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# Media Framing and Public Attitudes Toward Biofuels

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## Abstract

*This study investigates the relationship between media framing and public opinion on the issue of biofuels—transportation fuels made from plants, animal products, or organic waste. First, the paper investigates how media framing of biofuels has changed since the issue regained national prominence in the early 2000s. Through a detailed content analysis of newspaper coverage, the paper documents an increase in negative frames between 1999 and 2008, especially frames focusing on the negative economic effects of biofuels on consumers. Second, using data from a 2010 Internet survey of a random sample of the U.S. public, the paper analyzes the relative influence of these new media frames on public attitudes toward biofuels compared with other common predictors of public opinion, such as party ID, regional economic interests, and personal identity as an environmentalist. In general, the results confirm that public attitudes toward biofuels appear to be shaped by these new media frames, especially among those who indicate a high degree of attention to the media, suggesting the relative importance of framing effects on policy attitudes for environmental and energy policies in general.*

**KEY WORDS:** biotechnology, energy, media, national governance

## Introduction

Biofuels are currently the leading source of alternative fuel in the United States (Energy Information Administration [EIA], 2012). Over the last decade, production and consumption of biofuels has grown substantially. Legislative efforts aimed at promoting biofuels, have also increased at both the federal and state level and scientists are developing methods to produce biofuels from a wider range of feedstocks. At the same time, biofuels have become more controversial, yielding a diverse group of conflicting issue *frames*—arguments that emphasize different aspects of an issue to influence public opinion on the topic—in the media. Despite the uptick in media attention and legislative activity on biofuels, however, we know surprisingly little about public attitudes toward the rapidly expanding set of biofuels policies and technologies, or the relationship between new issue frames and public attitudes in this policy domain.

The purpose of this study is to investigate recent changes in media framing of biofuels and their possible effect on public attitudes toward specific biofuels technologies and policies. It relies on a content analysis of more than 600 articles from national media coverage of biofuels over the past decade, as well as data from an original national public opinion survey fielded in 2010. The primary research

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hypothesis is that changes in media framing of the issue have had an important influence on public attitudes toward biofuels.

The results are consistent with the primary research hypothesis. Media framing has become substantially more negative in the 10 years that we studied, with a notable rise of frames suggesting negative economic impacts from corn-based biofuels in particular. Public opinion on biofuels is also relatively negative in the national survey results, both on an absolute scale and in comparison with earlier national surveys. Finally, statistical analysis using logistic regression models finds high news attentiveness to be significant in predicting a lower chance of supporting biofuels, even controlling for other important factors such as party ID, regional economic interests, and environmental attitudes.

Theoretically, these results reinforce theories arguing the media influence public attitudes by emphasizing different issue frames and extend these theories by suggesting that media-driven framing effects have a particularly strong influence compared with other determinants of public opinion. Practically, the results suggest growing challenges for policy entrepreneurs promoting biofuels as an alternative energy option, as well as the need to consider the effect of specific frames, both positive and negative, on public attitudes toward specific biofuels technologies and policies.

The paper starts by summarizing recent developments regarding new biofuels technologies and policies. It then locates its research questions with regard to other work on public attitudes toward biofuels and alternative energy, as well as research on the role of media framing on public opinion in general. After reviewing the project's research design and methods, the paper discusses its findings concerning changes in media framing of this issue, as well as the apparent effect of increased negative media framing on public attitudes toward biofuels. The paper concludes with a few thoughts concerning the implications of the results for theories of framing effects on policy attitudes and for those interested in shaping public policy related to biofuels in the future.

## Historical Background on Biofuels Policy

In 2010, biofuels production totaled 13 billion gallons, a roughly tenfold increase over the last two decades (EIA, 2012). Most biofuel produced in the United States is corn-based ethanol, a fuel made from the sugar in corn kernels. Corn ethanol is primarily sold to American consumers as E10, a mixture of 10 percent ethanol and 90 percent gasoline that is suitable for use in all gasoline engines. E85, a mixture of 85 percent ethanol and 15 percent gasoline, is also available but is less widely used because it requires vehicles to have special "flex fuel" engines (EIA, 2009). In recent years, scientists have expanded the range of potential feedstocks to produce biofuels, especially so-called cellulosic or "second-generation" biofuels made from non-edible plant material, including corn stalks and husks, trees, and perennial grasses. Second-generation fuels are not yet commercially viable, however, and "third-generation" biofuels derived from micro-algae have not made it past the research and development stage.

Notwithstanding the recent flurry of attention, ethanol has been used as an automotive fuel since the late 19th century. Modern ethanol policies began with a

federal subsidy for corn ethanol in 1978 under the Energy Tax Act—a subsidy that continued at varying levels until 2011. At first, modern U.S. efforts to promote corn ethanol—or "gasohol," as it was referred to at the time—were justified as a means of stabilizing corn prices and farm income (Tyner, 2007). Later, the Clean Air Act Amendments of 1990 led to demand for ethanol as an oxygenate additive for gasoline to improve air quality (Solomon, Barnes, & Halvorsen, 2007). Although some hoped this policy would substantially increase ethanol demand, many vendors chose alternative oxygenates, such as methyl tertiary butyl ether (MTBE). The 20 years from 1978–98 were also a period of low oil prices, making ethanol relatively unattractive economically (Tyner, 2007). As a result, ethanol production increased slowly through the turn of the last century.

New reasons for using biofuels emerged in the last decade. Following the September 11 terrorist attacks, biofuels were touted as a way to reduce America's reliance on Middle Eastern oil. In addition, ethanol was also claimed to be a better fuel option for mitigating climate change (Tyner, 2007). Hence, the last 10 years gave the public a wider range of reasons to be in favor of biofuels. In addition, prohibitions on the use of MTBE as a fuel additive due to groundwater contamination problems increased demand for ethanol (Solomon et al., 2007), while crude oil prices soared to unprecedented levels after 2004, making ethanol more attractive economically (Tyner, 2007).

New policies to increase production of biofuels quickly followed, including the Renewable Fuel Standard (RFS) created by the 2005 Energy Policy Act and expanded in the 2007 Energy Independence and Security Act (EISA). This policy establishes minimum yearly standards for renewable fuel production and consumption. The requirements increase each year; in 2011, the policy required the use of 13.95 billion gallons of biofuels.[1] In addition, Congress revised the long-standing subsidy for corn-based ethanol in 2004, creating the Volumetric Ethanol Excise Tax Credit to streamline previous subsidies for corn-based ethanol (Solomon et al., 2007). Proponents of these policies declared corn-based ethanol an environmentally beneficial option to rebuild America's rural economies and decrease dependence on Middle Eastern oil (Bush, 2006). The subsidy for corn ethanol expired at the end of 2011, however, leaving corn ethanol production unsubsidized for the first time in more than 30 years. Despite the lapse of the corn ethanol subsidy, Congress has continued to encourage the production of cellulosic biofuels, most notably by establishing a larger subsidy for producers of second-generation cellulosic biofuels in the 2008 Farm Bill (Yacobucci, 2012).

Even as these new policies spurred increases in production, biofuels became increasingly controversial. By the mid-2000s, critics began to draw attention to the negative environmental impacts of biofuels production, such as water pollution and deforestation (Global Insight, Inc., 2007). They challenged claims that corn-based ethanol has a smaller climate change impact than regular gasoline (Farrell et al., 2006; also see Groom, Gray, & Townsend, 2008). They also contended that the diversion of corn from the food supply would create food shortages and higher food prices (Curtis, 2008; Global Insight, Inc., 2007; Tokgoz et al., 2007; Westcott, 2007). Advocates of advanced second- and third-generation biofuels responded that these fuels can overcome the problems associated with corn-based ethanol. In particular, they claimed that cellulosic biofuels do not

impact the food supply because they are made from nonedible plant materials (Bush, 2006; EIA, 2009).

In sum, biofuels have become more controversial in the past decade, with different sides trying to influence public opinion on the issue by framing biofuels positively and negatively in terms of their possible environmental, economic, and national security effects. Many of these frames have made their way into media coverage of the issue, and for this reason we expect public opinion on biofuels policy to be significantly affected by these new frames

## Public Opinion on Biofuels, Energy, and the Environment

Public support for corn-based ethanol, the leading biofuel in the United States, appears to be declining over the past decade (Delshad, Raymond, Sawicki, & Wegener, 2010; Pew Research Center for the People and the Press, 2008; Solomon & Johnson, 2009; Wegener & Kelly, 2008). A series of polls by the Pew Research Center for the People and the Press (2008) also suggests that public support for policies promoting ethanol has declined, with only a narrow majority of Americans supporting federal funding of ethanol in 2008. In addition, several studies have found that the public is willing to pay only slightly more per gallon of fuel to use biofuels instead of gasoline (Johnson, Halvorsen, & Solomon, 2011; Petrolia, Bhattacharjee, Hudson, & Herndon, 2010; Solomon & Johnson, 2009). Support for advanced "cellulosic" biofuels, however, has remained relatively high (Delshad et al., 2010; Pew Research Center for the People and the Press, 2008; Wegener & Kelly, 2008).

Only a few studies have tried to establish what arguments or frames shape public attitudes toward biofuels, and the results are inconsistent. In a national mail survey, Petrolia et al. (2010) found environmental reasons to be the most commonly cited justification for the government to pursue an alternative fuels program, with national security arguments a close second. In a series of focus groups with Indiana residents, by contrast, Delshad et al. (2010) found concerns regarding environmental quality were commonly used *both* to support and oppose biofuels. The focus groups also featured many references to the "fairness" or "unfairness" of certain biofuels policies, especially subsidies (Delshad et al., 2010). Finally, in contrast to Petrolia et al.'s (2010) study, Delshad et al. (2010) found very few individuals mentioned concerns regarding national security.

In terms of second-generation biofuels, empirical findings are also mixed. For example, a recent mail survey of three Upper Midwest states found that individuals concerned about climate change had a significantly lower willingness to pay for cellulosic ethanol, while those who were more worried about energy security had no measurable difference in their willingness to pay (Johnson et al., 2011). These results partially contradict previous work using a different statistical analysis of the same data that found a positive association between concern about climate change and willingness to pay for cellulosic ethanol (Solomon & Johnson, 2009). A smaller survey in the Southern United States found several stakeholder groups favored forest-based cellulosic biofuels based on three main strengths: energy security, the availability of sufficient forest biomass, and the lack of

competition with food production (Dwivedi & Alavalapati, 2009). Thus, recent research offers conflicting information on what arguments and concerns shape public opinion on this issue.

Perhaps surprisingly, existing research has paid little attention to the role of the media in shaping public opinion on this issue. This is despite theories dating back to Downs's (1972) "issue attention cycle" positing a key role for the media in affecting the public salience of environmental policy issues. Subsequent research suggests that as the public's primary source of information, the media has a powerful ability to influence public attitudes on all manner of political issues (Chong & Druckman, 2007; Clawson & Waltenburg, 2003; Nelson, Oxley, & Clawson, 1997). Framing is one particularly important way media coverage shapes those attitudes.

Formally defined, *framing* is the selection of "some aspects of perceived reality and make them more salient in a communication context, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation" (Entman, 1993, 52). An underlying assumption is that media frames will influence how people understand an issue, and thus their attitudes toward that issue. For example, by showing images of African Americans and discussing black ghettos and "welfare queens" in stories concerning welfare, the media leads the public to think of welfare in racial terms and incorrectly believe that most recipients of welfare are black (Gilens, 1995). This framing also makes some individuals more likely to oppose welfare policies. We expect media framing to influence public support for biofuels technologies and policies in a similar manner. Thus, we hypothesize (H1) that prominent issue frames in the media related to biofuels will significantly influence public attitudes toward biofuels and policies to promote them.

Several other factors are also thought to influence public opinion on energy and environmental policies. First, *regional economic interests* have been shown to play a large role in shaping public attitudes toward alternative energy policies and technologies. Economic arguments in favor of alternative energy sources can be a critical factor in building support for such policies (Rabe, 2004), and the dominance of fossil fuel industries can make states reluctant to adopt such policies even where natural conditions are well-suited for renewables (Carley, 2011; Rabe, 2008; Wiener & Koontz, 2010). In addition, controversies over policies such as the 1990 Clean Air Act Amendments that limited sulfur dioxide emissions from electricity power production displayed strong regional divisions (Cohen, 1995; Joskow & Schmalensee, 1998). Early requirements to add ethanol to gasoline to reduce local air pollution followed a regional pattern as well: unpopular in coastal states, but strongly supported by Midwestern states in the "corn belt" (Kraft, 2011).

Work on biofuels offers more equivocal evidence on the role of regional economic interests in shaping public attitudes. Delshad and others (2010) found that support for biofuels among residents of Indiana in focus groups was lower than documented in prior studies for the broader U.S. public (Pew Research Center for the People and the Press, 2008; Wegener & Kelly, 2008).[2] In addition, Johnson et al. (2011) found rural residents of the Upper Midwest to be no different from urban residents in their willingness to pay for cellulosic ethanol, despite any potential economic gains for rural areas from ethanol production. Even in the face of this limited evidence to the contrary, however, we hypothesize (H2) that individuals who

live in the Midwest will be more supportive of biofuels and biofuel policies in general, based on larger trends from research on energy policy in general.

A second important determinant of public opinion is *partisanship and ideology*. For the most part, Democrats are more strongly associated with pro-environmental protection attitudes than Republicans, especially on issues such as natural resource extraction or regulation of private landowners (Dunlap, Xiao, & McCright, 2001; Shipan & Lowry, 2001). At least one study of attitudes toward biofuels also found politically liberal respondents to have a significantly higher willingness to pay for E-10 than other respondents (Petrolia et al., 2010). Biofuels have also been promoted as a solution to climate change, a policy area where partisan and ideological divides have become very strong over the last decade. Several studies find a state's political liberalism to be an important factor in predicting adoption of climate change mitigation policies (Chandler, 2009; Wiener & Koontz, 2010).

Partisan and ideological differences are less prominent in studies of public opinion on other alternative energy policies. For example, the Pew Research Center for the People and the Press (2008) documents differences of only 1–3 percent between Republicans and Democrats in support for increased auto fuel efficiency, funding for alternative energy, and funding for ethanol research, findings echoed in other research (e.g., Rabe & Borick, 2008). In addition, several prominent political supporters of biofuels have been Republicans, including President George W. Bush and Indiana Senator Richard Lugar. Therefore, we are uncertain whether partisanship will significantly influence attitudes toward biofuels. Our tentative hypothesis (H3) is that Democrats will express greater support for cellulosic biofuels, which are expected to be more environmentally friendly and result in fewer emissions associated with climate change, but not for regular, corn-based biofuels.

Along the same lines, researchers have also documented that individuals who *identify as environmentalists* or have strong environmental values tend to be more supportive of alternative energy (Bang, Ellinger, Hadjimarcou, & Traichal, 2000; Johnson et al., 2011). Consistent with the previous discussion of partisanship, biofuels are an interesting test of this relationship because their environmental impacts have become more controversial. Once again, our tentative hypothesis (H4) is that environmentalists will express more support for second-generation cellulosic biofuels than non-environmentalists, but not for corn-based ethanol.

Finally, research has shown the influence of a few other demographic factors on public opinion in this area, including education level and gender (Johnson et al., 2011; Petrolia et al., 2010). We include these factors in our analysis as well.

## Research Methods

To assess changes in media coverage of biofuels we conducted a detailed content analysis of 610 articles from two major newspapers, The *New York Times* (*NYT*) and the *Washington Post* (*WP*), from 1999 to 2008. We gathered our media data using the *Lexis-Nexis* database, including all articles that mentioned the terms "ethanol, E85, biofuel, or biofuels" in the headline, the highlight (summary of the article), or the lead (the first three sentences).

Using qualitative content analysis techniques, we read each article and recorded how the media framed biofuels within that article. Prior research on media framing

**Table 1.** Media Frames for Biofuels, Based on Content Analysis of Articles from *New York Times* and *Washington Post*, 1999–2008

| Frame | Explanation |
|---|---|
| National security | Focuses on biofuels as a domestic alternative to "foreign oil." Often includes references to the Middle East and terrorism. |
| Environmental costs | Discusses potential environmental problems caused by biofuels production or use, including increased smog, water pollution, soil erosion, decreased conservation land, harm to animals on lands, deforestation and other harmful land-use changes, and increased or unchanged greenhouse gas emissions. |
| Environmental benefits | Focuses on potential environmental benefits derived from biofuel production/use. These include general references to biofuel as "cleaner burning fuel," as well as the alleviation of specific problems such as urban air pollution, and global warming. |
| Unfair | Suggests that the primary beneficiaries of biofuels production and policies are large, undeserving agri-business corporations, American automakers, and wealthy investors. |
| Fair | Suggests that the primary beneficiaries of biofuels production and policies are deserving rural citizens and farmers who grow corn and participate in co-op refineries—particularly in the Midwest Corn Belt. |
| Economic costs | Connects ethanol to increased consumer costs. |
| *Food versus fuel subframe | A prominent, recent subframe within the "Economic Costs" frame. Connects the production of fuel from edible crops to food shortages and increases in food prices. |
| Economic benefits | Connects ethanol to decreased consumer costs—particularly fuel/energy cost. |

*Food versus fuel also frames the issue in terms of economic costs, but in a particular way that emerged as common in the last 5 years. Thus, we identify it as a "subframe" within the larger group of economic cost frames in this analysis.

and public discourse regarding biofuels informed our analysis, but coding was not limited to a set of predetermined frames. Consistent with prior studies (Altheide, 1987; Charmaz, 2004), we read all articles and statements at least once, and coded all of the frames present in each, adding new frames to our coding sheet as required. In this respect, a single article could contain multiple frames. Finally, we tabulated the percentage of articles using each frame by year. The final list of media frames is summarized in Table 1.

We then compared patterns of media framing to trends in public support for biofuels and differences in attitudes among those in our survey who reported being more or less attentive to the news. In order to estimate public attitudes regarding the increasingly complex range of biofuels technologies and policies, we employed a survey research firm—YouGov Polimetrix—to conduct an online survey of a representative sample of the U.S. public (N = 1,000).[3] As generational gaps in the use of landline telephones have widened and computer literacy has proliferated, social scientists have turned to the Internet as an important new mechanism for gathering public opinion data. As a result, web-based surveys are now recognized in the academic community for yielding highly representative samples (Chang & Krosnick, 2009; Rivers, 2007). We also conducted our survey online because it allowed us to more easily convey information concerning biofuels and biofuels policies to survey respondents, including detailed frames for these issues based on our media content analysis, which was important given the number of specific fuels and policies discussed in the survey. Aside from being older and slightly more educated, our sample closely reflects the American public at large.[4]

The survey asked respondents a series of closed-ended questions concerning the following topics: biofuels, corn-based ethanol, cellulosic ethanol, biofuels policy in general, a corn ethanol subsidy, a cellulosic ethanol subsidy, and an Alternative Fuel Standard (AFS) policy similar to the Renewable Fuel Standard enacted by Congress

**Table 2.** Technology and Policy Descriptions as Presented in Survey Instrument

| Technology/Policy | Description |
|---|---|
| Biofuels and corn-based ethanol | Biofuels are fuels made from plants or other biological materials, e.g., fats or oils that can be used in cars, trucks, and other engines. One of the most common biofuels is ethanol, which is made by converting plant sugars into an alcohol that can be used as fuel. Several plants, including corn, can be used to produce ethanol. |
| Cellulosic ethanol | Cellulosic ethanol is fuel that can be used in cars, trucks, and other engines. Cellulosic ethanol is made from nonedible plant materials, which cannot be used to produce regular ethanol. Specifically, cellulosic ethanol is made from the nonedible parts of a wide range of plants, including corn stalks and cobs (rather than the kernels), native grasses, trees, or wood chips. |
| Alternative fuels standard | Some policy makers suggest that the government should require that a minimum amount of transportation fuel come from biofuels. In other words, the government should require filling stations to use a certain minimum percentage of biofuels in the mix of fuels they sell. |
| Corn ethanol subsidy | Some policy makers suggest that producers of ethanol (those who blend ethanol with gasoline) should be given a fixed tax credit equal to 45 cents for every gallon of ethanol they blend with gasoline. In other words, ethanol producers would pay 45 cents less in corporate taxes for every gallon of ethanol-blended gasoline they produce. |
| Cellulosic ethanol subsidy | The same kind of fixed subsidy but only for producers of cellulosic ethanol, made from nonedible plant material. |

**Table 3.** Biofuels Framing Questions from Survey

| | |
|---|---|
| 1 | Using more (biofuel technology) will help protect the environment. |
| 2 | Using more (biofuel technology) will help American consumers financially through lower fuel costs. |
| 3 | Using more (biofuel technology) will hurt American consumers financially through higher food costs. |
| 4 | Using more (biofuel technology) will help American farmers financially. |
| 5 | Using more (biofuel technology) will help America's national security by reducing our dependence on foreign oil. |
| 6 | (Policy) would benefit the environment. |
| 7 | (Policy) would benefit American citizens financially. |
| 8 | It is fair for the government to (enact policy). |
| 9 | (Policy) would help America's national security by reducing our dependence on foreign oil. |

Support for each frame asked using 5-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

in 2005. After asking respondents concerning their knowledge on each topic, the survey provided a brief explanation of each specific technology or policy before asking for opinions on that topic (Table 2).

Next, respondents evaluated different statements concerning the possible impacts of each particular biofuels policy or technology listed in Table 2. Each statement reflects a prominent media frame concerning biofuels, and responses to these questions help us assess the relationship between media coverage of biofuels and public support for those same frames. Finally, the survey included questions concerning other potential determinants of respondents' attitudes toward this issue, including party identification, identification as an environmentalist, level of attention to the news media, state of residency, and other demographic characteristics including gender and level of education.

We test for media framing influence in several ways. First, we compare our respondents' level of agreement with prominent media frames—using responses to the questions in Table 3—to trends in media usage of those frames. Second, we test

our hypotheses using logistic regression models. Within these models, the dependent variables are all coded 1 if the respondent supports a technology, policy, or frame, and 0 otherwise. The key independent variables in our analysis—news attentiveness, party identification, environmentalism, Midwestern resident—are reported as dummy variables. In most cases, these questions were asked in a binary manner, e.g., "do you consider yourself an environmentalist." In the case of news attentiveness, we asked respondents their level of interest on a 4-point scale, and then created a dummy variable for those reporting they pay attention to the news media "most of the time," which is the highest value on the Likert scale for the question. Gender is coded 1 for male, and 0 for female. Education was measured on a 6-point scale, ranging from no high school diploma to a post-graduate degree.[5]

We use a logistic regression model to estimate the relative influence of these independent variables on the probability of an individual's support for a particular biofuels policy or technology. To focus our analysis on the crucial political question of support versus nonsupport, we also collapsed our Likert-scale data on support for various biofuels policies, technologies, and frames into dummy variables, with scores of 4 or 5 on the Likert scale recoded as 1, indicating "support" for the policy.

We expect news attentiveness to have the greatest association with support for biofuels policies that are criticized or praised in the most common media frames. For example, if our primary hypothesis is correct, a prominent media frame attributing higher food prices to production of corn-based ethanol should lower public support for corn ethanol, but not for cellulosic ethanol. In this respect, the more detailed dependent variables in this survey allow us to test the apparent influence of media frames in a more sophisticated manner.

## Findings

We begin by reviewing the results of our media framing analysis. Second, we review public attitudes toward biofuels from our national survey. Finally, we present the results of our logistic regression analyses testing the influence of news attentiveness, party identification, environmentalism, Midwestern residence, gender, and level of education with support for biofuels in general, as well as specific biofuels options.

### *Media Framing of Biofuels*

Content analysis of media coverage of biofuels in the *NYT* and *WP* reveals seven common frames in media discourse over the past decade, as were summarized in Table 1. These frames characterize biofuels as facilitating national security through energy independence, as environmentally harmful or helpful, as unfair or fair, and as economically costly or beneficial. In addition, we find a "subframe" within the category of environmental costs, specifically criticizing biofuels for increased food prices. Four of these media frames characterize biofuels in a negative light: environmental costs, economic costs, food versus fuel, and unfairness. The other four frames—energy independence, environmental benefits, economic benefits, and fairness—highlight positive aspects of biofuels.

Table 4 summarizes the percentage of articles using each frame in the first and second 5 years of our data. The data suggest that media coverage of biofuels has

**Table 4.** Media Framing of Biofuels

| | 1999–2003 (%) | 2004–2008 (%) | Net Change (%) |
|---|---|---|---|
| Negative frames overall* | 65 | 89 | 24 |
| Environmental costs | 23 | 26 | 3 |
| Unfair | 19 | 16 | –3 |
| Economic costs | 24 | 47 | 23 |
| Food versus fuel subframe** | 0 | 27 | 27 |
| Positive frames overall | 97 | 96 | –1 |
| Environmental benefits | 42 | 36 | –6 |
| Fair | 13 | 7 | –6 |
| Economic benefits | 16 | 23 | 7 |
| National security | 26 | 30 | 4 |

*Figures represent percentage of all media article on biofuels using a particular frame in a given time period. Negative and positive frames overall rows reflect percentage of articles using at least one negative or positive frame, respectively.

**Articles using food versus fuel subframe are also included in totals for the economic costs frame.

become more negative over the past decade, particularly when it comes to the economic effects of biofuels. From 1999–2003, the media used more positive frames for biofuels, with 97 percent of articles mentioning at least one positive frame and only 65 percent mentioning at least one negative frame. The media devoted the greatest attention to the environmental effects of biofuels during this period: 42 percent of media articles highlighted the environmental benefits of biofuels, while only 23 percent took note of their environmental costs. Positive frames connecting biofuels to national security were also common—26 percent of all articles—peaking in the period around 9/11 (50 percent of articles in 2001 and 42 percent in 2002).[6] A good example is from October 19, 2003 edition of the *WP*:

> Because adding ethanol to gasoline makes the fuel more efficient, its use will help the United States reduce its reliance on foreign oil even as it helps to make the air we breathe safer.

While the overall trend in media framing during this period was positive, negative frames also appeared in a majority of all articles, with the media more commonly noting the negative (24 percent of all articles) as opposed to positive (16 percent of articles) economic impacts of biofuels, and the unfairness (19 percent of articles) as opposed to fairness (13 percent of articles) of biofuels policies.

From 2004 to 2008, however, media coverage paid greater attention to the negative impacts of biofuels. Eighty-nine percent of articles published from 2004 to 2008 mention at least one negative frame, an increase of 24 percentage points over the previous period. Negative framing focused on the economic impacts of biofuels on consumers, with the economic cost frame appearing in 47 percent of media articles during this period, and 67 percent of media articles in 2008. This represents a doubling of the frequency of articles with this frame compared to the first 5 years of our sample.

Particularly notable was the emergence of a subframe within this economic cost frame condmening biofuels for raising food costs. The excerpt below is a good example of what we refer to as the new "food versus fuel" subframe:

> . . . these fuels are driving up food prices and starving poor people . . . higher prices are leading to riots, political instability and growing worries about feeding the poorest people

> . . . While grocery prices in the United States have increased about 5 percent over all in the last year, some essential items like eggs and milk have jumped far more . . . (*NYT*, 4/15/2008)

This subframe did not appear in a single media article through 2003, but is featured in 27 percent of articles from 2004–2008 (and over 40 percent of articles in 2008). From 2004 to 2008, the media also continued to frame biofuels policies negatively by depicting them more frequently as unfair (16 percent) than fair (7 percent). Despite the overall trend toward negative framing, positive aspects of biofuels continued to be mentioned. Environmental benefits frames continued to appear more often (36 percent) than those portraying environmental harms from biofuels (26 percent), and 30 percent of articles included the national security frame, up slightly from the previous period.

Based on the increased prevalence of many negative frames in more recent media coverage, especially those related to the economic costs of biofuels, relatively weak approval for biofuels among our respondents would support our primary hypothesis regarding the influence of media framing. In addition, the recent prominence of the food versus fuel subframe suggests that if our primary hypothesis is correct, public support for corn-based ethanol should be substantially lower than for cellulosic ethanol, due to worries concerning higher food costs from fuels made from edible feedstocks. Finally, if our primary hypothesis is correct, the public should also support frames identified as prominent in the media analysis, such as the food versus fuel frame, and oppose frames that are increasingly challenged in the media, such as the fairness frame.

### *Survey Results—Public Attitudes Toward Biofuels Technologies and Policies, and Issue Frames*

As noted in the Methods section, survey questions were all asked on a 5-point Likert scale, with 4 or 5 indicating agreement or support for the frame, policy, or technology. We present the survey results in two ways: Table 5 summarizes the mean levels of support, while Figure 1 provides the percentage of respondents offering different levels of support or agreement with the specific biofuels policies, technologies, and frames used as dependent variables in our logistic regressions in the next section.

Consistent with the increase in negative media framing, our respondents offered relatively weak approval of *biofuels in general*. Figure 1 indicates a plurality of our respondents (45.3 percent) supported biofuels in general, while Table 5 shows that mean support for biofuels was a modest 3.31 on a 5-point Likert scale. However, the results also suggest that support for biofuels is on the decline. For example, only 37 percent of our respondents who agreed with the statement "using biofuels, such as ethanol, is a good idea," compared with 79 percent of respondents who agreed with the same statement in a previous national phone survey (Wegener & Kelly, 2008). Other studies from this earlier time period also found higher percentages of respondents supporting biofuels in general (e.g., Rabe & Borick, 2008). This weakening of support for biofuels is consistent with our primary hypothesis.

**Table 5.** Mean Public Support for Biofuels Technologies, Policies, and Frames*

| | Mean Support |
|---|---|
| Biofuels technologies/policies | |
| Biofuels in general | 3.31 |
| Corn ethanol | 3.18 |
| Cellulosic ethanol | 3.87 |
| Cellulosic ethanol from nonedible corn | 4.09 |
| Cellulosic ethanol from native grasses | 3.80 |
| Cellulosic ethanol from trees | 3.34 |
| Biofuels policy in general | 3.33 |
| Corn ethanol subsidy | 2.87 |
| Cellulosic subsidy | 3.07 |
| Alternative fuel standard (AFS) | 2.90 |
| Biofuels frames | |
| Corn ethanol helps environment | 3.24 |
| Corn ethanol helps consumers | 3.06 |
| Corn ethanol hurts consumers** | 3.43 |
| Corn ethanol helps farmers | 3.82 |
| Corn ethanol helps national security | 3.43 |
| Cellulosic ethanol helps environment | 3.79 |
| Cellulosic ethanol helps consumers | 3.68 |
| Cellulosic ethanol hurts consumers** | 2.33 |
| Cellulosic ethanol helps farmers | 3.86 |
| Cellulosic ethanol helps national security | 3.91 |
| AFS helps environment | 3.25 |
| AFS helps consumers | 2.94 |
| AFS helps national security | 3.25 |
| AFS policy is fair | 2.90 |
| Corn ethanol subsidy helps environment | 2.77 |
| Corn ethanol subsidy helps consumers | 2.63 |
| Corn ethanol subsidy helps national security | 2.99 |
| Corn ethanol subsidy policy is fair | 2.60 |
| Cellulosic subsidy helps environment | 3.13 |
| Cellulosic subsidy helps consumers | 2.98 |
| Cellulosic subsidy helps national security | 3.23 |
| Cellulosic subsidy policy is fair | 2.99 |

*Support for each *technology and policy* asked using 5-point Likert scale: 1 = strongly oppose, 2 = oppose, 3 = neutral, 4 = support, and 5 = strongly support. Support for each *frame* asked using 5-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.
**Specifies harm to consumers through higher food costs (food versus fuel subframe). See Table 3 for precise wording of all frames.

Also consistent with increases in negative media framing, respondents were only weakly supportive of *policies to promote biofuels* (46.2 percent support, 23.1 percent opposed, M = 3.33). Here, more respondents were opposed than in support of all specific policy options except a subsidy for producers of cellulosic biofuels, which is consistent with respondents' relatively high level of support for cellulosic biofuels in general. Table 5 also indicates that respondents disagreed on average with all *positive policy frames* except for the environmental and national security frames for the AFS and the cellulosic subsidy.

Consistent with the rise of the food versus fuel subframe, respondents were substantially more supportive of cellulosic biofuels (66.9 percent support, 8.1 percent opposed, M = 3.87) than of biofuels made from edible corn kernels (46.1 percent support, 31.8 percent opposed, M = 3.18). In addition, people were most supportive of making ethanol from the nonedible parts of corn plants (78.3 percent

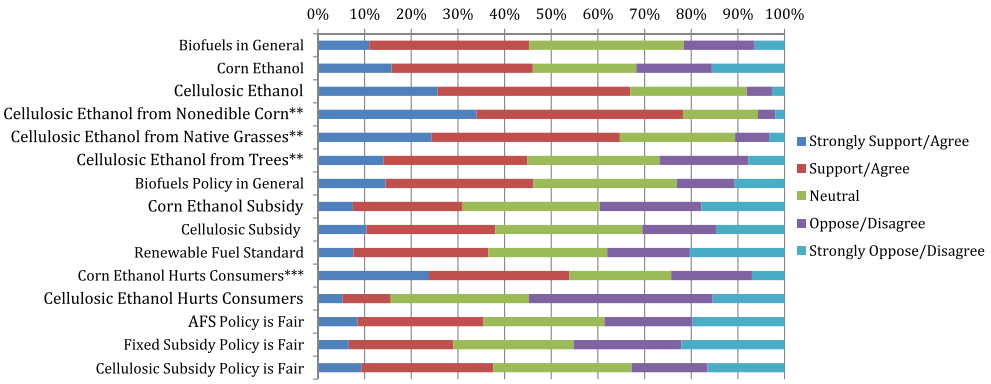


**Figure 1.** Public Support for Biofuels Technologies, Policies, and Frames, %Agreement*
*Support for each technology and policy was asked using a 5-point Likert scale: 1 = strongly oppose, 2 = oppose, 3 = neutral, 4 = support, and 5 = strongly support. Support for each frame was asked using a 5-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.
**These figures represent levels of support for cellulosic biofuels made specifically from nonedible corn, native grasses, or trees, respectively.
***Statements concerning corn ethanol/cellulosic biofuels hurting consumers are indicative of the food versus fuel subframe.

support, 5.7 percent opposed, M = 4.09) compared with other possible sources, including native grasses (64.7 percent support, 10.6 percent opposed, M = 3.80) and trees (44.9 percent support, 26.8 percent opposed, M = 3.34).

Respondents also followed the food versus fuel frame by disagreeing with frames suggesting *any policy* would help consumers. Respondents also agreed (53.9 percent agree, 24.3 percent disagree, M = 3.43) that corn-based ethanol would hurt consumers, but not that cellulosic biofuels will do so (15.6 percent agree, 54.8 percent disagree, M = 2.33). Finally, respondents were more supportive of the environmental benefits frame for cellulosic biofuels (54.8 percent agree, 16.3 percent disagree, M = 3.79) than for corn-based ethanol (43.5 percent agree, 32.2 percent disagree, M = 3.24), again consistent with the food versus fuel frame.

Figure 1 also indicates that respondents agreed least with the fairness frame for each policy, except for the cellulosic subsidy where agreement with the fairness frame was virtually tied with the agreement for the idea that such a subsidy would help consumers. Similarly, more respondents disagreed with the fairness of the corn ethanol subsidy (29 percent agree, 45.2 percent disagree) and the AFS (35.5 percent agree, 38.6 percent disagree), although a slight plurality agreed the cellulosic subsidy was fair (37.6 percent agree, 32.8 percent disagree). This view that most biofuels policies are unfair is also consistent with recent changes in media framing of the issue.

In sum, our results indicate that public support for biofuels is weak overall, relatively weaker than a few years earlier, and that the public prefers biofuels made from nonedible feedstocks. These results also indicate public agreement with several prominent negative media frames concerning biofuels, especially the new food versus fuel frame. These results provide initial support for our main hypothesis (H1) that media frames should be associated with public attitudes toward biofuels.

### *What Factors Best Explain Public Attitudes and Framing of Biofuels?*

We now use logistic regression models to examine the relative influence of specific factors in shaping the public's attitudes toward biofuels. Across the models designed to explain support for different biofuels technologies, high news attentiveness is the only variable that is consistently significant (see Table 6). Individuals who reported following the news "most of the time" were significantly less likely to be supportive of biofuels in general, as well as both corn ethanol and cellulosic ethanol, than individuals who reported following the news less frequently. A similar pattern exists for models predicting support for biofuels policies, except for support for biofuels policy in general. The effects are not modest and parallel the negative trends in media framing. For example, individuals with high news attentiveness were 49 percent less likely to support corn-based ethanol ($p < .001$) and 62 percent less likely to support the corn ethanol subsidy ($p < .001$) than individuals who are less attentive to the news. This result is additional evidence for our primary hypothesis (H1) that individual attitudes toward biofuels are likely to be influenced by prominent media frames.

Results concerning the influence of regionalism provide mixed support for our second hypothesis (H2). Consistent with our hypothesis, Midwesterners were about 1.5 times more likely ($p < .05$) to support both corn ethanol and cellulosic ethanol than non-Midwesterners. On the other hand, being from the Midwest had no effect on the likelihood of supporting any of the specific policies currently in use to promote biofuels, or biofuels policy in general.

Our models fail to support our hypothesis (H3) concerning partisanship. Contrary to our expectations, Democrats were significantly ($p < .001$) more likely to support biofuels in general and corn ethanol in particular, but were not more likely to support cellulosic ethanol. In addition, Democrats were significantly ($p < .001$) more likely than Independents and Republicans to support all biofuels policies, including subsidies for corn ethanol. In all cases, the magnitude of the effect was substantial, with Democrats nearly three times more likely to support various policies, and two times more likely to support biofuels in general or corn ethanol, than Independents and Republicans. None of this is consistent with our expectation that Democrats would favor cellulosic ethanol over traditional corn ethanol, based on new publications concerning the environmental advantages of these second-generation biofuels.

Finally, the results in Table 6 provide mixed support for our final hypothesis (H4) that environmentalists should support cellulosic biofuels but not corn-based ethanol. Consistent with our hypothesis, self-identified environmentalists were significantly ($p < .01$) more likely to support cellulosic ethanol than non-environmentalists. In disagreement with our hypothesis, however, environmentalists were also significantly ($p < .05$) more likely to support corn-based ethanol than non-environmentalists. In terms of biofuels policies, being an enviornmentalist had no effect on the likelihood of supporting a subsidy for either corn-based or cellulosic ethanol, although it did significantly ($p < .001$) increase the chances of supporting an alternative fuels standard and biofuels policy in general. In sum, environmentalists in our sample do not appear to discriminate between the different biofuels despite their different environmental implications.

**Table 6.** Factors Predicting Support for Biofuels Technologies and Policies (Logistic Regression Models)

| | Biofuels in General | | Corn Ethanol | | Cellulosic Ethanol | | Biofuels Policy in General | | AFS | | Corn Ethanol Subsidy | | Cellulosic Subsidy | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coefficient | Odds Ratio | Coefficient | Odds Ratio | Coefficient | Odds Ratio | Coefficient | Odds Ratio | Coefficient | Odds Ratio | Coefficient | Odds Ratio | Coefficient | Odds Ratio |
| Environmentalist | 0.54*** | 1.69 | 0.38* | 1.46 | 0.55** | 1.73 | 0.86*** | 2.36 | 0.81*** | 2.25 | −0.14 | 0.87 | 0.19 | 1.21 |
| Midwesterner | 0.21 | 1.24 | 0.40* | 1.50 | 0.49* | 1.63 | 0.16 | 1.18 | 0.07 | 1.07 | 0.24 | 1.27 | 0.36 | 1.43 |
| Democrat | 0.68*** | 1.98 | 0.73*** | 2.08 | 0.35 | 1.42 | 1.09*** | 2.96 | 0.97*** | 2.65 | 1.03*** | 2.80 | 1.01*** | 2.75 |
| High news attentiveness | −0.37* | 0.69 | −0.68*** | 0.51 | −0.44* | 0.65 | −0.23 | 0.79 | −0.38* | 0.68 | −0.96*** | 0.38 | −0.59** | 0.55 |
| Male | 0.19 | 1.21 | −0.30* | 0.74 | 0.08 | 1.09 | −0.01 | 0.99 | −0.31 | 0.74 | −0.57** | 0.57 | −0.03 | 0.97 |
| Education | 0.03 | 1.03 | −0.11* | 0.90 | 0.10 | 1.10 | 0.17** | 1.16 | 0.03 | 1.03 | −0.07 | 0.94 | 0.10 | 1.11 |
| Constant | −0.67 | 0.51 | 0.14 | 1.32 | 0.36 | 1.39 | −1.34 | 0.26 | −1.06 | 0.35 | 0.72 | 2.06 | −0.13 | 0.88 |
| N | 715 | | 768 | | 666 | | 753 | | 720 | | 518 | | 484 | |
| Chi-square (p-value) | 40.71 (.00) | | 72.98 (.00) | | 27.56 (.00) | | 101.15 (.00) | | 86.05 (.00) | | 72.85 (.00) | | 40.79 (.00) | |
| Cox and Snell $R^2$ | 0.06 | | 0.09 | | 0.04 | | 0.13 | | 0.11 | | 0.13 | | 0.08 | |

*p ≤ .05; **p ≤ .01; ***p ≤ .001.

In addition, we tested our main hypothesis regarding the influence of media framing on public opinion by running several logistic regression models to explain agreement with two prominent media frames as applied to specific biofuels policies and technologies (see Table 7). First, we analyzed factors predicting support for the food versus fuel subframe. Consistent with our main hypothesis (H1), the relationship between high news attentiveness and probability of agreement with the food versus fuel subframe was statistically significant ($p < .001$) and positive for this frame as applied to corn ethanol but not significant for cellulosic biofuels. In fact, those who were highly attentive to the news were 2.5 times more likely to agree that corn ethanol leads to higher food prices than those who were not highly attentive—making news attentiveness the most important in predicting support for this frame. Similar analysis (not reported in the table), of factors predicing support for the frame describing economic *benefits* from policies to support corn and cellulosic biofuels show the coefficient on high news attentiveness to be significant and negative, indicating those who pay greater attention to the media are less likely to support an economic benefits frame. Both results are consistent with our primary hypothesis regarding the influence of media frames on public attitudes as applied to the rise of the food versus fuel frame.

We also examined agreement with fairness frames for biofuels policies. Within these models, high news attentiveness was significantly associated with a decreased probability ($p < .01$) of supporting the idea that any of these policies were fair. Those who were highly attentive to the news were approximately half as likely to support a fairness frame applied to a particular biofuels policy than individuals who paid less attention to the news. Again, this is consistent with our primary hypothesis (H1) and with trends in media coverage, which in recent years has framed biofuels as unfair.

## Conclusion

A comparison of national trends in media framing and data from a national survey provide support for our primary research hypothesis that media framing has had an important effect on public attitudes toward biofuels. Our analysis of media framing of the biofuels issue from 1998 to 2008 documents the rise of new negative frames regarding biofuels, especially frames describing the economic costs of biofuels in general, and the threat of higher food prices in particular. A national public opinion survey offers remarkably consistent results with these shifts in media framing: weak public support for biofuels in general, and for corn-based ethanol in particular. Logistic regression models confirm that news attentiveness is a consistently important factor in predicting attitudes toward various aspects of the biofuels issue, even when controlling for other factors, including partisanship, region, and identification as an environmentalist.

Although we find strong support for the apparent influence of news attentiveness and media framing on public attitudes toward biofuels, the results are more equivocal regarding our other hypotheses. Because Midwestern corn-producing states stand to benefit more economically from biofuels, we expected residents of these states to be more supportive of biofuels technologies and policies. Although Midwesterners are significantly more likely to support corn ethanol and cellulosic

**Table 7.** Factors Predicting Support for Food Versus Fuel and Fairness Frames (Logistic Regression Models)

| | Corn Ethanol | | Cellulosic Ethanol | | | AFS | | Corn Ethanol Subsidy | | Cellulosic Subsidy | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Food versus Fuel Frame | Coefficient | Odds Ratio | Coefficient | Odds Ratio | Fairness Frame | Coefficient | Odds Ratio | Coefficient | Odds Ratio | Coefficient | Odds Ratio |
| Environmentalist | −0.20 | 0.82 | −0.07 | 0.93 | Environmentalist | 1.06*** | 2.88 | 0.46* | 1.58 | 0.71*** | 2.03 |
| Midwesterner | −0.11 | 0.90 | −0.54 | 0.58 | Midwesterner | −0.16 | 0.86 | 0.31 | 1.37 | 0.13 | 1.14 |
| Democrat | −0.88*** | 0.42 | 0.17 | 1.19 | Democrat | 1.19*** | 3.28 | 0.90*** | 2.45 | 0.93*** | 2.52 |
| High news attentiveness | 0.90*** | 2.46 | −0.27 | 0.76 | High news attentiveness | −0.57** | 0.56 | −0.90*** | 0.41 | −0.52** | 0.60 |
| Male | 0.73*** | 2.07 | 0.22 | 1.24 | Male | −0.20 | 0.82 | −0.13 | 0.88 | 0.23 | 1.25 |
| Education | 0.05 | 1.05 | −0.13 | 0.88 | Education | 0.09 | 1.09 | −0.03 | 0.97 | 0.13* | 1.14 |
| Constant | −0.45 | 0.64 | −1.06 | 0.35 | Constant | −1.33 | 0.27 | −0.85 | 0.43 | −1.48 | 0.23 |
| N | 735 | | 643 | | N | 701 | | 724 | | 671 | |
| Chi-square (p-value) | 103.97 (.00) | | 8.95 (.18) | | Chi-square (p-value) | 102.20 (.00) | | 72.01 (.00) | | 66.56 (0.00) | |
| Cox and Snell $R^2$ | 0.13 | | 0.01 | | Cox & snell $R^2$ | 0.16 | | 0.10 | | 0.10 | |

*p ≤ .05; **p ≤ .01; ***p ≤ .001.

ethanol, residence in a Midwestern state has no measurable association with support for various biofuels policies.

In addition, we find biofuels to be a more partisan issue than hypothesized, with Democrats overwhelmingly more supportive of biofuels technologies and policies than Republicans. Indeed, party identification has a stronger influence on the probability of supporting biofuels in general and all biofuels policies than any other factor. Finally, we find environmentalists to be more supportive of all biofuels technologies, including corn-based ethanol, than non-environmentalists, which is counter to our expectation that environmentalists would be less likely to favor corn-based ethanol due to recent controversies over the environmental impacts of those "first-generation" biofuels.

These results for region and partisanship suggest biofuels as a whole are not following a public opinion path typical of other energy policies, where support tends to be more regional than partisan. Instead, our results indicate biofuels are a partisan issue, at least for the public, with Democrats consistently more likely to support a wide range of biofuels technologies and policies. This suggests that biofuels may be at risk of a partisan divide that now demarcates attitudes toward climate change policy (Borick & Rabe, 2010), rather than a less partisan discussion along the lines of other energy policies. It may also reflect more general support for government influence over the private sector among Democrats that may cut across multiple policy issues, including biofuels.

Most notably, however, the results suggest that media framing effects are having an important influence on public attitudes toward biofuels. In addition, the results indicate that framing effects from media exposure may be quite substantial, even in comparison with other important predictors of public opinion such as partisanship and regional interests. This adds more evidence that media issue framing is a vital factor in understanding and explaining public attitudes toward policy options independent of other ideological or material factors. The results also suggest that public opinion toward biofuels is becoming more complex as new feedstocks and technologies inspire a widening array of negative and positive frames for the issue.

Future work evaluating public attitudes toward policies supporting renewable fuels will need to pay careful attention to media framing effects amid these growing complexities. An especially important detail seems to be to what extent the fuel is characterized as harming American consumers. Further research and analysis is required, however, to confirm the relative influence of this particular frame versus others on attitudes toward various biofuels policies.

The significant impact of news attention on public attitudes also raises interesting questions concerning the media's potential effects on public policy making. As we noted in our discussion of ethanol policies, the general trend has been to encourage greater ethanol production. However, policy makers have recently shifted away from government support of corn-based ethanol and toward increased government support of advanced (cellulosic) ethanol. Media coverage using the food versus fuel frame and describing potential environmental harms associated with traditional corn-based ethanol are consistent with this shift in policy. For example, after increased media attention to the food versus fuel problem in 2007 and 2008, the EISA of 2007 and the 2008 Farm Bill put greater emphasis on cellulosic biofuels. The EISA set targets for cellulosic biofuels and other advanced biofuels to exceed

the volume of corn-based ethanol by 2018. Similarly, the 2008 Farm Bill established a subsidy for cellulosic biofuels that is more than twice the amount of the subsidy for traditional corn-based ethanol ($1.01 per gallon compared with $0.45). Most recently, the Congress allowed the long-running subsidy for corn-based ethanol to expire, consistent with increasingly negative media framing and decreasing public support for this policy. This is suggestive of the need for more research exploring the role of media framing in affecting not only public opinion, but also Congressional policy agenda setting and actions.

In terms of policy implications, these results are not encouraging for those supporting corn-based ethanol as an important fuel alternative. Corn-based ethanol and policies supporting that fuel consistently received the lowest level of support in our sample, despite being the most common biofuel on the market today. The fact that this relatively weak support even extends to the Midwest suggests that policies on corn ethanol are politically vulnerable, consistent with the 2011 expiration of the corn ethanol subsidy. Public support for second- and third-generation "advanced" biofuels, by contrast, is higher, suggesting policies promoting these fuels made from nonedible feedstocks may face a brighter political future—as long as media framing of this technology remains favorable.

These implications also extend beyond the realm of biofuels. Throughout the history of energy policy in the United States, the success of alternative sources of energy has relied in part on government backing of new technologies, which is affected by the level of public support for those technologies. In short, policy makers are more likely to subsidize or otherwise promote technologies their constituents favor. In an era where concerns regarding climate change, energy security, energy costs, and the scarcity of energy supplies are higher on the national agenda, how the media frames the costs and benefits of all energy technologies has an even greater salience. Our results suggest that the media stands to be a key player in shaping which technologies will be winners and losers in the political struggle over how the country addresses the major energy challenges confronting the world today.

## Notes

1 The EISA of 2007 expanded the AFS for "conventional biofuels," or corn-based ethanol, to 15 billion gallons by 2015, and it increased the share of the RFS that must come from "advanced biofuels," such as ethanol from sugar cane, and biodiesel, including a mandate for 16 billion gallons of cellulosic ethanol by 2022.

2 Of course, this effect is not directly comparable due to differences in research design and question wording.

3 For more information see: http://research.yougov.com/services/scientific_research/

4 Our sample was nearly identical to the U.S. public in terms of party identification, race, gender, and income. The average age of our respondents was 50 years, which is higher than the average age of Americans reported in the most recent U.S. Census—37 years. Our respondents were also slightly more educated; 95 percent were high school graduates, whereas the U.S. Census reports 85 percent of Americans are high school graduates.

5 The full range of categories for the education variable was: 1 = no high school diploma, 2 = high school graduate, 3 = some college, 4 = two-year degree, 5 = four-year degree, 6 = postgraduate degree.

6 Annual figures are not reported in Table 4 due to space limitations, but we report them in the text where they are relevant. A full table of framing data by year is available from the authors on request.

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