. 2014), while increasing the incentive for the development of fuel alternatives and greatly reducing the administrative costs of government regulation.

This case study built upon the foundations laid by leading discourse analyses of environmental policy, notably Litfin's (1994, 1995) work on international efforts to ban CFC production, and Hajer's (1993, 1995) examination of British and Dutch responses to acid rain. Biofuels offer a similarly insightful lens into the intriguing process of U.S. environmental policy-making. However, it would be a mistake to believe that any of these issues have been relegated to closed chapters of environmental policy history. Globally, energy consumption continues to rise inexorably, even as climate change mitigation policies seek to drastically cut emissions – a sobering reminder of the need to find alternatives to burning fossil fuels. The RFS2 still exists, and may remain a cornerstone of biofuels policy until at least 2022. From that historical vantage point, it may be finally possible to assess with some certainty what influence the discourses I have described had on public policy. While biofuels continue to be a matter of interest in environmental and energy policymaking, five other examples of potential applications of

discourse analysis are noteworthy. The first three – climate change mitigation, fracking, and offshore oil drilling (as preceded the BP/Deepwater Horizon spill) have already been mentioned. The fourth is nuclear power. The partial meltdown and radioactive fallout of the Fukushima Daiichi power plant in Japan in March 2011 renewed long-standing debates, reminiscent of those surrounding the events of Three Mile Island and Chernobyl, over the safety and viability of nuclear power. After Fukushima, Germany, Switzerland, and several other industrialized countries halted or abandoned plans for nuclear power construction. In the US, where nuclear power had been supported by both G.W. Bush and Obama Administrations, the response to Fukushima was much more subdued. Discourse analysis may be used to examine how public and policy discourse of nuclear power has changed (and whether Fukushima marked a key turning point), how such changes have borne out in public policy, and how such discourses policies differ by country or region.

Fifth, contemporary with the recent rapid expansion of U.S. corn ethanol has been a proposed pipeline – Keystone XL, more accurately a series of additions to an existing network of pipelines – which, if approved and completed, would extend from Alberta, Canada, to the Gulf coast of Texas. The Obama Administration's handling of the project has been a matter of controversy and political debate. The Canadian government and many Republicans have pressed the Administration to approve the project, mobilizing arguments that it will provide jobs, grow the economy, and improve U.S. energy security. Opponents of the project include some landowners, and environmentalists such as Sierra Club and NRDC, which have argued that the pipeline could leak crude oil into environmentally sensitive areas, that it encourages the extraction of ecologically-harmful "tar sands" oil, and that it undermines America's commitment to reducing oil consumption and mitigating climate change. The discursive comparisons with

biofuels are manifold. Key stakeholders include major energy companies (including Koch Industries); geographically, the same region that would be affected by the pipeline is where much of the supposed expansion of cellulosic biofuels would occur; the political narrative of energy security appears to be somewhat misleading, since at least some of the crude oil would be refined in Texas and exported; scientific and environmental narratives are being leveraged by discourse coalitions both for and against the project; and as with biofuels, the Obama Administration's *Ecomodernist* credentials appear to be at stake.

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