Expertise, trading zones and the planning system: a case study of an Energy-from-Biomass plant

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Abstract

Planning disputes are sites of contestation in which science-based regulations come into conflict with the place-based knowledge of local communities. The procedural and often technical nature of these regulations means that these controversies are marked by an asymmetry of resources that is often experienced by community groups as an asymmetry in credibility. In short, the expertise of developers is generally accepted as such, whilst the knowledge claimed by citizens is dismissed as 'anecdotal' or 'NIMBYism'. In this paper, we make the argument that the asymmetries of expertise are less stark than the current system typically allows and that recognising and accommodating this would improve the planning system by enhancing the representation and inclusion of community voices. We explore this position by using a case study of the construction of a biomass-from-energy plant in South Wales. Drawing from 30 qualitative interviews, we maintain that the planning process has the potential to function as one of a network of 'trading zones' in which different communities enact their rights and have their claims to knowledge and expertise recognised. Crucial to this argument is understanding that the levels and kinds of expertise that different parties bring to the interactions are more than just matters of attribution: community groups can have genuine expertise.

Key words: trading zones, regulatory science, environmental governance, expertise, citizen science, epistemic injustice, environmental justice

1. Introduction

In England and Wales, localised disputes about the siting of renewable energy infrastructure, such as Energy-from-Biomass (EfB) plants, are mediated via rules-based planning and licensing regulatory systems. It is commonplace that these systems typically fail to provide local community members with *meaningful* levels of engagement with either developer-operators or other regulatory actors (Arnstein, 1969; Petts and Brooks, 2006; Wesselink et al., 2011; Hacking and Flynn, 2017; Slotterback and Lauria, 2019). Such procedural deficits often involve 'epistemic injustice', specifically 'testimonial injustice', in which the claims to knowledge are unfairly discounted on the basis of the speaker's identity (Fricker, 2007; Bell, 2022) which leads to (further) reductions in trust and legitimacy. Here, we argue that breaking this cycle of negative feedback requires better recognition of the types and levels of expertise that these community actors can draw upon. More specifically, we argue that seeing planning disputes as epistemic trading zones in which different types and domains of expertise must interact creates the circumstances within which this epistemic injustice can be addressed (cf. Eden et al., 2006; Mäntysalo et al., 2011; Balducci and Mäntysalo, 2013).

The central component to this argument is that community groups have genuine and relevant expertise that is being unjustly dismissed. We make this case by using theories developed within the science and technology studies (STS) literature – principally the idea of trading zones developed by Galison (1999) and the typology of expertises developed by Collins and Evans (2007) – to examine the controversy that has emerged around proposals to site an EfB plant in a small town on the South Wales coast. EfB plants provide a good case study for exploring issues of expertise and epistemic injustice as the planning and permitting process requires decision-makers to put the technical submissions provided by the developer-operator out to public consultation. This, in turn, creates the conditions within which different kinds of knowledge – scientific, legal, local to name but a few – are brought into contact (and conflict) with each other.

By using the idea of trading zones to characterise the different sites of interaction, and the typology of expertise to categorise the kinds of expertise available within each, we are able to show that place-based, local actors (cf. Vena, 2023) have the potential to improve the planning process and move on from the serial failures in public engagement efforts that are all too often witnessed in planning and environmental governance systems (Zakhour, 2020; Alfasi, 2021). The argument proceeds as follows. First, we review the relevant literature and introduce the key theories and concepts that underpin and scaffold the subsequent analysis. Next, we summarise the case study that forms the empirical base of our claims before presenting the results. The results include a re-conceptualisation of the planning system as a

series of inter-linked trading zones and a detailed examination of the most public-facing one of these.

2. Literature Review

This paper draws on, and combines, literatures relating to expertise, trading zones and epistemic injustice. In addition, the analysis often makes use of distinctions between environmental science, regulatory science, and community science. For clarity, these actors are described and defined first.

2.1 Definitions of Key Actors

Distinctions between different types and domains of science are notoriously hard to make because of the ease with which ambiguous, boundary cases can be identified. Indeed, one of the categories we define – regulatory science – is an example of just such a fuzzy category. Nevertheless, it remains the case that different actors and institutions have different roles within the planning system, and these need to be distinguished if any analysis based on the interactions between different groups is to be accomplished.

As an opening heuristic, we position *environmental science actors* at the opposite end of a continuum to *place-based actors*, with *regulatory science actors* sitting somewhere between. In this framework, environmental science actors refer to individuals and institutions involved in the production of knowledge that is intended to generalise rather than apply to specific places (Heilbron, 2003). It is the type of work most commonly conducted at universities and private research institutes where the pursuit of knowledge that produces general conclusions is funded by the state and corporations.

The work of environmental science actors is clearly relevant to planning decisions, but is not (always) directly applicable. Instead, it must be applied to the specific context and questions of the planning application. This is the role of the regulatory science actors, who straddle the boundary between scientific, technical, legal and political domains and supply an applied version of the various scientific disciplines used in the regulatory process (Moghissi et al., 2014). Regulatory science takes different forms and performs different tasks but is fundamentally concerned with turning the many uncertainties and ambiguities inherent in the more general domain of environmental science into specific statements and recommendations about individual proposals and contexts (Rushefsky, 1986; Jasanoff, 1990; Oreskes and Conway, 2011).

Finally, place-based actors refer to community members who live and work in a local area and, by virtue of this experience, have developed substantial expertise in local practices and conditions. This local expertise is often at odds with the assumptions made by regulatory science actors who, despite the applied nature of the remit, typically resort to standardised or ideal-type conditions when making their assessments. Place-based actors are often in a strong position to contest these assumptions and, in some cases, go further and pro-actively collect data that can be used to provide evidence that the situation on the ground is not as represented by others. Where these challenges involve the collection of local environmental data, then the work of place-based actors merges into that of citizen – or what we prefer to call, community – science (*Authors, under review)*.

2.2 Expertise and Trading Zones

Drawing on what has been called Studies of Expertise and Experience (SEE), we take expertise to be the outcome of successful socialisation into a community or domain of practice (Collins and Evans, 2002; Evans and Collins, 2007). Using this definition, the differences between the kinds of expertise mobilised by the three different kinds of actors – environmental science, regulatory science and place-based – are seen as sociological rather than epistemological. This, in turn, has important implications for how we understand their interactions and possible collaborations and provides the link to concerns about epistemic injustice. In essence, SEE allows us to separate the status given to a particular body of knowledge within a particular setting from the extent to which that body of knowledge represents a genuine expertise. Where expertise is unfairly discounted because of the speaker's identity – i.e., because it does not come from a 'recognised' source – then we have a case of epistemic injustice. In what follows, we outline the key tenets of this theory of expertise, highlighting how it links to the idea of epistemic injustice, and then show how it has been used to enrich the metaphor of trading zones that was developed by Galison (1997; 2010) to explain interdisciplinary collaboration.

In treating expertise as the outcome of socialisation, SEE follows directly from work in science and technology studies (STS) that emphasises the socially constructed nature of all knowledge. What distinguishes it from other work in that field is that it treats expertise as real and not merely relational (contrast with Carr, 2010; Evans and Collins, 2008). This is not to say that there is no relational aspect to the attribution of expert status or that technocratic forms of decision-making are to be encouraged. Rather the point is that any notion of epistemic injustice pre-supposes a genuine expertise that has been unjustly ignored and some way of accounting for this within a broadly constructivist framework is required. Focussing on expertise as a collective property that individuals acquire through socialisation

strikes this balance. The ‘content’ of the knowledge remains the property of the community – and hence socially constructed – but the socialisation required to successfully acquire such knowledge has either taken place or it has not. If socialisation has been completed, then we can say the expertise is real and ignoring it would represent and epistemic injustice. If it has not, then any claim to possess that expertise is unfounded and the decision to give it no weight is justified.

In practice, of course, socialisation is not so binary, and there are a range of ways and intensities with which an individual novice can interact with any expert community. These possibilities come with different opportunity costs, creating both a typology of different kinds of expertise and a distribution of these expertises across society as a whole (Collins, 2013; Evans and Collins, 2007; Evans, 2008; Evans, 2011). For example, there is knowledge that can be gained *without* interacting directly with the expert community. Depending on the resources used, one might gain a very basic knowledge that consists primarily of isolated facts, the kind of simplified representations found in publications aimed at a general audience, or the higher-level knowledge contained in the primary source material such as journal articles. Crucially, none of these involve social interactions with the expert community, which means they cannot include any of the specialist tacit knowledge that is essential to fully understand its practices, values and judgements. As such, whilst these lower levels of expertise might be enough to know that universities are generally good places to find experts, they will not be enough to know which university or individual is doing the best research in a specific discipline or area.

In contrast, the two kinds of expertise that are acquired through socialisation within the expert community do include the specialist knowledge that the domain experts possess and routinely rely on. The crucial distinction here is between contributory and interactional expertise. The highest level of expertise – contributory expertise – corresponds to complete socialisation into all aspects of the domain and includes mastering both its practical activities and the language used to describe those activities (Collins et al., 2016). Interactional expertise, which is the new category, refers to fluency in the language of the domain but without the ability to carry out practical tasks. The category is pivotal as it breaks the link between embodiment and expertise but, by retaining an emphasis on language as a social practice, avoids reducing language to the explicit knowledge found in published sources (Collins et al., 2016).

The idea of interactional expertise is important for understanding complex divisions of labour in which it is impossible for any individual to become expert in all the practical activities that

are required but in which some degree of mutual comprehension and co-ordination is necessary. By showing that language can be learnt through interaction, but without physical practice, interactional expertise explains how members of complex multi-disciplinary teams can communicate whilst also retaining their own specialist domains of (physical) practice [1] As Collins et al. (2017, 765) put it:

> "if practitioners [i.e., contributory experts] know how to walk the walk, [then] interactional experts know how to walk the talk."

The role language plays in facilitating collaboration between knowledge communities is most famously associated with Peter Galison's metaphor of a 'trading zone', originally developed to explain collaboration within the physical sciences (Galison, 1997). In the original model, trading zones were built around rudimentary shared languages that allowed co-operation and exchange to take place. In some cases, these pidgin languages might develop into richer creole languages that enable more sophisticated communication and more complex interactions, with the logical endpoint for scientific trading zones being the development of a new hybrid discipline with its own specialist set of languages and practices.

This is, however, just one possibility and there are several other ways in which the linguistic common ground needed for trading zones to function might be developed. Gorman (2002) provides the first attempt to link SEE with Galison's work on trading zones, with the 2 x 2 matrix shown in Figure 1 representing a more complete development of this work. The key innovation here is the inclusion of more partial models in which the original communities retain their original identities and language (the two columns)

[1] For more on interactional expertise see: Collins, Harry M. 2011. "Language and Practice." *Social Studies of Science* 41 (2): 271–300. https://doi.org/10.1177/0306312711399665; Collins, Harry M, Sanders, Garry. 2007. "They Give You the Keys and Say, 'Drive It!' Managers, Referred Expertise, and Other Expertises." *Studies in History and Philosophy of Science Part A* 38 (4): 621–41 https://doi.org/10.1016/j.shpsa.2007.09.002; For a more critical view see: Goddiksen, Mads. 2014. "Clarifying Interactional and Contributory Expertise." *Studies in History and Philosophy of Science Part A* 47 (0): 111–17. https://doi.org/10.1016/j.shpsa.2014.06.001; Plaisance, Kathryn S., Kennedy, Eric B. 2014. "A Pluralistic Approach to Interactional Expertise." *Studies in History and Philosophy of Science Part A* 47 (0): 60–68. https://doi.org/10.1016/j.shpsa.2014.07.001; P.A. Lima, Ribeiro, Rodrigo, Francisco. 2015. "The Value of Practice: A Critique of Interactional Expertise." *Social Studies of Science*, December, 0306312715615970. https://doi.org/10.1177/0306312715615970

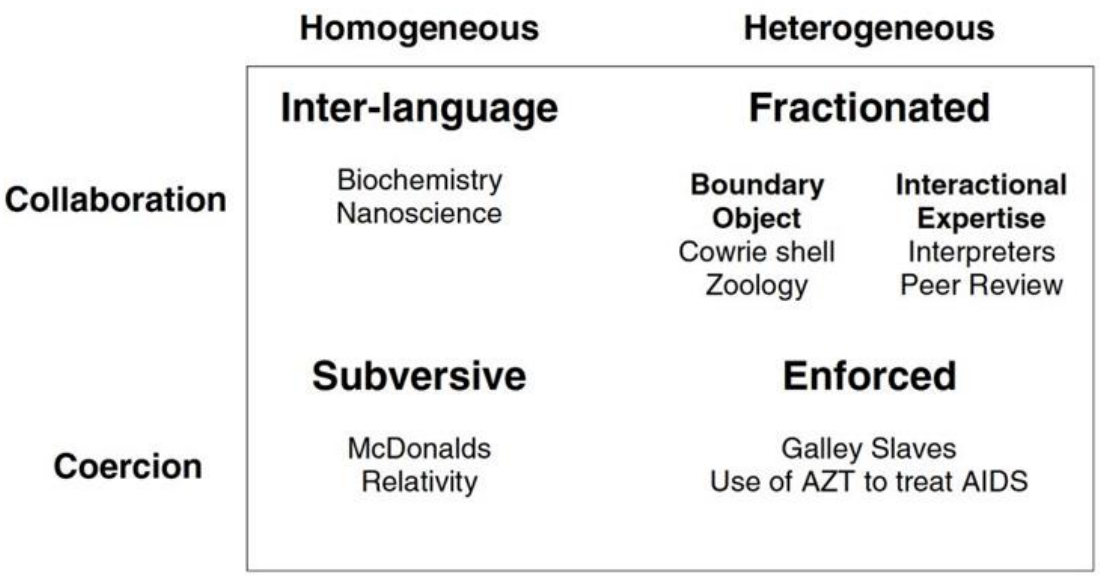

Figure 1: A general model of trading zones (from Collins et al, 2007)

and the extent to which they choose or are coerced (the two rows) into collaborating (Collins et al., 2007; Collins et al., 2019; Gorman, 2002).

3. Trading Zones and the Planning System

It is this latter way of thinking about trading zones that seems particularly relevant for the planning context, as there is no suggestion that the different groups of actors identified above are going to, or even should, form a single, more homogeneous community (Flyvbjerg, 1998). In fact, it makes more sense to think about the planning system as an overlapping series of different types of trading zone in which bilateral exchanges occur, as shown in Figure 2 below:

- The Regulatory Science Trading Zone lies between environmental science actors and regulatory science actors,
- The Planning Procedure Trading Zone lies between regulatory science actors and place-based, community actors, and
- The Community Science Trading Zone lies between environmental science actors and place-based, community actors.

Most of the public controversy and debate takes place in the Planning Procedures Trading Zone but, before considering this in more detail, we also need to briefly summarise the key features of the other two trading zones.

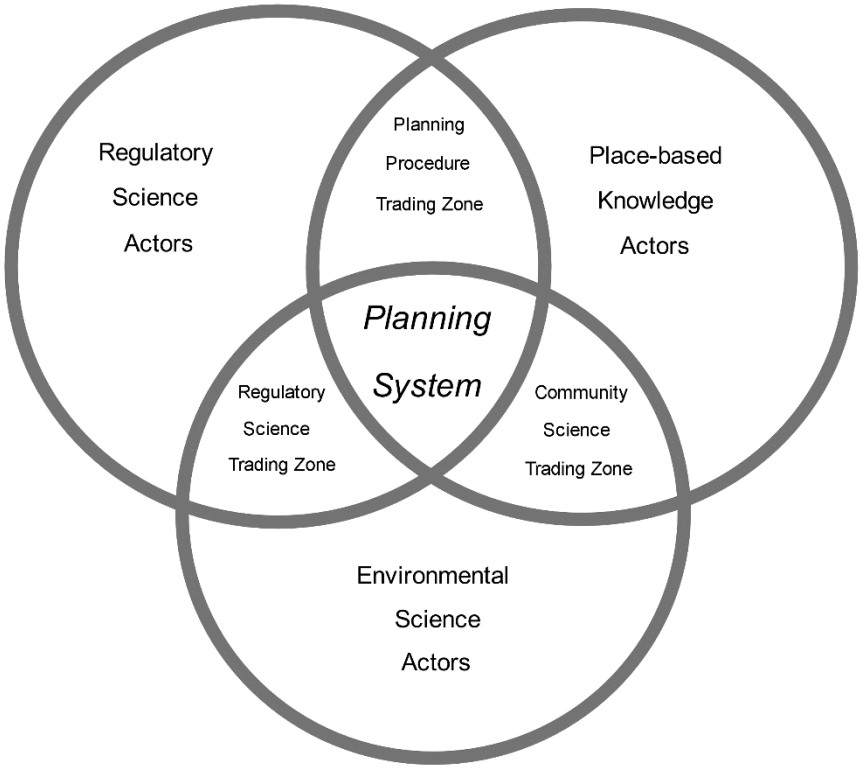

Figure 2: Diagrammatic Representation of the Key Actors and Trading Zones in the Planning System of England and Wales (authors' own)

The Regulatory Science Trading Zone is where environmental scientists interact with regulatory science actors and policy makers. This zone has been the focus of much research in STS and geography (Machen, 2018; Turnpenny et al., 2013) and is the closest to the original 'inter-language' trading zone in that collaboration is largely through choice and a stable set of shared language and practices has developed. As Hagendijk (2004, 56) notes, much of the scientific and technical knowledge that is used in these regulatory worlds "originates in laboratories, workshops, and study centres lying between science, government, and industry." Examples of these Regulatory Science Trading Zones include expert advisory committees, research management agencies, and so on, each charged with attempting to find consensus on what is 'good science' and relying on practices drawn from both science and politics (Miller, 2001).

In the Regulatory Science Trading Zone in Figure 2, specialised tests and measurements are used to determine the conditions under which a technology may or may not be authorized for use. Examples include clinical trials and the licensing of medicines; toxicological risk assessment and authorization of chemicals; technology assessment and pollution control technologies; fault-tree analysis for nuclear reactor design; life cycle analysis for elements of new transportation systems, and so on. These forms of knowledge are partly defined in *de jure* and *de facto* standards and guidelines (Cambrosio et al., 2009), but they also rest on professional conventions, the experience of the scientists and engineers who perform or interpret them, and an understanding of the socio-technical and cultural contexts in which they will be used.

The 'trade' is needed precisely because neither party is sufficient on its own: environmental plans, proposals and regulations all "need the approval of [pure] science for the credibility of their knowledge claims as well as the approval of political institutions for the legitimacy of their policy orientations" (Miller, 2001: , 483). As such, these trading zones provide a forum in which government and other officials can consult with knowledgeable and up-to-date practitioners in relevant scientific and technical fields. In an ideal world, this would "inject a much-needed strain of competence and critical intelligence into a regulatory system that otherwise seems all too vulnerable to the demands of politics" (Jasanoff, 1990: , 1). In practice, however, the claim is often made that they simply create a veneer of technical legitimacy over decision-making processes that have already been thoroughly captured by vested interest.

In the Community Science Trading Zone, scientifically literate boundary organisations communicate the work of environmental scientists to place-based actors using interactional expertise (Eden et al., 2006). These bodies, which include non-governmental organizations (NGOs) like Friends of the Earth, lawyers specialising in environmental issues and university-based scientists, are often sceptical about the ability of regulatory science to deliver adequate protection given its complicity in official decision-making processes. Here, we see activities that correspond more closely to the fractionated type of trading zones in which collaboration remains voluntary, but each group retains its own identity. Work in these zones often concerns opening up regulatory science activities to scrutiny by showing how the scientific evidence on which regulations rely is not as clear cut as it is often presented. As civil society has made more and better use of scientific knowledge, so the supposedly objective knowledge said to underpin pure science activity and regulatory policies has lost much credibility (Bäckstrand, 2003). This is also reflected in the development of new participatory experiments – consensus conferences, participatory technology assessment,

citizen juries and public hearings (Voß and Amelung, 2016; Van Bouwel and Van Oudheusden, 2017) – that have sought to give citizens a more meaningful role in environmental risk management. Within this space, the community-based citizen science projects engaged with environmental issues such as air quality, water quality, noise pollution are of particular importance as they are often set up specifically to challenge the outputs of the Regulatory Science Trading Zone (Kimura and Kinchy, 2019).

Finally, there is the Planning Procedures Trading Zone, 2 in which regulatory and planning agencies mediate between the corporate, commercial concerns that drive regulatory science actors and the more precautionary, place-based concerns that drive place-based actors and community groups. Experts within the institutions in the Planning Procedures Trading Zone interpret and apply the regulatory science activities whilst also attempting to take account of the counterclaims made by community groups and their supporters. The outcomes take the form of planning and/or other regulatory decisions in which compliance with relevant standards and thresholds forms a key part of the ways in which decisions are made, justified and challenged (Irwin et al., 1997; Borraz and Demortain, 2015). As such, this trading zone has at least some of the characteristics of an enforced trading zone as all actors, but particularly the community ones, are required to adopt the language and standards of the planning system and to abide by its outcomes.

In practice, of course, not all groups are equally constrained by this approach. Regulatory science actors from industry, including developers and operators, engineering consultancy and financial firms and associated professional bodies, have long been active with the regulatory institutions of the Planning Procedures Trading Zone. These actors find it easier to play by the rules of this zone. In contrast, despite many efforts to include more bottom-up, or place-based, knowledge community groups often struggle to gain access or be heard. As Robertson and Feick (2019, 91) suggest, using the example of the climate emergency: “Effects are often common across specific types of places … however, these effects are also expressed in locally unique ways. These types of place-based issues can only be addressed adequately with the knowledge that accrues from experiences in a specific locale and/or within an identifiable type of place.”

The outcome is that institutional authorities in the Planning Procedures Trading Zone are increasingly being asked to mediate between developer-operators, who are familiar with the system and its esoteric expertise, and community groups offering equally esoteric but much more local, focussed (and sometimes experiential) expertise. In so doing, these regulatory institutions must ensure that the technical language of the developers and operators is made

more accessible to community members but also that the concerns expressed by community members are not dismissed simply because they are formulated in a different register to the regulatory science with which they are more familiar.

There is, however, one aspect that is missing from the existing literature, and that is the peculiarly epistemic characteristic of planning disputes, which means that local communities may not only be denied their right to participate meaningfully in decision-making, but they may also be denied their capacity to 'know' their locality (Bell, 2022). This epistemic injustice (Fricker, 2007; Evans et al., 2023) occurs when community testimony that highlights the specific features of a local area is discounted and priority is given to standardised, 'universal' assessment produced by accredited experts. For example, it is not unusual for community testimony about local environmental features to be dismissed as anecdotal and subjective by regulatory actors, whilst the assessment produced by the developer's environmental consultants are seen as 'objective' or 'scientific' and weighted accordingly (Hacking and Flynn, 2017). In this way, the epistemic injustice has the potential to reproduce and reinforce wider structural inequalities, with elite groups retaining their privileged position and even relatively well-resourced community groups struggling to be heard.

This paper is principally concerned with the interactions between the different epistemic communities – environmental scientists, regulatory scientists and community or place-based actors – in three distinct trading zones linked to the planning process in England and Wales. The analysis focusses on the types, levels and domains of expertise that each group is able to mobilise and how these are combined (or not) through the interactions that take place in each of these trading zones, albeit with particular attention paid to the planning system (and especially the Planning Procedures Trading Zone) in so far as that is the site at which community and regulatory actors confront each other most directly.

4. Methods

This research is based on a case study of a waste wood biomass incineration plant. It was first proposed by a developer, Sunrise Renewables (Barry) Ltd, in 2008. The proposed site, in the formerly industrialised docks area of Barry, was always going to be controversial as it sits just four hundred metres from the Castleland ward, which has multiple indicators of deprivation, and just one hundred metres from newly regenerated waterfront housing. To grant planning permission to such a facility, however technologically advanced it was claimed to be, seemed perverse to many in the town as it went against their collective hopes for Barry's post-industrial regeneration (Evans et al., 2023). After initial planning permission had been granted to Sunrise Renewables, the site was sold to a new developer-operator,

UK Biomass No.2 Ltd, backed by Aviva Investors, who set about building the facility in 2018 and were subsequently granted a licence to operate by the regulator, Natural Resources Wales (NRW). The plant has yet to start operating, however, the final operating permit has yet to be approved and the new owner-operators remain in dispute with the Vale of Glamorgan's Planning Office over alleged planning infringements.[2] At the time of writing (September 2023), public consultations had concluded, and all parties were waiting for a final decision on planning permission. Parallel to this, another set of very similar plans for planning approval had been submitted by Aviva apparently as a fallback route should the current plans be derailed.

This paper is based on data collected during a participatory community science project in which we worked with a local community group that has been campaigning against the biomass plant for many years. The aim of the project was to develop their capacity to collect air quality data about their local environment and to document the expertises that were needed and/or developed in doing this. In addition, and alongside this work, we necessarily engaged with them in a series of wider discussions about their concerns and motivations and attempted to gather data from other key actors involved in the planning dispute.

Along with numerous informal meetings with various members of the community group, we conducted 30 more formal, semi-structured interviews with 18 people. Most of these (16) were with community members involved in the Barry Citizen Science Group (BCSG) that was created through the research project. Many of these individuals were also active members of Barry and Vale Friends of the Earth (B&V FoE), the Docks Incineration Action Group (DIAG), both of which have fought against the biomass plant since it was first proposed in June 2008, and Beautiful Barry, a spin-off group from DIAG that runs a popular Facebook page dedicated to promoting a more positive image of Barry by supporting local businesses and encouraging environmental activity like litter picking. Both Beautiful Barry and the BCSG formed in 2018 after the biomass plant's licence was granted. The BCSG has spent two years working with us taking baseline air quality readings of the town with both amateur and professional air monitoring equipment. Alongside a broader vision of protecting and promoting their local environment, the BCSG also wants to be ready to measure the biomass plant's air pollution should it gain planning permission and begin operations.

[2] There has also been a referral of the project to the devolved body Planning and Environment Decisions Wales (PEDW*).* A more detailed description of the planning decisions and associated controversies can be found in Evans et al (2023).

The remaining two interviews were conducted with representative of the main regulatory bodies involved in the decision: the Vale of Glamorgan Planning Authority and Natural Resources Wales. We also asked the developer-operator, UK Biomass No. 2 Ltd and the Welsh Government's Planning Division for interviews but they have so far declined to take part.

Finally, to understand and contextualise the interview data, we also:

- assessed a range of documentary evidence regarding the biomass plant including DIAG and community responses to public consultation efforts, legal notes, minutes, letters, emails, completed freedom of information requests, press cuttings, corporate records, and transcribed video of council meetings.
- held 30 face-to-face and online meetings with 18 members of the community group, two of which involved the deployment of small air quality monitoring kits designed by academic researchers at Fab Lab in Barcelona (Balestrini et al., 2015; Woods et al., 2018) as well as one professional-level air quality unit provided by Think Air Ltd based in South Wales.

The groups involved are named in this paper with their permission so that they receive the appropriate intellectual capital (Lewis and Atkinson *accepted*), but individual contributions remain anonymised. The interviews were recorded, transcribed and coded manually (all three authors agreed and undertook analysis and interpretation). Written transcripts could be interpreted against other documents which put into context the activities of a number of these governance actors. We were guided in our handling of data by Prior (2016), Edwards and Holland (2013) and Schubotz (2020).

5. Results and Analysis

We structure the reporting of our results by using the three main sets of communities defined above and the three trading zones discussed in the literature review.

*5.*1 Regulatory Science Trading Zone – Where Regulatory Statutes Get Made

The Regulatory Trading Zone is where regulations are made (Figure 2). This zone can be said to both dominate and feature only indirectly in our case study. It dominates in the sense that most of the actual controversy concerns the extent to which regulations and standards have been followed correctly. An example of this, from a similar study, is provided by

Hacking and Flynn (2017, 15) who report how an Environment Agency Wales officer described their role:

> ‘‘[O]urs is a technical ecological assessment. We don’t have the freedom to say ‘yes’ or ‘no’ just because we don’t like something or we think something else would be better, or that it should never have been there in the first place.’’ (‘E1 Interview’, recorded in 2009)

But this zone features only indirectly here because these legal determinations are made well upstream of individual communities becoming affected, which means that the appropriateness of these regulations and standards is rarely challenged directly. In what follows, we summarise the nature and outputs of this trading zone in relatively general terms, drawing on the extant literature rather than our own data, which refers more directly to activities within the other two trading zones.

The key products of the Regulatory Science Trading Zone are the powerful documents that codify the environmental protocols and standards that provide the policy framework within which specific infrastructure projects are proposed, built and operated (cf. Machen, 2018). It is for this reason that we characterise it as an inter-language trading zone based on shared language, practices and identity. In practice, the trading zone includes:

- actors concerned with making policy and regulations such as MPs and Members of the House of Lords, members of the Welsh Government, departmental policy specialists, government solicitors and legal advisors,
- groups and individuals that provide specialist technical advice relating to the domain in question, including government and departmental scientific advisers, members of expert advisory bodies, and experts representing a range of difference research centres or bodies,
- representatives of those likely to be affected by the regulations such as industry bodies, infrastructure developers and other commercial bodies.

The tension between the epistemic character of the trading zone and its more economic, political and moral concerns comes from the inherent uncertainty and incompleteness of the scientific knowledge on which it relies. On the one hand, the new knowledge produced by environmental and other scientists might suggest reasons for greater caution in developing new infrastructure. On the other, new knowledge-claims might offer solutions to problems and hence provide a justification for expanding particular types of infrastructure. As Hacking

and Flynn (2017, 14) point out in a case study of an energy-from-waste plant, in either case, the accepted ways of working are:

> [O]verwhelmingly procedural, technocratic and expert-led … [their] definition of 'good health' was … biophysical … [and] largely based on epidemiology and toxicology to make health risk assessments [to make] downstream risk assessments of 'how damaging to health might it be?'.

Within the trading zone, however, there is a high degree of interactional expertise as these different claims will be picked up, amplified and circulated by other actors – investors, developers, industry bodies and so on – in order to advance their own interests and so shape the formation of the environmental laws, statutes and guidance that are ultimately codified in the shared language of regulations and policy. In many cases, the documents that are produced will be international in nature, further complicating the negotiation and extending the period of expert consultation and contestation.

In the context of our case study, the relevance of this trading zone is the environmental regulations and statutes that provide the framework within which all other actors have to operate, e.g. the *Waste Framework Directive* (EC, 1975) (plus its subsequent amendments). Whilst such documents do not, in themselves, constitute new knowledge they do recognise and give legitimacy to knowledge produced by some actors and, in doing so, downgrade or reject that provided by others. In this sense, the trading zone, and the various consultative bodies through which it is operationalised, co-ordinates both the sifting and sorting of expertise and the future activities of developers, planners, regulators and communities.

*5.*2 Community Science Trading Zone – Where Regulatory Science is Troubled

This is the trading zone where the place-based expert knowledge that exists in communities interacts with environmental science and in particular the intermediary organisations that seek to bridge the gap between the esoteric-but-universal world of the scientific community and the mundane-but-contextualised world of the local community (Vena, 2023). It is for this reason that we classify it as a fractionated trading zone. In the case study reported here, these intermediary organisations that might possess the interactional expertise needed to translate or move between scientific and community groups include university researchers, including ourselves, and NGOs such as Friends of the Earth (FoE), UK Without Incineration (UKWIN) and Biofuelwatch.

Unlike the Regulatory Science Trading Zone, where the relevant technical expertises have a degree of shared content and values that will help to bridge gaps, the differences within this community-focussed trading zone are larger, making the job of creating a shared language more challenging (Eden et al., 2006). Like the regulatory setting, there will be a range of environmental science disciplines such as air quality and toxicology but, unlike the regulatory setting, their knowledge must be applied to a specific setting and translated in a language that community actors can understand and use, and vice versa. As we show below, this is not impossible, but the increased heterogeneity of the participants gives intermediary organisations an especially important role in translating and supporting community groups as they develop the expertise needed to engage with the planning process.

The typical work done in this trading zone is the bringing together of knowledge from environmental science with the local, place-based expertise of community groups. For example, new research identifying potential environmental pollution pathways is re-packaged and disseminated by national and international NGOs, not-for-profit environmental lawyers and university researchers using their existing contributory and interactional expertises. This knowledge is then picked up and used by place-based actors who assimilate this information with their own expertise based on experience in their local environment. Especially important for our analysis is the extent to which this communication takes place through face-to-face settings, with local FoE groups being a particularly important site for this shared learning to take place. As one of the Barry and Vale FoE members, who is also a member of DIAG and the BCSG, said:

> "Because I worked for [an NGO], that's how I got the knowledge about [the] incinerator business and about the laws, the … policy documents that we [in Wales] were supposed to be following. … If they really stuck to what Europe says [on] controlling and regulating incinerators [then] this one would have got knocked back. [It] wouldn't have got a licence from NRW [Natural Resources Wales] because it said you have to properly study the use of the waste heat. And NRW just ignored it." (Interviewee 12, 2021)

This concern about losing valuable heat from the biomass incinerator was one of several points of critique that expertise from FoE's central UK operation in London, and more recently from UKWIN and Biofuelwatch, enabled the community group to develop. Another was the need to recycle more through a regulatory mechanism known as the waste hierarchy (initially enshrined in EC, 1975) in which processes higher up the hierarchy are more sustainable:

> "[B]urning … waste wood … should be first recycled and [the original developer-operator, Sunrise, and the regulators] weren't looking at that … [Some companies at the time were] stripping chipboard and re-using the chopped board … [as] new boards. We just said 'Well, this is higher up the waste hierarchy, [it] should be adopted." (Interviewee 12, 2021)

Another frustration is that, typically, new scientific knowledge is adopted into rules and regulations via the Regulatory Science Trading Zone at a very slow pace (see cases cited for medicine, for example, Anklam et al., 2022). This is due to the complex and often drawn-out consultation and bargaining procedures between a range of scientific and regulatory actors. These delays mean that regulations and standards deployed by institutions in the Planning Procedures Trading Zone always lag well behind the research frontier. Evidence for this is provided by the progressively more stringent limits on pollution levels that are eventually set by individual countries, trading blocs like the EU, and the World Health Organisation, but which only come into force many years after initial research findings.

This concern with the delay and difficulty of responding to new research also gives the Community Science Trading Zone a different set of values and priorities compared to its regulatory counterpart. Where the Regulatory Trading Zone might be characterised as generally 'enabling' economic and industrial development, the community-based trading zone is often more responsive to new concerns and hence more precautionary in its approach. This reflects both the environmental and epistemic injustice created when place-based knowledge is rejected by regulatory authorities (Fricker, 2007; Hacking and Flynn, 2017; Bell, 2022) and the alternative reading of scientific research as likely to identify more, rather than less, risk.

*5.*3 The Planning Procedures Trading Zone – Where Plans Get Delivered

This is the trading zone in which much of the controversy that characterises the case study reported in this paper takes place. Here, regulatory actors including the Vale of Glamorgan Council Planning Office, the Vale of Glamorgan Council Planning Committee, Natural Resources Wales, the Planning Inspectorate of Wales (PEDW), and the Welsh Government mediate between the developer and the community and, in doing so, determine whether the proposed development can proceed. The interactions between the various parties are structured by the legally binding planning legislation and other regulatory documents described above. This gives the trading zone its 'enforced' character(Hacking and Flynn, 2017). In the case of the biomass plant, the *Town and Country Planning (Environmental Impact Assessment) Regulations Wales (2017)* is particularly important as it sets out the

conditions that must be met in order for permission to be granted. In addition, compliance standards set out by NRW, such as thresholds for carbon dioxide (CO_2) and particle matter (PM) outputs from the plant's chimney stack, must also be met.

The controversy emerges as developers claim these conditions have been satisfied, whilst the community groups dispute this, arguing that the process set out in the regulations has not been followed and that, contrary to the information provided by the developer, the proposed plant does not comply with the regulations. In exploring the competing justifications offered by the regulatory bodies and the community groups, we see the importance attached to procedure and standards. For example, when describing their work, a senior member of NRW maintains:

> "We are the regulator. We have to make the … decision and we have to be transparent, and we have to be accountable, because there are appeal mechanisms, there [are] judicial review mechanisms etc. So, we can't just do things willy-nilly, we have to apply the rules as the Law allows us and, within our functions, that we're allowed to do." (Interviewee 20, 2021)

A similar rules-based environment drives the actions of the other regulator in the Planning Procedure Trading Zone, the Local Planning Authority located in the Vale of Glamorgan Council:

> "We may be developing a Strategic Development Plan … throughout the city region. And, that plan will slot in-between the Local Development Plan and the National Plan … We will have to have regard to what that plan says. But that is what we do, we assess having regard to the statutory frameworks … the statutory plans that are in place and obviously other material considerations … things like noise, disturbance, how it impacts upon residents in terms of transport, all these other things." (Interviewee 20, 2021)

Crucially, for both these institutions, the rules and regulations they must enforce are those framed by the interests represented in the Regulatory Science Trading Zone described above. In other words, the kinds of knowledge that are valued and which are seen as providing 'evidence' is typically that produced by official and accredited experts, with the thresholds and standards that must be met being the ones agreed in consultation with those same experts and industry bodies. The outcome is that planning applications become codified as official documents designed to show their compliance with the relevant

regulations, by, for example, showing that the plant will lead to a reduction in carbon dioxide emissions. In the case of UK Biomass No. 2, these documents included an Environmental Permitting application (2017) and an Environmental Statement (ES) application (2022), submitted as part of planning permission. Both of which run to many hundreds of pages and contain highly technical data throughout.

By law, these documents must be put out to statutory consultees and to public consultation before any decision approving or rejecting the proposal can be made. During the public consultations, community groups produced alternative interpretations of the environmental risks described in these official documents, submitting their own documents, which also run to several hundred pages (e.g., DIAG, 2017, Clarke et al, 2022). In taking on this challenge, community members have worked with intermediary organisations and conducted significant amounts of online and other documentary research challenging both the application of the process and engaging with the wide range of technical issues – for example, assumptions about feedstock, operating cycles and transport – that are covered in the planning documents (Evans et al., 2023)

Over time, this has led to a substantial degree of shared expertise in the professional language of environmental risk evaluation:

> “There are people in the community now who are quite used to looking at lots of data [and] sorting it out.” (Interviewee 12, 2021)

And, as a result, members of the community have become confident in making judgements about the technical and legal competence of others:

> “We had a look at [Vale of Glamorgan planning officers’] advice before it was voted on and it was completely wrong legally.” (Interviewee 3, 2021)

Of particular significance here is the ways in which community groups can draw on local knowledge that challenges the often decontextualised assumptions of the licensing and planning applications from the developer. A good example of this is the community’s critique of the way the smoke plume from the plant had been modelled:

> “It is the way the hills in Cardiff [are formed], a basin of hills. And in Barry, they dominate the way in which the winds go. And you get these, well they like to talk about temperature inversions, or they did then. And [the] trapping of the plume in the basin. And we all know

> it happens from observation. And it's just to be able to tell them 'This isn't in your models', and 'It might be important'. NRW weren't listening." (Interviewee 12, 2021)

As new knowledge has been gathered by these community members, so their developing expertise has been recognised in the ways that the regulatory actors now behave towards them, perhaps challenging the more traditional deficit understanding portrayed in the literature (Miller, 2001; Petts and Brooks, 2006):

> "Over time [the regulators] have got more respectful of the knowledge that the community have gained and shared with each other … It should come from the community because … we've got the best knowledge. Whether we know it or not, which we didn't realise, I didn't realise before all of this, the community have the best knowledge of the area and what is needed." (Interviewee 2, 2021)

That said, however, the planning system remains bound by the procedures and thresholds set out in the legislation and, despite 15 years of campaigning, the community has yet to succeed in blocking this planning application.

6. Conclusions

Planning disputes can be complex, lengthy and have life-long impacts on communities. At the heart of these contestations is an epistemic argument. For that reason, we have drawn from work within STS to understand the expertises that each of the groups involved is able to draw on and the extent to which these are shared with and challenged by other groups. Seen this way, the planning system can be understood as a series of trading zones, each characterised by different relations of collaboration and coercion and different kinds of expertise.

We note that the highest degree of collaboration occurs in the regulatory and community trading zones, where high levels of shared understanding are created. Structural differences in resources mean that only the Regulatory Science Trading Zone can achieve the degree of shared understanding necessary to be classified as an inter-language trading zone. On the other hand, as many inter-disciplinary collaborations within science demonstrate, successful collaboration does not require that all members of the group are equally expert in all aspects of the task. Instead, success can be achieved through a division of labour in which different individuals develop expertise in particular aspects of the task and take on the responsibility of sharing that with others. This creates what has been called a fractionated trading zone, with only some aspects of the expertise being shared and each group retaining their own

identity. This model is the one adopted by community groups and underpins their campaigning and other work within the Community Science trading zone. Finally, there is the Planning Procedures trading zone, where the developers and community groups come together. This exemplifies the enforced category as the regulations and policies that frame its workings specify both what can be questioned and the kinds of evidence that can be used to do this.

Given the conflicting aims of commercial and community actors it is unlikely that any 'trade' that the planning system brokers will satisfy all parties, which is why the notion of epistemic injustice is especially relevant. In particular, the nature of planning disputes means that they are not simply about the democratic right of a citizen to be consulted, but also their right to be recognised as a '*bona fide'* knower – that is, a person whose experiences in a local community or area, and the expertise these give rise to means they should have a chair at the deciding table. In other words, regardless of the outcome, improving the planning process so that community voices are not just heard, but seen to be heard, is important for developing a sense that these rights do matter and can be enacted, and in so doing reducing any epistemic injustice. Indeed, as our analysis shows the arguments and evidence being marshalled by community groups is becoming increasingly expert and influential in potentially undermining claims made by developers, regulators and planners (Evans et al, 2023).

Since Arnstein's pioneering paper in 1969, developers, regulators, environmental scientists and policy makers have been encouraged to engage more effectively with a broader range of expertises in order to build community members' collective trust and repair within civil society (Petts and Brooks, 2006; Slotterback and Lauria, 2019). To do this, practitioners need more sensitivity towards alternative modes of engagement and mediation that are more in tune with, and more able to recognise and use the evidence on the ground (Flyvbjerg, 1998; Hacking and Flynn, 2017). Unfortunately, the experiences reported here, resonates with other evidence, from both the developed and developing world, that suggests that planning policies are typically enforced in a top-down manner (Hacking and Flynn, 2018). Previous Habermasian theoretical perspectives have assumed that developers and regulators involved in mediation with communities will somehow be prepared to leave their power and expertise outside the door of meeting rooms when engaging the public (Mäntysalo et al., 2011; Balducci and Mäntysalo, 2013) but this seems unlikely. Instead, if greater technical democracy is to be achieved, then the planning system in England and Wales must change the trading 'rules' it enforces by recognising that all the knowledge-claims it deals with are situated and local. Removing, or at least reducing, the privilege

granted to science opens the way for other kinds of expertise to be recognised and heard. This will not make the decisions any easier, but it will go some way to redressing the epistemic injustices the current practices create and, in so doing, create the conditions for more robust and better evidenced outcomes.

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The authors have no competing interests to declare.

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