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Managing the Experience of Evidence England's Experimental Waste Technologies and their Immodest Witnesses

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Abstract:	This paper explores the techno-environmental politics associated with government sponsored climate change mitigation. It focuses on England's New Technologies Demonstrator Programme, established to test the "viability" of "green" waste treatments by awarding state aid to eight experimental projects that promise to divert municipal waste from landfill and greenhouse gases from the atmosphere. The paper examines how these demonstrator sites are arranged and represented in order to produce non-controversial and publicly accessible forms of evidence and experience and, ultimately, to inform environmental policy and planning decisions throughout the country. As in experimental science, this process requires that some bear witness to the demonstrators, but in a disciplined way. Whether through the extrapolation of facts about technical performance by affiliated third party consultants, or the orchestration of visitor centers open to the general public, making the demonstrators public involves controlling the ways in which they are interpreted and perceived. However, the unstable publicity of waste management facilities proliferates unofficial accounts as well. These acts of counter-witnessing, as I refer to them, not only potentially dispute the official evidence collected from the demonstrators, they also can pose a challenge to the understanding of technology upon which such government initiatives are based.

Managing the Experience of Evidence: England's Experimental Waste Technologies and their (Im)modest Witnesses

Introduction

While most analyses of climate change mitigation have focused on the ramifications of newly created markets in carbon allowances stemming from the Kyoto Protocol (Lohmann 2005, Luke 2008, MacKenzie 2009) or changes in food prices and supply associated with subsidized biofuel production in the U.S. (Katz 2008), considerably less attention has been directed at the prominent role of new technologies in the proposed creation of "new energy economies." Technical innovation may be one of the intended outcomes of biofuel subsidies and cap and trade schemes, but a distinct techno-environmental politics results from climate change initiatives that directly promote new devices and techniques, such as hybrid cars, "clean coal" technologies, "smart grids," wind turbines and other renewable energy generators.

One such device is an anaerobic digestor, an alternative waste treatment system that transforms biodegradable waste, such as food scraps and garden clippings, into reusable fertilizer and biogas. Though still rare in the UK, the English market town of Ludlow has had one since 2006 and it is meant to serve as a demonstration of the UK's possible future. From the electric lorry that gathers its own fuel during weekly collections, to the biodegradable cornstarch bin liners that residents use to sort their kitchen waste, Ludlow's waste treatment system gives the appearance of a sustainable loop: waste in, products out.

The digestor forms part of an experiment sponsored by England's central government, one that has international and global, as well as national implications. International, because the EU Landfill Directive (1999) requires that all member states decrease the amount of biodegradable municipal waste (BMW) they landfill; global, because the primary motivation for

the Directive was to reduce greenhouse gas emissions, of which methane released from biological decomposition is an important contributor.[1] As has been typical of the tactics of European government since the early 1990s, the EU has sought to do this by way of "concrete, precise and realistic objectives" rather than through agreement on "general principles" (Barry 1993, 316; see also Holmes 2000, 28). Each state committed to reaching specific targets, reducing the amount of landfilled BMW by 25% of 1995 amounts by 2006, 50% by 2009, and 65% by 2016.[2] The exploration of new methods of diverting waste from landfill, already widespread elsewhere in Europe, thus contributes to the further "harmonisation" of the European Community (see Barry 1993).

The national implications of the Ludlow experiment lie in the landfill diversion targets devolved to the UK's Local Authorities by central government. Ludlow's digestor is one of eight sites funded by England's Department for Environment, Food, and Rural Affairs (Defra) to trial new waste treatment systems. Through the New Technologies Programme, Defra pledged up to £30 million for projects that could demonstrate the capabilities of potential substitutes for landfill considered "unproven" in the UK. According to Defra's website, the goal was twofold: "to prove the economic, social and environmental viability (or not) of each selected technology," thereby "arming key decision makers with the facts and realities of implementing new technologies and empowering them to make informed decisions."

My focus in this paper is not whether technologies have proven themselves "viable" through the Demonstrator Programme. Nor do I ask what this process means to those involved in

[1] Methane is thought to have twenty five times more of an impact on global temperature than carbon dioxide. Landfill gas emissions are thought to make up 30-45% of total UK methane emissions (Cameron 1999, 274).

[2] As of 1996, 70% of waste in the UK was buried in landfills, amounting to over 200 million tonnes (Cameron 1999, 266). Along with several other landfill-dependent countries, including Greece, Ireland, Italy and Spain, the UK was permitted to delay its attainment of the targets by up to four years, meaning that it's dates of reduction are effectively 2010, 2013 and 2020 (Cameron 1999, 275).

or affected by it, at least not directly. Rather, I explore what establishing proof (or disproof) means *for them.*[3] For any demonstration the problem is how to manufacture the right conditions whereby knowledge can be constructed and publicly witnessed. My questions are less about how experiences of evidence are interpreted, therefore, and more about how they are shaped: what is technological viability according to the parameters established by Defra? How is it made knowable through demonstration, and to whom? And, finally, how do such government-sponsored demonstrations relate to alternative forms of truth telling?

The Demonstrator Programme is part of a recent European trend that has encouraged more "participatory" policies related to the governance of science and technology. Emphases on public consultation and engagement are partly a response to a "legitimation crisis" in the '80s and '90s that divided a disenfranchised and mistrustful "lay public" from practitioners of techno-science (see Beck 1992; Wynne 1992; Irwin 1995; Collins and Evans 2002; Jasanoff 2003). Many of those who once argued for the democratization of decision-making about science and technology now call for critical appraisal of "public engagement" as a form of European governance (Irwin and Michael 2003; Leach et al. 2005; Rowe and Frewer 2005; Irwin 2006).

Public demonstrations are but one form participatory initiatives can take, but it could be argued that they are preferable because: "As material set-ups, they appeal to peoples sense and allow for playfulness, and as such effectively address the challenge of how to draw easily distracted audiences" (Marres 2009, 118). But how does the sensory appeal of a demonstrator relate to its evidentiary purposes? What kind of attention, exactly, are they meant to draw?

For Andrew Barry, demonstrations are exercises in the control of truth telling. With all forms of demonstration, whether technical, political or otherwise, "there is a politics to who can,

[3] I wish to thank an anonymous reviewer for helping me to clarify this point.

and who should be allowed and trusted to witness…under what conditions and in what ways" (Barry 2001, 178). In Shapin and Schaffer's (1985) influential account, the birth of the modern experiment involved the selection of suitable witnesses. Witnessing was not simply a matter of being there, it was taken as a moral act – only those perceived to be "modest" in their bearing could be entrusted to verify results on behalf of the scientific community then emerging. Experimental science was thus made reliant on precise social inclusions and exclusions: the role of witness could only be inhabited by those whose bodies could disappear in the highly classed and gendered domains of scientific practice (Haraway 1991, 25).

Following the literature on scientific demonstration and public participation, it is important to consider the ways Defra's demonstrators are made public and the possible forms of contestation they anticipate.[4] Because these sites have a higher profile and are more publicly accessible than most scientific laboratories, the moral and intellectual comportment of their witnesses is less assured. Thus, the sites themselves must be carefully controlled so that the modes of witnessing they invite will not be partial or capricious. Public inclusion is thus practiced as a form of "impression management" (Goffman 1959), it is not only important that site visitors receive a favorable impression, but that they define their encounter in the right way. Noortje Marres suggests that public experiments are not only responsible for producing new knowledge, but entirely new entities as well (2009, 119). Relying on my own experience touring two of the Demonstrator sites, I argue that one of the new entities that formal participatory

[4] The notion of the modest witness is historically linked to the liberal conception of the public sphere, where free participation also meant ideally suspending one's body and identity to assume an empowered stance. Consequently, the Habermasian notion of "the public" has been subjected to similar critique within feminist and queer theory (Fraser 1990, Warner 2002).

engagements are meant to produce is a citizen-witness who is semiotically equipped to engage 'in the right way'.

In order to properly stage this encounter between demonstration and witness, a wide variety of spokespersons from the non-profit and private sectors were enrolled in the Demonstrator Programme from its earliest stages. Based on interviews with a variety of Programme employees, I argue that one of their most significant tasks is to control the means by which each demonstrator is to be evaluated. Since Defra's stated goal is to inform and empower councils throughout the country, they must see to it that each site produces evidence separated from the specific contexts of socio-material practice within which they are embedded. In this way complex and heterogeneous technical situations are translated into *technological facts*. By this I mean a representation of technical artifacts as belonging to general types that exist outside of any individual device or application. According to Ingold, this process is tantamount to making embodied know-how into formal technological knowledge (2000, 316). While the former is context-dependent and cannot be learned outside of its practical application, the latter can be encoded in abstract rules, taught through engineering classes and textbooks, and applied anywhere in principle.

Since all technical designs are to some extent re-engineered and reinvented through application, however, "technology" in Ingold's sense is never finally achieved (see Bijker and Law 1992; MacKenzie 1998; MacKenzie and Wajcman 1999). Introducing a new anaerobic digestor into Ludlow, for example, involved constant material and social re-engineering as tanks, disposal habits, kitchens, materials, and microbes were brought into a tentative balance with one another. The act of extrapolating stable technological facts from the complexities of technical innovation is thus a political one, that is, it is inevitably partial and potentially contestable. As

with other political demonstrations – the World Bank's much publicized neoliberal experiment in Peru, for example (Mitchell 2005, 318) – conditions must be arranged to make possible the abstraction of particular facts, whether economic, technological, or otherwise.

Insofar as demonstrations are made public and take material form, the claims made about them can be challenged to a certain extent (see Keane 2008, 36).[5] After reviewing the kinds of witnesses Defra's demonstrators are intended for and the forms of publicity called upon to reach them, I rely on selective interviews, conversations and surveys with people living in the vicinity of waste treatment plants to argue that the unstable publicity of waste technologies – their tendency to spill over outside of the frames established to test their viability – creates the potential for *counter-witnesses*. That is, social actors whose modes of witnessing call into question the Demonstrator Programme's claims and who may go on to engender counter-publics in opposition to the companies and authorities responsible for these claims. Openly biased and bodily, this decidedly *immodest* mode of witnessing serves as a reminder of the situated production of all knowledges (see also Redfield 2006). More than that, however, counter-witnessing poses a challenge to the use of demonstration as a tool of government. While some counter-witnesses expose the limitations of reducing technical assessments to narrow measures of mechanical performance, others refuse outright to disentangle the "viability" of technical devices from their senses of place and environment.

In the conclusion I suggest that successfully trialing new environmental technologies requires not more stakeholder inclusion, per se, but more attention to the multiple ways in which people are "included" (often inadvertently), which is tantamount to recognizing that processes of

[5] As Timothy Mitchell (2005) does with respect to the alleged "success" of the Peruvian economic experiment.

technical innovation are always in a relationship of mutual "dependency" with the various publics they engender (Marres 2009, 119).

Abstracting Technological Facts

In this section I want to introduce the Demonstrator Programme in more detail. My main focus will be the ways that it has been organized to standardize results from different projects, thereby allowing for the "viability" of technical devices to be extrapolated from their contexts of application. This process of abstraction also tends to reduce the possibility for controversy or disagreement over these technological experiments and their effects.

News of the Demonstrator Programme was made publicly available in late 2003 and Defra received the first round of applications later the following year. A Technical Advisory Committee was established, composed of academic consultants, civil servants, environmental advocates, and representatives from the waste industries, to create selection criteria for project proposals and evaluate them. Two environmental consultancies were also chosen, after a competitive bidding process, to oversee the projects in their initial stages and in operation, respectively, in order to ensure they would conform to the parameters of the Programme. Finally, after another bidding process, academic consultants from several university departments were selected to collect evidence of technical performance from the different sites and so provide comparative quantitative data with which to judge their "viability."

Based on the Committee's recommendations, Defra selected eleven preferred bidders and ten final recipients by the end of 2004, nine of which were eventually promised funding. Of these, four biological treatments were approved, including three in-vessel composting units and the Ludlow anaerobic digestor. Each biological treatment employs enclosed tanks which break down food and/or garden waste into reusable compost, in the case of the digestor also producing

usable energy. Four thermal treatments were also selected, including two gasifiers, one pyrolzer, and one combined facility. In different ways, each thermal site employs advanced heating methods to transform waste into an energy generating "syn-gas." Finally, Defra approved one mechanical heat treatment facility, which was designed to make municipal waste more readily recyclable. Despite radical differences in terms of technical methods and material outputs, different standards were normalized across these projects, making the relatively simple, microbial conversion of separated biological wastes into fertilizer comparable with the highly technical conversion of dry wastes into synthetic gas.

At the same time, such standards also disrupt comparability. Each demonstrator was to be operable by March 2006, which only two succeeded in doing, and conclude at least 8000 hours of operation by March 2009, which at least four did not do. In the field of engineering "8000 hours" is widely used as shorthand for an approximate length of time suitable for evaluating the performance of an artificial process or product. Approximately a year of operation, 8000 hours offers a generic value by which very different waste treatments could be compared with one another and held accountable by government. However, early failures and obstacles encountered by the demonstrators illustrated the importance of accommodating new treatment systems to local conditions, and struggles with planning, in particular, caused severe delays for several of them. While seemingly a neutral criterion, some of the demonstrators claim the original targets were arbitrary and have negotiated with Defra to give them more time to have their performance measured.

Even where measurement is not contentious, it is political in another sense. The academic consultants responsible for monitoring the demonstrators, for instance, must translate the complex and heterogeneous operation of distinct plants into quantitative technological facts that,

ideally, will be accepted by the general public. By extrapolating precise metrological data, Defra's affiliates simultaneously limit the spread of controversy and supplant less scientistic modes of evaluation.

But achieving such extrapolation is a difficult task. Creating evidence about the viability of technologies requires measurements of technical performance that isolate devices from planning permissions, local infrastructure, elections, disposal habits and so on. Consider the monitoring procedures of a civil engineer and consultant named John. He and his team won the bid to monitor three demonstrators, as well as conduct additional student research projects on behalf of his University, as is typical of many of the monitoring contracts. With one demonstrator, an in-vessel composting unit in Southern England, they have been tasked with verifying what kind of reduction in biodegradable matter has occurred in the municipal waste processed. To do so, they trace certain batches as they go through the treatment process, collecting samples along the way for comparative analysis. Following this they attempt to answer some rather basic questions: was the right material processed? Were they in the composting tunnels for the right amount of time? And at the right temperature?

The work John does, along with his students, is meant to capture the performance of the demonstrators through momentary glimpses of their material flows and processes in situ. Generalizing from fragmented samples, they are tasked with characterizing the operation of novel technical processes, but to do so they must treat the devices as self-contained wholes. They do not trace the waste back into the homes of waste producers, for example, or outward to the sites where the outputs from the plants go. They do not examine the traffic to and from the sites, nor the effect of odors, noises or other nuisances on those living nearby, quite simply because Defra does not require it of them. The selectiveness of the official performance evaluations

might seem incidental, but it is nevertheless crucial to Defra's Programme. Eventually, consultants like John are meant to assist in creating a collective database to present the information they've gathered. This database is meant to equip targeted stakeholders with the means to understand and compare complicated and unfamiliar treatment options, but it does so precisely by regimenting the form such comparison and understanding can take.

The Witness Stance

Shaping the way in which the demonstrators are evaluated becomes even more important when they are more directly experienced by the public. In this section I will discuss the purpose of the Demonstrator Programme's visitor centers based on my experiences visiting two very different sites, the Ludlow anaerobic digestor and the Isle of Wight gasification facility. While at different stages of development, both sites reveal through their public "front" (Goffman 1959) the difficulty of containing experiences in order to arrange appropriate kinds of witnessing.

Andrew Barry makes a distinction between laboratories, where instruments require the mediation of qualified spokespersons, and more interactive sites – such as the contemporary science museum – where participation is mediated by open-ended bodily engagement rather than rigid instrumentation (2001, 147-51). In the latter instance, the individual citizen is afforded an opportunity to develop their own understanding, i.e. to learn through self-government. Ideally, the visitor centers of the Demonstrator Programme would represent a similar effort at reconciling discipline and empowerment. Unlike other practices of dissemination associated with the demonstrator projects, such as publications in specialist journals and websites, or talks at trade conferences, the visitor centers are intended for a more general public to experience waste sites for themselves. Even more specifically, they are meant for key decision-makers from local councils to acquire the knowledge they need to pursue the waste management targets delegated

to them by central government.[6] It is precisely for this reason, the Programme's political aspirations, that great care is taken to ensure the impressions visitors experience take the form of evidence, which in this case means carefully staging the 'interaction' to lessen unpredictability and uncertainty. Where one of the sites I visited exemplifies this point, the other is the exception that proves the rule.

The Ludlow digestor is co-owned by South Shropshire District council and ADPower[7], a company that specializes in designing, building, and repairing anaerobic digestion facilities. I visited ADPower's main headquarters in the fall of 2008 to conduct interviews with some employees and receive a tour of the plant. One of the technicians I'd come to interview escorted me to the plant, along with a sales manager who normally dealt with visitors. We walked from the main offices to the back of the industrial estate where the digestors were hidden – blocked on one side by a warehouse and on the other by trees lining the local highway. There were none of the obvious signs of a waste disposal facility – heaps of matter, peculiar odors, busy traffic – just an empty, nondescript lot. I was led upstairs to a meeting room with a large flat screen television, multiple rows of chairs, and several large windows overlooking plant operations. The sales manager explained the basic details about the anaerobic digestion process as we walked from one window to the next. The arrangement of the room, the way each window revealed a new phase of the operation in logical succession, gave the impression that the facility was built specifically for our viewing pleasure. The windows offered a simple frame that contained a moment of the process, held it still for observation at a distance.

[6] Those demonstrator sites I have researched confirm that a large number of inquiries and visits come from local authorities.

[7] As a matter of courtesy, I have changed the names of companies where the events I document are not a matter of public record.

In one window I was shown where food waste was unloaded, sorted and placed onto a conveyer belt which led to the tanks. Inside, I was told, the material would be combined with grass clippings and thousands of tonnes of food waste from other sources in Ludlow, the West of England and Wales. Because the tanks are carefully maintained, they can support the fragile microbes that decompose the waste and ensure it is heated long enough at a high enough temperature to satisfy the Animal By-products Regulation.[8] Next window. During the process, the microbes exhale a biogas, which is captured and converted into energy in a Combined Heat and Power unit. Most of this is sold to the National Grid as electricity, while the rest is used to heat the tanks and fuel the collection vehicle. From where we stand the gas is "invisible," it has no presence save the large tanks and pipes, no agency except for the background movements of the electric lorry. At the final window, at the other end of the warehouse, another conveyer deposited piles of all that remained of the waste after it was processed – an earthen, nutrient-rich material called "digestate." The material, which appeared like regular soil, was neatly piled out of sight, where I was told it would be loaded up and given to local farmers to fertilize their fields, visible outside the facility in the distance and surrounding the town.

The ADPower digestor was presented as a perfect linear process: I was meant to see the food waste, the tanks, and the digestate as three discrete stages. As a witness, my experience of the treatment process was reduced to a particular observational stance: a passive onlooker dependent on a translator to explain what happened next. Rather than the ideal of interactivity that Barry (2001) describes in contemporary science museums, I was meant to observe from a secure distance and a fixed perspective, not to manipulate or explore.

[8] The temperature of the tanks is meant to prevent the spread of pathogens, such as are held responsible for the recent outbreaks of BSE and Foot and Mouth disease among British livestock.

A great deal of work goes into crafting such a stable witness stance. This became more apparent to me when I toured the gasification plant on the Isle of Wight, which had only recently opened and did not yet have a completed visitor center. I had been invited to tour the new facility, along with dozens of other audience members, at a conference for the Chartered Institute for Wastes Management (CIWM) held in Torbay in the summer of 2008. A trade organisation for the UK's waste businesses, the CIWM meet annually, increasingly hosting councilors from Local Authorities as well as industry insiders. Consequently, one of the avenues through which the demonstrator sites have been required to publicize their activities is through the CIWM meetings and journal.

The gasifier was also obscured from public view, completely surrounded by a forest on the outskirts of Newport. Once a visitor enters the grounds of the facility, however, the waste collecting and sorting operations for the whole island become visible. The buzzing confusion of debris, machines, structures and people has its own order, of course, but it is not one the newcomer readily understands. Where the official visitor center would one day be, there was now a temporary trailer housing the gasification company's technical staff. I was not led to an enclosed office room, but was given a spare hardhat and reflector vest and taken through the actual facility, by foot. As a result, my experience witnessing the plant involved far more interactive bodily engagement with the device, the materials it processed, and the people working behind the scenes to make it function. First we approached the massive entrance to the warehouse, where a crane lifts bales of shredded residual waste, from which recyclables and biodegradable materials have been removed, which is then fed into the gasification chamber. As we stood there watching and I received this explanation, stray paper debris broke loose from the crane that floated above us and scattered in the wind. Unexpectedly, one landed on the corner of

my mouth, which led me to spit repeatedly for the rest of the day, unable to forget the disturbing taste.

The ways that the processes and products of waste treatment impact the bodies of unsuspecting residents will be discussed more in the next section, but this possibility has consequences for the management of experience during visitation as well. The ADPower facility presented a far more controlled environment, which was meant to be surveyed from one room, where one could not smell the breakdown of organic matter or hear the vibrations of the power generator. My experience was not more or less direct or mediated, per se, but was certainly more stable, admitting of fewer alternatives. If the one presented waste management as clean entertainment, the other left me awash in matters of technical detail which surrounded me uncomfortably. The rest of the Isle of Wight tour involved stopping in the control room, where Norwegian technicians were busily completing the commissioning work in order to handover the plant to their English counterparts. I could talk to them, shake their hands, smell their sweat, bump into them. From there, we followed pipes and chambers, walking underneath hanging machinery and climbing onto catwalks, in order to trace the path of the waste as it was processed between different segments of the large gasifier apparatus. I struggled to identify everything described to me amidst the noise and periodic interruptions from employees, surrounded by a complex network of components.

While a contrast can be drawn between the two demonstrator sites, my impromptu tour of the Isle of Wight facility actually reveals something common to all forms of public demonstration. More like a trip to a wilderness reserve than to a science museum, they require expert guides to help you see the actors and events that you came to witness. Demonstrators require spokespersons that can translate the actual complexity of technical operations into

something the "lay" witness can understand. At the ADPower facility, much of this work had already been done before my arrival: the treatment process was disaggregated into different display windows, creating the effect of a visual compartmentalization to accompany the tour guide's explanation. The way the device itself is framed does some of the interpretative work, but this does not change the fact that in both cases the visitor is dependent on the work of someone speaking on behalf of the technology, even if only to call attention to the frame and indicate what the visitor can then see for themselves.

Interestingly, the ADPower sales manager had been reluctant to show me the kind of up close tour I received on the Isle of Wight. After the official tour, the technician that had accompanied us to the digestor insisted on showing me the Combined Heat and Power generator that turned methane gas from the decomposing food waste into electricity. After we'd walked outside and around the back of the warehouse where the CHP and tanks stood, it was apparent why this was not part of the official tour. The generator was loud and the odor of decomposing matter was much stronger outside than in the air-conditioned visitor center. In fact, ADPower is nationally renowned for granting more access to their plant than most. I do not wish to dispute this, but rather to suggest that for them, as for all the demonstrators, the concept of public access is realized in a particular way.

And how could it be otherwise? For a company demonstrating its product, it is not much different from a person being evaluated in an everyday social encounter as described by Goffman: "Regardless of the particular objective which the individual has in mind and of his motive for having this objective, it will be in his interests to control the conduct of the others, especially their responsive treatment of him" (1959, 4). Goffman adds that "this control is achieved largely by influencing the definition of the situation which the others come to

formulate" (ibid.). If the "situation" is public engagement, the forms and forums of witnessing that are incorporated in the Demonstrator Programme reveal a pattern of carefully managed inclusiveness. The use of interactive tours is meant to facilitate understanding among interested non-experts, to make the demonstrators accessible to a wider set of publics. For this to work, however, they must serve as fair witnesses, ones who are properly informed by enlightened spokespersons and assisted by inoffensive visuals that tell a clear story.

Under the scope of the Programme, only those aspects of the demonstrator sites that can be relayed through select media – tours, displays, reports, and samples – can enter into assessments of "viability" and, in order to successfully translate complex technical phenomena into usable evidence and experience, these intentionally limit alternative interpretations. The Isle of Wight demonstrator now has a new visitor center comparable to the one in Ludlow, complete with a projection room where formal presentations can be given. Whatever its exact design, it is certain to offer a more predictable, manageable experience than the one I received. In this way, it has actually strayed farther from bringing people in touch with the messiness and uncertainty of techno-environmental intervention. It is no less real, but it has replaced a close encounter with the actors and materials "back stage" with a differently staged encounter between witness and demonstrator.

Counter-Witnesses

Insofar as public demonstration means experimenting outside of a controlled setting, it can attract more *unintended* attention than is usually the case for more contained laboratories. It is well known within the waste industry that laypeople have considerable power to challenge technical designs if they organize. The derisive term for such political antagonists is "Nimbys" ("Not in My Back Yard"), or as I have heard similar groups denoted in the UK, "Antis." While

they may criticize such collectivities as anti-modern or unscientific, planners, technicians, politicians and companies have to respect their influence.[9] At its core, the label "Nimby" is meant to suggest that critics lack the distance and objectivity to contribute to technical debate. In other words, Nimbys and Antis are meant to represent the very opposite of the modest witness of classic experimental science – they are those whose perceptions are thought to be colored by emotion, self-interest and ignorance. In this sense, Nimbys and Antis represent a tension within the very notion of publics, identified by pragmatists in the early twentieth century – that they are not equipped to address the complex debates of techno-science (Marres 2007). In a sense, this tension lies within the technological fact as well. As Marres makes clear, there can be no absolute distinction drawn between technologies and the sometimes-antagonistic publics they bring into being (2009, 119).

When such unauthorized interlocutors achieve a degree of public influence, I call them *counter-witnesses.* This is partly in reference to the concept of a "counter public" (Fraser 1990, Warner 2002), to which it is related, and partly developed from Bruno Latour's use of "anti-program" (1991, 1992) and "counter-laboratory" (1987, 79-94), to characterize the social negotiations embodied in technical innovations. In both cases, Latour is describing scenarios where tactical resistance to an original statement, rule, or design is incorporated into the very material design of an artifact. When, upon opening their digestor, ADPower encountered problems with non-biodegradable "contamination" in their collections, they worked with the council to create separate "kitchen caddies" and food waste bins – an anti-anti-program that

[9] The modernization of waste disposal technologies over the last century or more has depended on such confrontations with public resistance. Historian John Clark (2007) suggests that modern chimneystacks grew in response to public opposition to the late nineteenth century's first incinerators.

encouraged residents to categorically separate food disposal from regular rubbish, in the same way many had been trained to separate garbage for recycling.

Haraway (1991) has noted that the force-related metaphors in Latour's early work betray an implicit attachment to a vision of science as a masculine enterprise where heroes emerge victorious. My use of his terms is not meant to portray these technical negotiations as essentially combative, per se, but rather like a processual dialogue, where one party speaks and the other replies (see Goffman 1981). In some cases, this may consist in quite open and consensual collaborations. When some of Ludlow's residents began to experience disturbances caused by low frequency vibrations (so loud that some could not sleep), ADPower investigated the problem and, reportedly on recommendation from a resident, shifted the position of a blower attached to the gas turbines, successfully redirecting the noise. Indeed, many technical innovations in the waste industry serve to anticipate such opposition before it occurs, though they can never prevent alternative modes of witnessing altogether.

While collective opposition is more likely to involve those who live in proximity to waste sites, it can proliferate well beyond their acknowledged boundaries and radically alter them from a distance. A good example of this is the in-vessel composting demonstrator located outside Durham. The operator, Premier Waste, uses a system designed to accept mixed municipal waste and divide it into recyclables and "compost like output" (CLO). With demonstrator funding they added a third composting tower. Beginning in 2007, the CLO was used for land restoration of a closed landfill site less than twenty miles away. But in the following year a BBC special aired highlighting residential complaints about unpleasant odors coming from the CLO stockpile by the old landfill. While this alone might not present a challenge to the demonstrator's official claims, the BBC crew took samples of the CLO to a "certified laboratory" where a soil scientist

confirmed that the material had not been fully composted and that the four samples collected showed high amounts of recyclable materials, heavy metals, and E. coli (BBC Inside Out 2008) A government inquiry ultimately concurred and Premier was forced to landfill 10,000 tonnes of the CLO material as well as re-engineer their plant.[10]

While the Durham site was monitored by external consultants, the "fragility of measurement" always contains the possibility of potentially disastrous errors (Barry 2002). As was pointed out to me by John, who was one of the people tasked with monitoring the Durham site, it is difficult to analyze the processes associated with the single "Defra tower" when it is only one component of a larger waste processing system. Some of the data collected about the site's performance is therefore unavoidably imprecise and involves approximations about what goes in, what comes out, and what happens in between. Whereas the evaluations of consultants are limited to approximations of the demonstrator's performance, the even more qualitative and wholly biased noses of "the public" (assisted by the media) were able to force a legal inquiry and, ultimately, new forms of measurement and evaluation. Yet, these acts of counter-witnessing did not threaten the basis of the Programme - the Programme's evaluative enterprise was simply reconfigured. Indeed, the BBC investigation was framed in terms of composting techniques, in the abstract, thus furthering the desired separation of technological facts from situated arrangements of techniques, materials, and socio-microbial relations. If anything, the legal proceedings have only made John's work on Premier's Defra tower more specialized and more secretive, i.e., less publicly inclusive.

[10] An internal investigation concluded that the temperature control unit was faulty on one of the composting devices and Premier now claims on their website that a needed upgrade will raise the quality of their CLO to the regulatory standard.

However, there are forms of counter-witnessing that do suggest a more critical reappraisal of the Programme. Many of the companies operating demonstrators are using this as an opportunity to showcase their technology to future customers, since the demonstrators are often thought more likely to secure contracts with the private sector. In the case of Synco, the company that operates the pyrolysis demonstrator in Scarborough, they are hoping to achieve a record of successful performance in order to secure planning approval for a Somerset facility that would accept construction and demolition debris. An employee informed me that the planners are, in effect, waiting to see Synco's demonstrator plant operational before they grant permission.

But they are not the only ones interested. References to the Scarborough demonstrator also appear on a website dedicated to preventing a pyrolysis plant from being built in Somerset. In response to the planning proposal, a group of concerned residents from the Wells Environment Protection Group (WEPG) created a website to counter the claims made by Synco and Somerset council. Originally formed in opposition to a new housing development, their concerns about the pyrolyzer are similarly rooted in a desire to maintain the rural landscape as it is.[11] On the WEPG website, pyrolysis is described as equivalent to incineration, an interpretation which representatives from the advanced thermal industries wholly reject. As a Synco representative told me (and as is reported on the WEPG website), incineration requires oxygen to perform combustion, whereas pyrolysis must be oxygen free. The activist website responds by asserting that advanced thermal treatments are regulated by the Waste Incineration Directive, as they also release emissions. More to the point, they argue that the residents of Wells should not be exposed to this. As one protestor told me, "particulates [released by the plant] are going to fall

[11] According to some of the protestors, the site was chosen because it is currently listed as a Brownfield development, even though it is located in a residential area.

on… residential houses." By placing "local knowledge" of the area above and apart from the technical expertise of the developers, they attempt to draw the residents of Wells together as people exposed to a common threat.

This last point is, in fact, key to WEPG's challenge to the Programme. The re-categorization of pyrolysis as incineration is not due to ignorance of technical issues, as is asserted by the industry, but is part of a more fundamental rejection of the abstraction of technological facts and experiences from their enabling contexts. As a leading member of WEPG told me, technologies should be evaluated not simply based on what they are, but where they are located – "if they'd put it in the right place and not the wrong place there'd be no arguing." When I asked him whether the performance of the demonstrator in Scarborough might change his mind about the viability of pyrolysis, he said that he was already convinced *that site* was viable: "I've seen where it is on Google," he told me, "It's in the ideal place, that's what we've been saying all along." Pyrolysis was viable in Scarborough because there were no houses around it, no village nearby – he cites this as the reason that the Scarborough plant received no objections when it was twice evaluated for planning approval. "Viability" is not here a matter of technology abstracted from technique, but is critically informed by social context.

In the examples discussed, the bodies of counter-witnesses do not disappear as in the classic depiction of the modest witness, but are relevant precisely because of their *immodesty*, their connection to the odors and sounds, the buildings and histories bounded to a particular setting. As such, they represent the impossibility of preventing technological demonstrations, and the purportedly "neutral" facts they produce, from affording alternative modes of interpretation and, potentially at least, evoking a broader politics of technology and the environment.

Conclusion

The Demonstrator Programme is indicative of recent directions to transcend divides between experts and the lay public by placing emphasis on the involvement of members of the public in processes of decision making. At the same time, it is meant as a mechanism of informing such decision-makers, of making up for presumed deficits in their knowledge (see Owens 2000). As Barry puts it, "public demonstration… can never be described as disinterested – it is always intended to have effects on, or challenge the minds or affect the conduct of others" (2001, 178). As I have argued, the Demonstrator Programme is meant to govern the production of technological evidence and shape experiences of it. If the goal is to determine which technological interventions are a "best practice" that can be applied anywhere in the country, counter-witnesses illustrate how such efforts inevitably "become enmeshed in the particularities of the places from which they are derived" (Bulkeley 2006, 1029). In this sense, new waste facilities also demonstrate that the politics of public inclusion are not limited to whom you include or engage, but by what means this is accomplished and with what impact on processes of techno-scientific innovation (see Wynne 2003). If inclusion is framed as a process of controlled scientific revelation, rather than a more open-ended dialogue, it does little to transform the prevailing politics of technology.

The moral claims of climate change initiatives are arguably unique within Europe's techno-political landscape because they are defined against prominent examples of what one could call *worst practice*.[12] Defra's demonstrators serve as counter-laboratories, of a sort, to the century-old technique of landfilling waste in the UK. In a critical reappraisal of Latour's description of the political influence of artifacts, Law and Mol (2008) argue that "material

[12] It is the same with more recent demonstrator projects, such as the Hydrogen, Fuel Cell and Carbon Abatement Scheme, which is counterpoised against fossil fuel industries.

politics" could be seen differently. Certain practices can be interpreted as political insofar as they represent alternative ways of "ordering the world" through material means, in a way that creates contrasts with other, equally possible modes of ordering. More than they are competing with one another, the demonstrator projects are meant to compete with an entrenched fossil fuel economy, and their appeal and dismissal is often couched in precisely these terms. In effect, both the EU and the UK are attempting to cultivate a new material politics of waste and greenhouse gas.

If the proposed alternatives to landfill are one day adopted as widely as their rival, they have the potential to reorder relations between people and the material world across a variety of scales. Those interested and invested in the Demonstrator Programme recognize that the Programme is actively involved in *producing* possible worlds, not just modeling them. In fact, insofar as a variety of technologies are being experimented with in different locations through the Programme, the government is multiplying the number of possible worlds that might result from the material struggle against landfill and global climate change (Callon 2007, 352). The importance of recognizing counter-witnesses to Defra's demonstrations is that they stand for the inherent limitations of any attempt to model the heterogeneous complexity of techno-environmental innovation and intervention, of having full control over the worlds they may create. As governments adopt the demonstration approach, furthermore, the variety of publics invested in their efforts will only multiply, as will alternative ways of interpreting the problems and solutions of climate change. "Including" them cannot solve this; rather, the very process of technical innovation has to be redefined so that we adequately recognize the various ways in which other people and other ways of thinking are already involved.

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