Bioenergy Experts and Their Imagined “Obligatory Publics” in the United States: Implications for Public Engagement and Participation.

Abstract:

The social science literature on renewable energy technology (RET) development emphasizes how imagined publics who play passive roles in technology systems influence technology design and public engagement. It further documents expert adherence to deficit models for conceptualizing publics’ responses to RETs. Building on this literature, this paper examines two related questions that have received little attention. First, how do experts conceptualize publics whose *direct participation with* technology development, rather than *quiescence toward* technology development, is framed by experts as mandatory for the RET project’s success? Second, given both the prevalence and problematic outcomes of expert and institutional adherence to deficit models, what might an alternative model for conceptualizing publics look like? To address these questions, we draw from a case study of 30 “bioenergy experts” in the Northeastern U.S. and their imagined landowning publics. Our analysis provides two contributions. First, we develop the concept “obligatory publics” to examine expert imaginaries of publics whose direct participation is seen as mandatory for successful RET development. And second, we suggest a “hermeneutic-dialectic” approach, which emphasizes the role of dialogue between experts and publics for achieving new and mutually agreed upon understandings, as one possible alternative to public deficit models.

Introduction

Science, Technology and Society (STS) research on the social dimensions of technology development has established that expert conceptualizations or imaginaries of the behavior and response of publics, including community residents, citizen activists, or end-users, has implications for public engagement practices and outcomes (Bucchi and Neresini 2008; Einsiedel 2008; Freudenberg and Pastor 1992; Jasanoff 2003). The role of imagined publics is especially salient for emerging large-scale infrastructure and energy projects that, by design, must involve large numbers of people and quantities of material resources (Sclove 1995). In this paper, we examine the role of imagined publics in the field of renewable energy technologies (RET) by focusing on the roles publics play in RET development, and how experts conceptualize publics' responses to RET projects. As recent research reports, the aim of experts who promote RET development is to secure the social acceptance or "loyalty" (Maranta et al. 2003) of "citizens," "neighbors" (Bunningham et al. 2007), "consumers" (Marris 2015), Cooperative Extension and natural resource managers (Wright and Eaton 2014), and other "potentially overtly political actors who express opinions about; engage in opposition to; or support what is being produced, used by others, located, and operated in particular contexts" (Walker et al. 2010 933). That is, the idealized role for various publics—whose participation with "what is being produced" is at best indirect—is to embrace or, at a minimum, respond with indifference or quiescence to RET projects (Heidenreich 2015). What is key for experts is that publics act as passive recipients of fully conceived technological projects, rather than raising concerns (cf. Callon et al. 2011), or mobilizing to secure broader inclusion in planning and designing RETs (Hess 2007). Moreover, research shows experts frequently

conceptualize publics via deficit models (Wynne 1992), asserting that “education” or exposure to “facts” causes publics who are unaware of, misinformed about, or misunderstand RETs to accept development. Many scholars argue that experts’ reliance on deficit models limits public participation in the design and selection of RETs, giving rise to technological controversies (Burningham et al. 2015; Hess 2007; Levidow 2015; Marris 2015). In short, for many experts, the idealized role for end-users or other publics is passive acceptance of, or quiescence toward, RETs.

While these insights are important for understanding public responses to RETs, two related questions remain unaddressed. First, how do experts conceptualize publics whose *direct participation with* technology development, rather than *quiescence toward* technology development, is framed by experts as mandatory for the RET’s success? And second, given both the prevalence and problematic outcomes of expert and institutional adherence to deficit models, what might alternatives for conceptualizing publics look like? Our aim in this paper is to develop, respond to, and integrate these lines of inquiry.

We draw on interviews with 30 bioenergy experts (e.g., academic scientists, engineers, industry representatives) in the Northeastern United States who are involved with or promoting perennial grass or woody-biomass energy development to answer these questions. Our analysis provides two contributions to the imagined publics literature. First, we introduce the term “obligatory publics” to open a conceptual space for examining expert imaginaries of publics whose direct participation is seen as mandatory for a given technology’s success. Actor-network theory (ANT) uses the term “obligatory passage point” (OPP) to describe the arranging of a network of human and non-humans in order to achieve a specific aim. Most notably, Callon’s (1986) study of scientist

directed attempts to reverse the falling stock of scallops in St. Brieuc Bay during the 1970s shows how scientists framed the interests of all parties—experts, fishers, and scallops alike—as converging around one OPP: scallop larvae attaching themselves to a shelter designed to enable their proliferation. That is, scientists framed scallop attachment as mandatory for the project’s success—and in doing so, positioned themselves as obligatory for the project’s success as well, because only they as scientists could measure and understand scallop behavior. We borrow from Callon to extend the imagined publics literature by asking how experts imagine publics whose direct participation in a technology system is framed as an OPP for the project’s success.

Second, we offer a “hermeneutic-dialectic” (HD) approach as an alternative to public deficit models for conceptualizing public behavior and responses, and in particular for imagining obligatory publics. To do this, we draw from literature on hermeneutic-dialectic theory (Busch 1978; Habermas 1987 [1981]; Ihde 2009) to critique the public deficit models employed by bioenergy experts when imagining obligatory publics. The HD approach interjects two initial steps in the larger project of improving engagement between experts and publics. The first is to make explicit the implicit and powerful causal assumption that introducing scientifically derived knowledge or facts into interactions between experts and publics *causes* the changes in public behavior desired by experts. Second, dialogic interactions—i.e., the process of presenting, scrutinizing, and justifying claims for the purpose of achieving new and mutually agreed upon understandings—are introduced as an alternative means for conceptualizing the cause of changes in behavior. In short, an HD approach is the questioning of assumed causes of behavioral change in

publics and experts alike (e.g., adoption of new technologies) and substitution with a dialogic process.

While our aim of identifying deficit models and replacing them with an alternative model for conceptualizing the causes of behavior change resonates with other public engagement approaches (e.g., citizen science, deliberative dialogue, etc.) already documented in the STS literature (e.g., Longstaff and Secko 2016; Bucchi & Neresini 2008; Eaton et al. 2014), our approach here for improving public engagement is distinctive. The STS literature on public engagement with science and technology aptly describes how deficit models are problematic. However, as we discuss in more detail below, much less attention has been given to questions of what can be done to move beyond deficit thinking. Researchers and practitioners are taking up the more general charge of improving public engagement with science and technology—for instance, via novel strategies for connecting residents and local decision-makers on technology development issues (Phadke 2014) or for engendering reflexivity on extant engagement approaches (Chilvers 2012). However, the HD approach outlined here remains a novel contribution to the STS literature on public engagement with science and technology for its clear and intentional contrasting of deficit models specifically with a practical, alternative model premised on the same key question of causality (i.e., causes of behavior change) that is foundational to deficit models and also central to the puzzle of technology adoption.

Our analysis shows how bioenergy experts employ public deficit models when imagining landowning publics whose direct participation with bioenergy development via growing bioenergy crops on their land is envisioned as obligatory if the project is to

succeed. That is, experts assume landowner reluctance to grow energy crops results from landowner knowledge deficits. Here, landowners are envisioned as “empty vessels that simply need to be filled with correct information in order to think as experts do” (Burningham et al. 2015, 251), or, alternatively, as misunderstanding facts or being misinformed. In short, it is assumed that what is *obvious* for experts will become *obvious* for landowners once they are exposed to the “truth.” This “causal explanation of the process by which people make judgments (choices) concerning innovations” (Busch 1978, 460) underlies the information provision aims of outreach campaigns intended to “educate” landowners and secure their loyalty.

The HD tradition we discuss below offers an alternative model for conceptualizing obligatory publics, one premised on “clarifying the process of understanding itself” rather than “explaining” causality (Busch 1978, 460). It is only through dialogue, rather than “education”, that motivation to participate in a technology project might emerge. From this perspective, landowners are recognized as bearers of meanings that deserve incorporation into engagement rather than as either “empty vessels,” or alternatively, misunderstanding or misinformed publics.

This paper proceeds as follows. First, we briefly review the literature on imagined publics in the field of RETs, giving particular attention to deficit model critiques. Next, we summarize our research methods before presenting evidence that the interviewed bioenergy experts draw on deficit models when imagining obligatory publics. We then draw on HD theory to illustrate and elaborate the theoretical and practical implications of these findings, and conclude with suggestions for future research.

Imagined Publics, Deficits Models, and Engagement

The imagined publics literature argues that experts who design technological systems necessarily do so with an idealized imagined public in mind (Heidenreich 2015; Walker et al. 2010)—or what Maranta et al. (2003, 151) describe as “conceptions of lay persons as they are manifested in the products and actions of experts.” That is, while experts may not explicitly recognize or discuss how they envision publics, these conceptualizations are nonetheless implicitly embedded in their discourse and activities, with consequences for the solutions they propose and apply to problems. Further, the models of publics that guide expert actions are determined by the various competences that experts ascribe to publics, including not only epistemic constructions (e.g, publics as ignorant, misinformed), but also other functional competences seen as motivating publics to act, such as economic rationality (Maranta et al. 2003). In short, experts expect publics to act in certain ways, and these expectations are “anticipated and internalized into organizational practices and working practices” (Walker et al. 2010, 943). As such, public agency is not only a matter of collective action. Instead, the public carries agency through expert conceptualizations of their response to technological projects (Burningham et al. 2015). In this way, imagined publics shape how technologies are developed and implemented, the decision-making processes that determine their dissemination and siting (Heidenreich 2015), and how their promoters will interact with publics (Levidow 2015).

These insights are important in light of research demonstrating that experts often conceive of publics as ignorant, mechanistic, and inadequately educated or misinformed about technoscience projects (Belsey and Nisbet 2013; Burningham et al. 2007;

Heidenreich 2015; Michael 1996; Walker et al. 2010)—what Wynne (1991) terms deficit models. Imagining publics via deficit thinking constitutes the “habitual, unquestioned ways of thought and practice” for many experts (Wynne 2001, 475). Perhaps this is to be expected, considering how “the training scientists typically receive can make it difficult for them to conceptualize the non-scientist public as anything other than recipients for expert knowledge” (Salmon et al. 2015).

Welsh and Wynne (2013) chart a historical progression of expert imagined publics, each the product of scientism or denial of the implicit normative commitments embedded within dominant scientific agendas and worldviews (Harding 1986). They explain how during post-WWII years, the lay-public was imagined as a “passively compliant, awe-struck audience” (2013, 549). With increased visibility of resistance to technoscience during the social movements and protests of the 1960s and 1970s, the public was reimagined as an “incipient threat” to not only scientific or elite agendas, but also to “what is good for” the public more generally (cf., Levidow 2015). This again transformed in our present post 9/11 era of global terrorism, where “uninvited” social movement organizations are subjected to increased policing and surveillance, while engagement with “invited” publics is sought in order to lend credibility. De Saille (2015, 106) adds the idea of “disinvited” publics to the above distinction to call attention to the “unruly public whose insistence on engaging with science on its own terms is vehemently discouraged by policy-makers.” Hess (2015) conceptualizes this current state of (imagined) affairs in terms of “mobilized publics” or “counterpublics” that threaten the agendas of elites or “official publics.” Counterpublics may either oppose particular technological projects (e.g., pesticides, resource extraction) outright, or support the

project in general while mobilizing for specific changes in standards, design, or implementation of technologies (e.g., wind turbines) that may threaten profit margins or market share. In short, this literature draws attention to the agency of various forms of imagined lay publics in terms of expert conceptualizations, as well as the tendency for publics and their participation in technology development to be imagined by experts as threatening to technoscience agendas. However, less attention has been given to charting the imagined public we term obligatory publics whose direct participation is not only desired, but imagined as mandatory for the technology project's success.

In the field of RETs, several case studies have demonstrated that experts attribute public resistance to knowledge deficits and irrationality (Barnett et al. 2012; Walker et al. 2010), and often envision publics as being “a barrier to a desired transition” (Skjølsvold & Lindkvist 2015, 2). For example, Skjølsvold (2012) found bioenergy experts in Norway frequently imagined publics as being opposed to local development, necessitating engagement strategies such as preemptive meetings intended to dissuade perceived opponents rather than identify and incorporate their perspectives into bioenergy planning (cf., Marris 2015; de Saille 2015). In a study of contestation over bioenergy development in northern Michigan, Eaton et al. (2014, 243) found project proponents assumed area residents’ “typical fear of the unknown” inevitably leads to some degree of dissatisfaction, “which, in turn, justifies turning a deaf ear to supposedly unreasonable critics.” Similarly, Heidenreich (2015) found that expectations of irrational public resistance were used to justify experts’ exclusion of public opinion about offshore wind energy development in Norway.

Reliance on deficit models typically leads experts to formulate information provision and public relations strategies to educate publics, with the expectation that removing knowledge deficits, misunderstandings, and/or concerns will readily produce public support. For example, Burningham et al. (2015) found that RET developers described wind energy opponents as having deficits of knowledge, rationality and legitimacy, and believed filling these deficits with education and specific experiences would turn project opponents into supporters. Moreover, in their study of RET developers in England, Walker et al. (2010) found the actors they interviewed shared an imagined public, with the experts anticipating that publics would oppose their projects. This shared imagined public was seen to condition not only their informants' public engagement strategies to gain consent, but also the material forms of the technologies themselves. Likewise, Barnett et al. (2012) found that anticipated public opposition to the siting of RETs led to a preference for top-down information provision late in the development process as opposed to earlier engagements driven by mutual exchanges of views. Further, because experts linked opposition to knowledge deficits, information provision to fill those deficits was the focus of engagement as education was seen as a prerequisite to acceptance. Confirming earlier research findings, Levidow (2015, 67; see also Marris 2015) argues anticipatory "engagement activities have coincided with a shift toward seeing the public as an incipient threat—initially attributed to cognitive deficits and/or irrationality," which in turn, "[lays] the groundwork for conflict whenever products reach the market."

Moving Beyond Descriptions of Deficits?

This literature thus far confirms that experts' adherence to deficit models can encourage skepticism, alienation, and mistrust amongst publics (Wynne 1992). Given this, what suggestions does this literature provide for addressing troublesome deficit models? In general, the literature on deficit models calls for increased reflexivity—defined as self-examination of “what the proper human meanings, conditions, limits, and purposes of scientific and technological innovation should be” (Wynne 2002, 472) — amongst experts and institutions as a means to move beyond deficit thinking (Heidenreich 2015; Maranta et al. 2003). Consider, for example, Heidenreich's (2015) call for more research into whether a “pessimistic mindset” is reproducing reliance on deficit models amongst experts, or Burningham et al.'s (2015, 258) similar argument that “this “syndrome” clearly informs developers' constructions of the public and public responses to RETs, with a clear contrast being drawn between their own objective assessments of the need for and safety of the technology and local publics' subjective rejections of local proposals.” Wynne (2006) moves beyond these analytical aims in suggesting that differences between publics and experts be reframed in terms of differing “cultural worlds” rather than differences of correct knowledge. Similarly, Maranta et al. (2003, 164) suggest the solution is to “rethink the epistemic asymmetry not in terms of knowledge and ignorance but based on a plurality of tasks and competences that people in modern societies are equipped with.” In their study of the U.K. chemical industry, Burningham et al. (2007, 41) argue experts “will have to develop beyond viewing their publics only as ‘consumers’ and ‘neighbors’ with the associated limited and local engagement.” Salmon et al. (2015) go further in exploring opportunities for engagement between public understanding of science scholars and experts as means to both identify

incentives for scientists to overcome disciplinary hurdles and practice engagement and challenge scholars' own deficit thinking in assuming the literature on engagement will "speak for itself." Welsh and Wynne (2013, 562) appeal to social movements as means for opening "an explicit deliberative politics around normative questions hidden" in expert conceptualizations. In short, while this literature makes clear imagined publics play important roles in RET development, and that reflexivity and knowledge "co-production" (Jasanoff 2003) are important for moving beyond public deficit models, less is offered in terms of what these alternative models for conceptualizing public behavior and responses might look like.

Methods

This study centers on 30 semi-structured interviews conducted with Northeastern U.S.-based bioenergy experts between July 2014 and October 2015. These participants represent a cross-section of professional experts including academic researchers, Cooperative Extension professionals, policy analysts, energy engineers, plant scientists, and others who engage in bioenergy development for a variety of reasons and with a variety of goals, but all of whom share a vested interest in the success of bioenergy projects on a range of scales in the states of New York, Pennsylvania, Vermont, and beyond. We first used a targeted sampling strategy to select participants identified through discussions with researchers involved in the U.S. Department of Agriculture funded Northeast Woody/Warm-season Biomass Consortium. We identified additional bioenergy experts to interview through snowball sampling. To minimize the likelihood that asking our interviewees to recommend potential participants would lead to a

homogenous sample, we asked them to recommend bioenergy experts from different relevant associated sectors, including government agencies, academia, industry, non-profit organizations, and representatives of agricultural interests.

Interview questions focused on the 1) role that bioenergy could and should play in the Northeast's energy sector; 2) challenges and barriers for developing bioenergy; 3) opportunities for developing bioenergy; 4) positive and negative impacts that bioenergy development would have on communities and the environment; and 5) requirements to make bioenergy development successful. Interviews were recorded and transcribed verbatim. Transcripts were analyzed with the support of ATLAS.ti. Coding was performed following the basic three-step process outlined by Neuman (2011). First, each transcript was coded to identify the major themes and insights relevant to bioenergy development. This focused-coding produced a set of initial codes that were compared and revised into one set of codes (i.e., the codebook). This first step identified three themes related to experts' imagined landowner publics: 1) publics are seen as economically rational actors, 2) publics have resourcist value orientations, and 3) publics possess knowledge, certainty, and trust deficits that reduce the likelihood they will plant energy crops. A second round of coding was performed using the codebook to organize key ideas and identify sub-themes within the initially identified themes, with a focus on gaining deeper understanding of the interactions between bioenergy experts' imagined publics and the challenges, barriers, and solutions the experts identified. Our final coding step involved identifying quotes from the interviewees that illustrate the themes and sub-themes identified in the first two analytical steps.

While we did not explicitly ask about how they conceptualized publics, bioenergy experts commonly discussed publics' roles when they spoke about both the barriers to industry development and what needs to happen for the bioenergy economy to succeed. Thus, our approach is similar to that in Maranta et al.'s (2003) study of imagined lay persons, where they did not directly ask experts about their views of lay persons, but rather derived their interpretations of experts' imagined publics by examining the ways that they wrote, spoke about, and communicated with them. Our interviewees voluntarily focused on how various publics think and what compels them to act, and also on how their own work needed to be tailored to the subjectivities they ascribed to these publics in order to get them to grow bioenergy crops on their land.

Expert Constructions of Landowners as Obligatory Publics

While bioenergy experts discussed many publics relevant to bioenergy development, such as policymakers, end-users, and environmentalists, they most frequently mentioned landowners. Indeed, in all of our interviews, experts made at least some mention of how the landowning public thinks about their land and makes decisions about whether or not to adopt new technologies, especially bioenergy crops. This emphasis accords with the significance of landowners for developing a perennial grass-based biomass bioenergy industry in the Northeast U.S. and informs our conceptualization of landowners as *obligatory publics* in the view of industry advocates. Figure 1 situates obligatory publics within the set of possible ways that publics are imagined in the literature. As Figure 1 illustrates, obligatory publics join their antithesis “counterpublics” (Hess 2015) in the realm of active publics, or individuals and groups

that are imagined as playing direct roles in technology development. Both of these groups are demarcated from quiescent or otherwise passive publics referenced in the literature reviewed above.

Figure 1

The promotion of bioenergy crop production is premised on tapping into the Northeast U.S.'s vast expanse of wet, steep, poor soil quality, or otherwise “marginal,” but potentially useable, privately owned land—land that to a large extent had supported a distributed system of small and medium sized dairy farms that have now become fewer, larger, and more spatially concentrated. In the words of one bioenergy expert interviewee, a former oil industry employee who developed and now operates a biomass torrefaction facility:

I am talking about taking marginal agricultural land and putting it into energy crops. If it were good agricultural land, [dairy farmers] would probably be still in business. It was never prime agricultural land. It is marginal agricultural land (Interview 29).

Moreover, according to many bioenergy experts, declining rural places could find economic salvation via a new bio-economy. Consider the words of a wood biomass-heating expert with extensive experience in implementing wood energy systems on college campuses and in municipal heating applications:

If we were to convert to as much local biomass as we could, and reduce the amount of fossil fuel that is used accordingly, then [most] of that money stays in our economy instead of going out of the region, out of the country. That is huge. I don't think that anybody has really quantified that, really made that real so the legislature and governor say, 'oh my god, look at that, look what we could do' (Interview 15).

Or this retired farmer with agricultural engineering experience now working to implement a local bioenergy cooperative:

I think there is a real opportunity to do economic revitalization in areas where agriculture has really taken a hit. I feel very strongly about that. (Interview 27).

Table 1 summarizes the three broad themes that bioenergy experts applied in imagining landowning publics. While the remainder of this paper emphasizes deficit sub-themes, we stress that deficits represent but one broad construction of publics that experts draw upon when imagining landowner behavior. For instance, landowners are imagined as economically rational actors who only adopt bioenergy crops when, “they see value and profit” in doing so (Interview 29). Further, landowners are imagined as beholden to what Eaton et al. (2014) describe as “resourcist” value orientations, which emphasize using natural resources now rather than “wasting” them. For instance, experts explained

how the Northeast region's history of dairy farming and hay production engenders personal and community values that lead landowners to favor some form of productive agricultural resource use on the land as opposed to having land revert to unusable shrub or forest land. As one NGO representative working to implement policies favorable to bioenergy said while explaining why bioenergy is a good fit for the region,

There are a lot of people that are farmers or familiar with farming who think that using the land is a good thing; that it is better to have something growing on it that is going to bring money in rather than just have it sit there (Interview 2).

Table 1 about here

In this study, bioenergy experts characterized landowning publics using language that resonated with deficit models that conform to the traditional public understanding of science approaches outlined above. Specifically, bioenergy experts imagined landowning publics as having three deficits that inhibit energy crop adoption: deficits of knowledge, certainty, and trust.

Knowledge Deficits

Experts described landowners as possessing either insufficient or incorrect knowledge about bioenergy. Phrases such as “people don’t understand,” “they just need to understand,” or “they misunderstand,” were frequently repeated in their discussions of

landowner willingness to plant energy crops. The knowledge deficit most often ascribed to landowners was that they lack awareness of the possibilities for growing and profiting from energy crops. The explanation by a professional forester and wood pellet industry representative that “there are many landowners who have no knowledge of it, that it is even an option for them to consider” (Interview 7) was typical for many expert interviewees. This explanation was often extended to include how a lack of awareness of technologies, such as pellet stoves that can be used to combust switchgrass pellets or other bioenergy feedstocks for heat, inhibited industry growth. A related knowledge deficit identified by experts was that landowners and rural publics more broadly do not understand the rural development or climate mitigation potential of bioenergy development.

A second form of knowledge deficit characterized landowners not as lacking information about bioenergy, but as harboring faulty understandings of what it is and how exactly bioenergy feedstocks are used. For instance, landowners were described as misunderstanding the food versus fuel impacts of using perennial biomass crops as bioenergy feedstocks. In discussing public perceptions of perennial agricultural crops versus cordwood or other bioenergy crops, including corn for ethanol, a crop scientist interviewed for this study lamented, “There is a lot of skepticism and misunderstanding. It takes a lot of time and effort to help people see that [perennial grass bioenergy] is different” (Interview 6). Moreover, bioenergy experts imagined publics as misunderstanding bioenergy technologies. For instance, one technical consultant working with an NGO to advance community scale biomass energy bemoaned the landowning public’s general misunderstanding of technical differences between these technologies:

Modern pellet boilers and wood chip boilers that [use] antiquated 1950s technology spewing pollutants out into the air. [Landowners] have no real sense of the differences between a multitude of different criteria and whether or not wood or grass is better than oil or natural gas, whether it be NO_x or PM emissions. I think people just make assumptions and don't really understand truly what the differences are" (Interview 8).

Certainty Deficits

Some experts also conceived of landowners as being risk averse—a behavioral subjectivity we term “certainty deficits.” Experts whose jobs entailed direct contact with landowning publics primarily voiced this conception. Here, experts went beyond characterizing landowner decisions as bound by knowledge deficits to argue that landowner participation is contingent upon several forms of certainty not currently in place; namely, a lack of historical market for bioenergy crops and data about their market performance, available crop insurance, industry or regulatory standards for crop and feedstock quality, and infrastructure for transport and delivery. As two experts (a federal employee working on energy policy and an agricultural consultant working on bioenergy feasibility in the Northeast) with experience recruiting landowners to grow energy crops, explained:

If I am a farmer, and I am considering taking 50 acres out of soybeans or out of another crop that I might have that is already productive and it has

insurance coverage, that is a thing they have to think about. What if this crop fails? What if at the end of the day the intended use falls apart and I don't have anywhere to sell it? So an uncertain market is also a factor and is tied up into whether or not there is insurance (Interview 30).

Farmers, on their own land mostly, have figured out how to work themselves into an ecology of available markets to make a reasonable living. Those who are successful are able to stay in business. And as a new crop, bioenergy crops don't fit that pattern. The established markets aren't there; the certainty that somebody will be there to buy it isn't there...All you can do is hope that somebody will give you a contract and that contract is rock solid and that the person you are doing the contract with isn't going to go out of business (Interview 31).

In short, providing landowners with the correct information is not enough to engender their direct participation, as landowner adoption of energy crops also requires a heretofore non-existent guaranteed market.

Trust and Scientific Information Deficits

Finally, some bioenergy experts presupposed landowners harbor a tarnished impression of the bioenergy industry that damaged publics' trust in experts and their projects. Whereas Burningham et al. (2015) found wind energy experts discounted public concern over negative prior experiences with the industry as irrelevant, the experts

studied here framed landowners' negative experiences with the bioenergy industry as legitimate and attributed these concerns to deficits of trust. Two experts in particular imagined that landowners felt their trust in the industry had been violated by the juxtaposition of the high visibility, but slow pace of the industry's development, which ultimately amounted to too many broken promises. As explained by a farmer and county employee working on pellet biomass in the Northeast:

Farmers have been hearing about this for too long. They have become somewhat disillusioned because nothing happens with it (Interview 16).

And by a biomass production consultant who maps marginal land, and is also a farmer:

[Landowners] have seen that most of the promised bioenergy conversion businesses have been a good story, but never happened. So to make that commitment is really difficult (Interview 1).

Moreover, many experts we interviewed quickly dismissed landowners or other publics who "voice" (Maranta et al. 2003) criticism, or publics whom we refer to as concerned publics, as "passionate" or "irrational" in that they lack a scientific understanding of environmental, economic, and planning processes. This supports recent findings reported in the literature on deficits found in RET experts' framing of their publics in which experts' assessments of risk are conceptualized as objective and publics'

risk assessments are believed to be subjective (Burningham et al. 2015). For example, when asked about opposition to projects developed in the past, one engineer working for a non-profit on economic development in rural communities described an advocacy group that actively resisted his work as follows: “they tend to have very emotional, knee-jerk, non-science based reactions to all of it” (Interview 4). Similarly, a Cooperative Extension professional instrumental in leading state efforts to implement bioenergy in NY described public responses in the region in terms of, “...a not in my backyard kind of thing...It was an us against them, and it was lack of information,” all of which was described as “premature” considering “we are not there yet,” meaning the project was not commercially viable (Interview 3).

Our experts’ framing of public deficits diverged in at least one key way from the literature reported above, and in particular literature on the use of “NIMBY” in planning and development disputes (Devine-Wright 2007; Devine-Wright 2011). Burningham et al.’s (2015, 258) research on wind energy developers’ conceptualizations of publics aptly summarizes this literature:

In this field “the experts” do not see public responses as informed so much by erroneous assessments of risk as by *self-interest*. Where local publics raise concerns about risks, these are not only dismissed but more fundamentally seen as providing a cover for a *more interested (selfish)* rejection of the proposals (Italics added for emphasis).

In our study of bioenergy experts' imagined *obligatory* publics, as compared with this literature's focus on publics with *indirect* participation with technology systems, we found no evidence of bioenergy experts accusing landowners of acting with "selfish" intent. Rather, bioenergy experts' assertions of landowning publics' deficits appear to crest at diagnoses of irrational behavior, misperception, and misunderstanding. For instance, in arguing for the viability of technical solutions to environmental risk concerns, the NGO representative we introduced above told us: "People never want to get that far in the conversation. They just get really upset about particulates and children getting exposed to them and kind of stop listening" (Interview 2). In short, beyond knowledge deficits, the behavior of obligatory publics is envisioned as being driven not so much by selfish intent and rather more by disinterestedness, or unwillingness to review available information (citation removed for blind review). Next, we underscore how experts prescribe a regimen of "discipline" to correct these deviations from the "presupposed loyalty" (Maranta et al. 2003) of obligatory publics.

Deficits as Barriers and Imagined Solutions

As the above sections suggest, experts appear convinced that the industry's slow start and the lack of landowner adoption of energy crops result from landowners' deficits of knowledge about bioenergy technologies, including knowledge of both potential benefits and misunderstandings about environmental risk. Consider the response of a forester who runs wood energy programs for schools to our question about major barriers to the industry:

Ignorance. They frequently say, what is biomass? People just don't know what it is. And that is one of our challenges: to get open houses, to get out invitations and get people to come [to] workshops with people from the school districts so they can come and look at a biomass facility and learn that, oh, the feedstock is available from somewhere nearby that we can use. So just ignorance (Interview 25).

This statement reveals both the barriers identified by experts (e.g., misinformed, unaware, misunderstanding, unwilling, subjective rather than objective landowners) as well as their solutions for overcoming these barriers (e.g., the provision of scientific information, opportunities for direct experience with the technology, other engagement activities intended to “educate”). The solution then to the barrier of “ignorance” is cast primarily in terms of correcting misunderstandings. Nearly all 30 experts interviewed for this study provided some illustration of this assumption, including the aforementioned NGO representative who developed a resource intended to respond to “misperceptions” about the industry via “graphics and explanations that are easily understood by people who haven't studied this for very long” (Interview 2). In sum, imagining obligatory publics as harboring this particular “array of deficits” (Burningham et al. 2015) produces for experts the implicit assumption that deficits on the part of publics are a foundational barrier to the industry. Furthermore, if bioenergy development is to occur, and with it the provision of economic, environmental, and other benefits, then the efforts already underway to “educate,” “raise awareness,” and ultimately “discipline” (Levidow 2015) for the purposes of producing “loyalty” (Maranta et al. 2003) will need to be increased.

Considering Possibilities in the Hermeneutic-Dialectic Tradition

Our aim in this paper has not been to criticize the intentions of bioenergy experts, or their vision of the “good society” (Jasanoff & Kim 2009) that could be obtained were landowners to adopt bioenergy crops. Nor is our intention to prescribe new or existing public engagement formats or activities to “democratize” bioenergy technology development (cf. Wright & Eaton 2014), or uncover why deficit models are prevalent in the first place via analysis of disciplinary training and constraints (Maranta et al. 2003; Entradas 2015; Ottinger, 2013; Baillie et al. 2012). Rather, our aim is to move the critique of deficit models beyond its current descriptive phase. Said differently, can more be done than documenting the prevalence of deficit models? As the above literature attests, using deficit models to make sense of public behavior is problematic (Devine-Wright 2011). However, little attention has been given to identifying what, if any, alternative models might be available to experts for the specific purpose of conceptualizing causes of behavior change. Here we suggest the Hermeneutic-Dialectic (HD) tradition as one such alternative model.

Our findings suggest experts see landowner direct participation in bioenergy development via growing energy crops as an obligatory prerequisite for enabling a new bio-economy. This contrasts sharply with the literature reviewed above documenting how experts imagine quiescence toward technology projects as the ideal role for publics. In the field of perennial grass bioenergy in particular, landowner direct participation, and the envisioned resulting social benefits, hinge on providing information in order to inform unaware parties or correct their misunderstandings. That is, landowners must be

transformed from unaware, misinformed, or misunderstanding entities, into new actors who understand, or more precisely, hold the same meanings as experts, and as a result adopt energy crops on their land. As Figure 2 illustrates, this transformation in landowner behavior is presumably *caused* by the experience of the meanings experts themselves hold for bioenergy development. Note also how communication flows in only one direction—from experts to publics.

***Figure 2 about here ***

It is the assumed causality within this model specifically that we want to problematize. This assumption is captured in the influential Adoption Diffusion (AD) literature popularized by Rogers (2010). Recent research reports how RET experts draw from the AD tradition both implicitly and deliberately (Skolsvold 2012). As pointed out by Busch (1978, 460), “AD has sought to produce an explanation of understanding; it has sought to produce a causal explanation of the process by which people make judgments (choices) concerning innovations.” This logic is echoed clearly by bioenergy experts who presume landowners’ “ignorance” can be transformed via experiencing the correct information. We argue that bioenergy experts rarely question this causal assumption—or, at least, we found no evidence of this in our data or literature review. But perhaps expecting scientists, engineers, or other experts to question this assumption is unreasonable considering how a contending position in the debate over causality remains ill-defined and has received little scholarly or popular attention.

Busch (1978) suggests that the hermeneutic-dialectic tradition provides a useful point of contrast to the causal assumptions within the AD tradition and public deficit models. The HD tradition, often associated with linguistic phenomena, arose as an approach for interpreting biblical texts, but through the work of philosophers such as Jürgen Habermas, was adapted to questions of communication more broadly (Busch 1978). For instance, Habermas (1987) [1981] argues “communicative action,” or the process of collectively producing new cultural knowledge via argumentation and justification of validity claims that are open to criticism, is possible as the human capacity for rational action is inherent within language. It is through this argumentative process that new mutual understandings are produced. Boltanski and Thevenot (1999, 364; Thevenot 2012) add that, in non-violent public disputes, researchers should conceive of actors in disputes as “endowed with an ability to differentiate legitimate and illegitimate ways of rendering criticisms and justifications.” This reflects the hermeneutic approach generally, which can be thought of as a set of interpretive principles. For instance, its initial proponents held that, “understanding and interpretation were the unique methods for understanding human psychological and social phenomena” (Idhe 2009, 63).

Both the AD and HD traditions therefore address the same problem of understanding, although they do so from different starting points. On the one hand, the HD tradition, based on the premise that the world can be understood as a text, envisions reality as being subject to the same “exegesis,” or interpretive flexibility, to which texts are subjected (Busch 2016, personal communication). That is, HD recognizes every situation as being open to multiple, but not infinite, variations. For instance, Idhe (2009)

argues the things we experience (e.g., technical artifacts/practices) can exhibit “multistability” (cf. Whyte 2015). Ihde offers the case of bows and arrows/archery as an example, and points out that while all archery is the “same” (i.e., bows, strings, and arrows), the material construction, bodily practice, and cultural context can vary. However, while a range of variations is indeed possible, the number of variations is limited by the collective understandings for the “same” artifact/practice. For instance, in the case of bows and arrows/archery, justifying an interpretation of these artifacts as being useful for sending satellites into space is absurd.

The technology objects in this paper, energy crops like miscanthus, provide an apt illustration. Miscanthus is a perennial grass that can be grown and harvested on pastureland, including wet, steep grade, or other “marginal” land. The bioenergy experts interviewed in this paper interpreted grasses like miscanthus as ideal inputs for energy production, or for other purposes, such as providing ecosystem services or raw materials for animal bedding. Landowners may agree, or they may interpret miscanthus as less desirable than other crops or grasses (e.g., maize or hay) they already grow on their land. Or, more critically, some landowners may interpret miscanthus as problematic, claiming the plant’s deep root systems clog drain tiles, are difficult to remove from the field, that stems left behind after harvesting puncture tractor tires, or that it is an invasive plant species and therefore a threat to native or locally grown crops or grasses. Likewise they may claim that as a monocrop unsuited for rotation, it may threaten rather than enhance biodiversity. More generally, landowners may claim miscanthus or other perennial bioenergy crops (e.g., switchgrass or shrub willow) pose a more general threat to established ways of life in their community—for instance, land leased for bioenergy

crops may be interpreted as raising local land rental costs or making land previously available for other purposes (e.g., cash crops, dairy farming) unavailable. Note however that interpreting miscanthus as, say, a threat to human health is an impotent claim as such a statement cannot reasonably be justified in a public context (Boltanski and Thevenot 2006 [1991]).

Examining these claims and contestations from the perspective of HD suggests that experts' obligatory publics express a range of meanings, including those falling under scientific headings (e.g., technical disputes over potential biodiversity impacts), but also other ways of making sense of reality that cannot be reduced to scientific terms, such as normative expectations that belie scientific justification, or what Taylor (2002; cited in Welsh and Wynne, 2013) describes as "social imaginaries." What this illustrates is that while landowners express a range of meanings for bioenergy crops being planted on their land, or in their communities, in implicitly relying on deficit models, bioenergy experts tame this multitude of meanings, recasting them as deviations from the one correct scientific understanding constructed and promoted by these and other bioenergy experts.

HD's recognition of the multistability of technology artifacts like miscanthus runs counter to the AD tradition. In following the natural sciences, AD "proceeded by *explanation* rather than understanding, and explanation was conceived of along hypothetical-deductive lines" (Ihde 2009, 63). This provides an approach that assumes *a priori* the existence of one right truth (although in some instances scientific research may have yet to settle on that truth). Moreover, this singular truth is envisioned as self-evident in that it speaks on its own behalf. For instance, as reported in a Penn State Extension fact

sheet (2013), it is an established fact that the energy crop miscanthus, and specifically giant miscanthus, is not an invasive species:

Because...giant miscanthus is sterile, there is no concern about invasiveness from seed. Some other varieties of miscanthus can be invasive, so it is important to choose true giant miscanthus rather than other varieties.

In contrast, from the perspective of the HD tradition, meaning-making is an ongoing intersubjective activity, as it is only through dialogue that agreed upon understandings, and in the process new meanings and identities for landowners, can emerge (Habermas 1987 [1981]). As such, truth and facts are flexible, context specific, and, when agreed upon, represent the temporarily stabilized outcomes of an argumentative process. Said differently, meanings that are *obvious* for experts at a given point in space/time may be *opaque* for landowners at that same space/time, and vice-versa (Busch 2016, personal communication). Further, the HD tradition assumes stabilized meanings/understandings can change over time as the context in which people live changes. Figure 3 illustrates these processes.

Figure 3 about here

Consider again the case of landowner meanings for miscanthus and expert imaginaries of these obligatory publics. If fact sheets illustrate a deficit approach, how could expert-public interactions be different through the use of the HD approach? The

utility of fact sheets is premised on the implicit causal assumption that there is one right understanding about miscanthus (i.e., giant miscanthus is not invasive, or that its deep roots improve, rather than inhibit, drainage in hard soils) and that providing such information changes behavior, specifically the behavior of obligatory landowning publics, by clearing up misinformation and misunderstandings, or providing information that publics have no prior experience with. While facts sheets do, of course, provide information, from the HD perspective fact sheets implicitly deny alternative understandings by bracketing out contending scientific understandings and other ways of knowing the world not adequately captured in scientific terms. Further, they are unidirectional in that information only flows from experts to publics, which is antithetical to dialogue, and are therefore in and of themselves incapable of producing new collectively agreed upon understandings. Importantly, from the HD perspective, the issue at hand with bioenergy technologies like miscanthus is not that facts are unimportant, or whether or not it is a scientific fact that miscanthus is noninvasive. Rather, the HD insight is that reaching agreement between experts and publics on the implications of such a fact could only come about through dialogic interactions. In short, in absence of the mutual exchanges of ideas and justifications for meanings, fact sheets are likely insufficient for enrolling obligatory publics.

An HD approach to engagement would instead first prioritize reassessing the implicit causal assumption underlying outreach tools like facts sheets or demonstration sites, perhaps via facilitated group interactions between experts, outreach specialists, engagement professionals, and other institutional actors—or this might be organized in conjunction with stakeholders or broader publics. The explicit aim here would be to

foster a collective problematization of the casual assumptions underlying existing interactions with obligatory publics, including fact sheets and other forms of outreach. A second step would be to identify and/or construct opportunities for productive dialogue between experts and their obligatory publics; specifically, spaces where publics and experts alike engage in an argumentative process of sharing and scrutinizing existing meanings for the topic at hand (e.g., energy crops), presenting evidence to justify the validity of those experiences, and weighing the meanings (including but not limited to scientific understandings) expressed by others.

Importantly, from the perspective of the HD tradition, this process will not invariably *cause* landowners to participate—nor is it assumed that dialogue will necessarily nudge landowners toward participating in the project rather than away. Instead, dialogue is merely prerequisite for change in meanings and behavior, as it is through dialogue that new (good and bad) meanings for bioenergy technologies are constructed, and that specific desired meanings (such as claims that miscanthus is noninvasive, improves soil drainage, or, more generally, that bioenergy development could provide benefits to rural communities) could become present and salient for obligatory publics. While this emphasis on dialogue aligns with many deliberative dialogic approaches to democratizing technoscience (e.g., Bucchi and Neresini 2008), the unique strength of the HD approach is its positioning of argumentative dialogic process as an alternative to deficit models and their underlying causal assumptions. In short, if the goal of bioenergy experts is to achieve an agreed upon understanding for, and the realization of direct participation of landowners with bioenergy development, it will be necessary for experts and their obligatory publics alike to engage in dialogic process of

presenting, scrutinizing, and justifying various claims concerning bioenergy development.

What the HD tradition suggests then is that we problematize rather than implicitly assume a causal link between exposure to facts and landowner behavior. Doing so constitutes a first step in moving beyond description of deficit models and toward useful alternative conceptualizations. The public deficit model, like AD theory, implicitly assumes scientific “truth” is self-evident, and that particular meanings reside *a priori* in particular narratives/claims/things/situations. As our interview data attests, experts subscribing to these assumptions are often frustrated when publics fail to express the same meanings as experts, even when they are presented with what scientists see as indisputable facts. Viewed through the lens of deficit models, publics act irrationally when they question, raise concern, or simply ignore expert understandings (Latour, 1987). Examining this process from the HD tradition opens an alternative explanation for landowner behavior premised on the co-construction of new collective meanings as causal mechanism, rather than informing or correcting deviant understandings with the one right truth.

Conclusion

In this paper, we borrowed from Callon (1986) to introduce the term obligatory publics to conceptualize imagined groups, such as the landowning publics discussed by our bioenergy expert interviewees, whose willing direct participation in technology projects is not only desired, but framed by experts as essential for success. The STS literature charts a range of imagined publics, and historical phases of dominant imagined

publics, from “awe-struck” to “incipient threats” to our current era of policing and surveillance of social movements and other politicized publics (Welsh and Wynne 2013; Hess, 2015). This literature offers nuanced assessments of invited, uninvited, and disinvited publics (de Saille 2015), yet tells us little about publics whose participation is required not only for purposes of legitimacy, but whose direct participation in technology development is seen as fundamentally necessary for successful technology development. Our obligatory publics concept adds to this literature by charting this position amongst other imagined publics. Moreover, we showed how the non-participation of obligatory publics is imagined as stemming from deficits of knowledge, certainty, and trust.

In uncovering the deficit models these bioenergy experts rely on for conceptualizing the behavior of their obligatory publics, we suggested the hermeneutic-dialectic (HD) approach as means to push the STS expert epistemology literature into prescriptive waters. This approach calls attention to the implicit causal assumptions inherent in the adoption-diffusion (AD) tradition—and prevalent among these interviewed bioenergy experts—and suggests appealing instead to the hermeneutic insight that only through discourse can shared understandings of reality emerge. Our aim in bringing together the obligatory publics concept, a critical description of bioenergy experts’ deficit models, and HD insights has been to open a conversation about how the HD tradition may form the basis of a cohesive model that can ultimately offer experts who are interested in undertaking a reflexive assessment of their own assumptions a tangible alternative to AD and deficit models.

While this study drew from data collected from interviews with bioenergy experts active in bioeconomy development in the Northeastern USA, these findings suggest

similar patterns of adherence to deficit models are likely across the growing national and global bioenergy industry. The Northeastern USA can be seen as providing unique opportunities for perennial crop bioenergy development due to its regional climate and land features. However, other geographies also currently receive policy and bioenergy industry attention, including the forestlands of the upper Midwest and Western USA, Canada, the UK and Scandinavia, the cane fields of Brazil and elsewhere in South America, as well as land in many African countries (Stecher 2013). For other places and situations where bioenergy development is proposed and underway, insights developed here echo Walker et al. (2010) who suggest that landowner agency is more than a matter of behavioral responses to bioenergy technologies such as perennial energy crops, but also manifests through the conceptualizations of experts. This situation points to the possibility of a flexible and open-ended future for expert-public engagement in the field of bioenergy development. Next steps include identifying coherent, practical models for expert-public engagement premised on the HD approach outlined above, investigating opportunities for such engagements as well as already existing interactions, and partnering with engagement professionals and other stakeholders to develop and introduce HD engagement approaches into practice.

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Figures and Table

Figure 1: Array of imagined bioenergy publics in the Northeastern United States

Figure 2: Public Deficit Logic

Figure 3: Hermeneutic Dialectic Model

Table 1: Bioenergy expert imaginaries of landowning obligatory publics

Imaginary theme	Bioenergy expert conceptualizations of landowning publics	Implications for public engagement agenda
Economically Rational Actors	<p>Landowners make decisions according to the logic of profit maximization. Low market value of energy crops explains lack of widespread landowner adoption of energy crops.</p> <p>Direct experience via demonstrations is best means to provide information and produce landowners who know the “facts.”</p>	<p>Experts advance technoscience agenda of increasing yields in order to increase landowner returns on investment.</p> <p>Experts rely on demonstrations as primary form of outreach.</p>
Resourcist Value Orientations	<p>Landowners value using natural resources now, rather than wasting them.</p> <p>Landowners value and aesthetically prefer productive, working landscapes, rather than abandoned landscapes.</p>	<p>Experts believe bioenergy represents a natural extension of the rural Northeast’s history, values, and land management goals, and is therefore a natural fit for rural communities and landscapes.</p>
<p>Knowledge Deficits</p> <p>Certainty Deficits</p> <p>Trust Deficits</p>	<p>Landowners possess insufficient and incorrect knowledge about energy crops.</p> <p>Landowners need several forms of certainty in place in order for them to adopt energy crops.</p> <p>Landowners’ previous “bad” experiences with failed bioenergy projects damaged their trust for the industry.</p>	<p>Experts believe what is “obvious” for experts will become “obvious” for landowners via exposure to the “truth.”</p>