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The infrastructural ecologies of industrial decarbonisation: Visual methods and psychosocial logics in place-based public engagement

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ABSTRACT

Major changes to land and sea infrastructure are underway to achieve decarbonisation of energy generation and industrial processes. People who live and work locally alongside energy production and industrial sites will most intensely experience the transitions. There are growing calls within the environment and climate change fields, and aligned social justice and policy research, to address how such change risks producing inequalities from the economic, spatial and political impacts. This paper presents research on public responses to industrial decarbonisation gathered from deliberative workshops carried out in Wales, UK. The paper offers a reframing of place that we term *infrastructural ecologies*, encapsulating the understanding of place as porous in relation to global flows whilst holding distinctive local attributes. The turn to infrastructure has shown place to involve ongoing constellations of material techno-functions entwined with psychic and sensory experiences. Change-making requires deepened understanding of how opinions are formed and remain in flux. We present a novel methodology to engage people across cognitive, emotional and affective registers. Central to the research is the use of photographs that provided tools to situate professional visions within everyday locales and meaning making as one way to level uneven power relations inherent in professionalised future visions. The paper utilises object relations theories to analyse how lively objects and psychic mechanisms are active in opinion making processes. Our discussion offers a deepened understanding of how decarbonisation of industry could align to shared goals amounting to a future that also aims to achieve social justice.

1. Introduction

This paper presents research on public responses to industrial decarbonisation plans drawing on findings from deliberative workshops carried out at two towns in South Wales, UK during 2022. In a developed economy such as the UK achieving energy transitions including industrial decarbonisation presents a challenge that requires major changes to land and sea infrastructures, transportation fabric, and the development of a large skilled workforce [1–4]. Impacts from new technologies and large material fabrications will reach across localised sites to wider regional infrastructures, economies, and transport routes. Consequently, decarbonisation strategies are being developed and scrutinised at multiple scales by cross sector and in many cases transnational global networks of stakeholders. Yet it is people who live and work in locations where there are energy production and industrial sites who will most intensely experience the decarbonisation transition. It is widely understood that views of local people and affected communities must be involved in planning for such infrastructural change [5]. However, in the UK, industrial change and energy transitions public engagement remains instrumentally shaped [6] by corporations (comms agendas), governments (planning frameworks and policy), and academics (funding priorities, disciplinary gaps and blind spots).

1.1. Responding to calls for social justice

The paper responds to recent interest in what meaningful public engagement on changes to major industry for decarbonisation entails within environmental and sustainability studies [7–9]. We present deliberative public engagement research conducted at two locations, where energy transition plans are afoot to decarbonise industry and address fossil fuel reliance. Within environmental studies there has been a renaissance of interest in how place matters to better understand how to achieve social justice for local communities who are, or will be, heavily impacted by decarbonisation infrastructure change. But

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research needs to go beyond static portrayals of people in place by shifting attention to theoretical shifts for thinking about affective and psychosocial dynamics of external and internal aspects of everyday life. Thinking cross-temporally, as Sovacool et al. have also recently argued, is required to understand place attachments in relation to deindustrialisation and aligned industrial ruination [9:15]. This elides with the notion that to achieve just transitions, reparative solutions (to past problems) need to be incorporated into future-plans. Consequently, within the environment and climate change fields and policy there are growing calls and attention to concepts of social justice to address inequalities from both spatial and political impacts of change [6,10]. These foci and concerns share calls to conduct further research in order to fathom out what is at stake and for whom [11:3–7]. In this paper we argue that determining what and how material and psychic objects are active in peoples' lives is necessary to achieve social justice in relation to the decarbonisation pathways [4,9].

1.2. Contributions

The research contributes to the above concerns firstly through a conceptual reframing of place that we term *infrastructural ecologies*, encapsulating the geographical understanding of place as porous in relation to global flows whilst holding distinctive local attributes [12:146]. We argue that the objects that make up such an ecology are both material and psychic, enacting as ongoing constellations of material functions entwined with experiences. Secondly, we provide a novel research design that responds to the construct of infrastructural ecologies through conducting interactive deliberative workshops with local people. The research captured emotional and cognitive experiences to comprehend how transitions can shape the things that matter to people. We included visual tasks to open up and reframe popular and professionally constructed future visions, that normatively mediate the concerns of local people. Thirdly, we offer deepened insights relevant for social acceptance research by providing psychosocial analysis attuned to the multiple registers that are active during opinion making processes. We provide empirical explanations of how objects, understood as material installations and as psychic attachments, come to matter. Lastly, we illuminate how decarbonisation of industry could develop with shared goals amounting to a future that democratically responds restoratively to local civic needs.

1.3. Paper organisation

The paper is organised in the following way: Section 2 introduces the research locations and key industrial and spatial characteristics. Section 3 presents the conceptual framework that brings together four relevant academic fields: interpretive risk theories that we align with industrial community trauma research, the turn to infrastructure and lastly psychoanalytic object relations theories. We argue that working with a transdisciplinary framework more fully addresses recent shifts towards more interconnected and fluid approaches to people in place. Sections 4 and 5 explain the research design and workshop methodology that utilised visual tasks to gather emotional and cognitive responses to visions for change. In Section 6 we move to the central findings of the paper presented in two stages. Section 7 follows with a discussion informed by object relations theories explaining what social acceptance entailed in Port Talbot and Pembroke Dock. In Section 8 we conclude our paper with a reflection on the research contributions.

2. Industrial transitions: Port Talbot and Pembroke Dock

South Wales has for many years been the second biggest industrial and power carbon emitting region in the UK, due to the presence of heavy industry and power generation facilities [13]. We selected research locations with the then two largest emitters. The first workshop was in Port Talbot, home to Tata Steelworks (the UK's largest steel producer). The second workshop was in Pembroke Dock where oil and gas refineries including storage facilities are located close by at Milford Haven and Pembroke including the RWE NetZero Centre at the Pembroke Gas-fired Power Station. The decarbonisation vision plans can be viewed via the relevant citations in this section [13–1]; however it should be noted that the visions are continually superseded by more recent plans. At the time of conducting the research Associated British Ports (ABP) [14] in partnership with South Wales Industrial Cluster and Neath Port Talbot council had produced the Port Talbot dock vision including a hydrogen and carbon docking area, and infrastructure to upload wind turbines (potentially fabricated at the steelworks site) ready to be towed out to offshore wind farms. There were further plans involving the development of hubs where industries would work together to share resources, utilise greener energies and potentially for the collection and transportation of carbon. In Pembroke the plans were based around the Celtic Freeport partnership [15]. Plans involve developing Pembroke Dock capacity for offshore wind turbine assembly and maintenance, towing components out into the Celtic Sea, and as a base for maintenance teams. There were also plans to develop power lines from the windfarms to land near the RWE Pembroke NetZero Centre (PNZC) [16]. The PNZC planned to decarbonise its energy generation through carbon capture and storage (CCS); to investigate burning hydrogen in the power station instead of natural gas; and conduct feasibility studies for green hydrogen production including a ‘pathfinder’ electrolyser. Both workshop locations are home to several demonstrator sites for research into hydrogen onshore transport hubs, wave and tidal technologies, solar array infrastructure and civil engineering for future buildings.

The South Wales coastal area is a ribbon of towns, beaches and industrial zones built up since the 1800s during the heyday of coal and related manufacturing. We conducted research at Port Talbot and in Pembroke Dock (covering also Pembroke town, Neyland and Milford Haven). The spaces and places that these represent do not sit neatly within generic categories of ‘place’: rather they have rhythms alive with unique ecologies that are more than the sum of their localised material infrastructures through their embedded global networks [12,17]. The towns share attributes aligned to industrialisation and port infrastructures. However, they also differ in many respects. Pembrokeshire is home to South Hook, Dragon LNG, and Valero global refineries based along the mouth of the large river Cleddau known as the Milford Haven Waterway. Port Talbot sits between hills and the Bristol Channel and has deep rooted communities connected via the steelworks and a long mining and industrial heritage. Port Talbot is closely connected via motorway and mainline railway to nearby cities, including Swansea and the Welsh capital Cardiff. Pembroke Dock is situated on a peninsula, and while the towns of Pembroke, Milford Haven and Neyland are nearby, they are small, with no motorway or major railhead. Although industrial, the Pembrokeshire refineries are disconnected from the area's history of fishing, ship building and as a naval military base. So, whilst the two landscapes share many attributes - de/industrial pasts, presents and futures, coastal, Welsh – each category as a comparable object soon dissolved without much closer inspection, given that their industrial pasts weald from different industries utilising differing skills, conditions, lifespans, and local rewards and risks. The coastal characteristics differ too. The Pembroke area has towns dotted each side of the river Cleddau which weaves through the long peninsular, lined with coves and beaches and facing towards open sea while also providing a series of safe deep-water anchorages for oil and gas tankers. By contrast, Port Talbot sits on the Bristol Channel enjoying a wide sandy bay, sheltered by the Gower peninsula and the city of Swansea on one side, with a chain of settlements held between beach and hills with the mining valleys beyond. As the research unfolded the differences between the two locations expanded, and this is evident in the following analysis.

3. Conceptual framework

In the following section we draw on interpretive social science and community trauma research to argue that global and local are not discrete lenses, but rather need to be understood as entangled flows of active objects. Next, we argue that the concept of infrastructural ecologies can account for material and psychic aspects active in conceptions of place. Lastly, we introduce psychosocial logics to explain how people respond to changes framed through infrastructural ecologies.

3.1. Risk and uncertainty: globalised and local interconnectivities

There are now confluences of ongoing risks across the globe (health pandemics, environmental breakdown, wars), with consequential uncertainties such as food scarcity, poverty, migrations of peoples and increased social divisions [18,19]. Fears are experienced both locally in place, and simultaneously at global scale through media transmission and the impacts of economic globalisation [20,21]. The impacts of actual disasters and anticipated risks are felt in differing intensities according to cultural norms, wealth, and material interfaces [10,22]. Social theorists have argued that, in parallel with globalisation, there has been an erosion of universal social norms, with people identifying more as individuals, constructed reflexively through choices and opinions [21,23].

3.2. Industrial trauma research

The shifting evolution in how 'communities' have been viewed as essentially homogeneous entities, towards more recent portrayals of individuated subjects dis-embedded from community, has been critiqued and re-worked by scholars involved in granular research with industrial communities [24,25]. For example, research exploring how de-industrialisation has enacted as a 'slow violence' elucidates the psychic trauma imposed on people through harsh, toxic, dirty life conditions [25–27]. Explanations of how communities become traumatised through industrial processes offer relevant insights to the decarbonisation challenges ahead. Granular accounts of industrial working and un-working lives, and of living surrounded by contaminated land and air have provided insights into how change impacts everyday life [23,27,28]. However much of this scholarship portrays both individuals and communities as static entities, removed from current flows of ongoing life practices. There remains the need to comprehend subjecthood as non-fixed both constructed in relation to ongoing wider cultural and material change as well as shifting internal psychic states [29].

3.3. Reading place as infrastructural ecologies

Although environmental studies and policy attend to social impact frames by emphasising the need for ethical strategies and reparative solutions to change, there remains a gap in our understanding of the psychosocial and affective relations entwining people across localised and global infrastructures [24]. The 'turn to infrastructure' within cultural anthropology and urbanism [30] offers a vehicle to expand place orientated social research [31] with macro theories of risk and uncertainty [21,32]. Conceptions of place framed through the lens of 'infrastructural ecologies' invites exploration of how subjects are constructed by, and engage with, material and cultural objects [30,33] with much to offer environment research [34:176]. This is especially relevant to the industrial locations we are interested in because as Ash Amin puts it: 'The [se] hyper-visible and constantly evolving infrastructural developments make the atmosphere of place that forms the precognitive of mental, sensory and affective dispositions: the residents' experience of living …' [12]. 'Infrastructure' includes constantly evolving material fabric (the wires and pipes, concrete, glass and stone that make up built space). Critically infrastructure also includes the political will enacted through plans and visions, and the interfaces and relations connecting objects with people whose lives are settled there or who pass through [12,30,33]. Attending to infrastructure in this way foregrounds that, as Sareen and Grandin articulate, places 'are not geographically bounded but constituted by the relations and flows of which they are part' [17:104]. The 'flows of which they are a part' in South Wales include supply chains from across the planet, governance from distant organisations and authority, as well as decisions made in boardrooms situated in other continents. Moreover, there are more mundane flows - for example to relatives or working life elsewhere, media and holidays that enliven people to other perspectives, and attachments to brands, hopes or possibilities.

3.4. Reading infrastructural ecologies through object relations

Framing the research through the lens of infrastructural ecologies required thinking about how past and present objects and their interrelations inform current responses to change. In order to comprehend the infrastructural constellations as material and psychic objects we turned to psychoanalytic concepts, termed 'object relations' theories developed by Melanie Klein [35]. Object relations theories provide an analysis framework to understand both how and why people construct good (acceptable) or bad (unacceptable) objects. In objects relations theory it is understood that psychic instability and defence can involve splitting objects into ideations regarded as wholly bad or wholly good [36]. Splitting can involve idealisation of good objects, as well as *othering*, demonization, or denial of bad objects. Object relations need to be comprehended as mobile psychic states that Seitz refers to as *toggling* between depressive/reparative and paranoid/splitting states [29]. Hence, in this research we were looking for evidence of reparative processes [34] where the splitting of *goods* and *bads* become integrated, through affective and cognate weighing up of infrastructural objects. In addition to this, we were also attentive to potential ecologies expressing overall instability, e.g. where overwhelming forms of rupture or wounding were managed through splitting defence mechanisms such as denial, sometimes manifesting as a literal refusal to *see* problems or fears at large [37]. The data provided indicators of how different objects across the locations, temporalities, media and broader scales of experience formed infrastructures creating resilience or instabilities. Further we were able to understand which objects were meaningful and in what ways. We considered whether the infrastructural ecologies enact as spaces of containment, where people experience overall stability and integration of ongoing fears and uncertainties [34,38].

4. Research design

We have argued that just transitions research requires comprehending place as geo-specific but not spatially bounded, involving complex, partial, mobile and evolving experiences and practices. Framing material and psychic aspects as infrastructural ecologies required methods designed to capture emotional and cognitive registers that emerge via internal and external processes. We constructed the research to gather affective, emotional, and cognitive responses to change, anticipating that this would invite deepened participant expressions that included spatial and temporal everyday aspects that were lively in opinion making processes. In this way we were able to conduct analysis of both surface public engagements as well as constructing deepened reflections on the meaning-making processes involved.

4.1. Place-based deliberative workshops

It is widely understood that public participation leads to better outcomes for change [5,39,40]. Public engagement methods aim to engender discussion that enables citizens to frame and decide the key issues themselves, rather than respond to pre-determined 'expert' narratives and frames [5,41]. Deliberative research workshops enable people to spend time *deliberating* potential pathways for change, situated

within their localised experiences and knowledge. Commonly deliberative workshops introduce participants to change proposals inviting consideration of what is both known and unknown (and by whom) about the environmental, social, legal and ethical aspects of technical proposals situated within wider potential impacts. Where proposed changes involve technological complexity, industrial stakeholders and governance agencies continue to rely primarily on informing as engagement offering reduced collaboration opportunities for citizens [39,40]. Emotional aspects are curated through professionally constructed visions that foreclose open engagement with the emotional and affective aspects of industrial places [42]. We deployed novel visual methods to deliver workshops that were both collaborative and attuned to the emotions active in participants' own perceptions of change, thereby destabilising professional visions.

4.2. Focus on infrastructure as affective through visual tasks

A central strategy for the research design was the use of photographs operative both as denotative signifiers of local fabrications and as affective objects [43]. Material fabrications and images share many sensory and aesthetic attributes [33,44]. It follows that both existing infrastructure installations and proposed techno-visualisations can be understood as holding 'living signifiers' that are felt and processed through aesthetic frameworks in much the same way as other visual media. Moreover, across sectors visuals are often utilised as stand ins for, or else are operative as, emotional holders or affective amplifiers of information [42]. Relatedly, the industrial stakeholder communications in South Wales often rely on visualisation tools (e.g. infographics, CGIs and photographs). The new energy decarbonisation installations are likely to have loose, less rigidly coded aesthetic and sensory signifiers because they are not yet fully embedded into either cultural or material spaces. Professionally constructed visions are political because they enact forceful descriptions of possible futures, endorsed through powerful affiliations and formal structures such as policy frames, incumbent organisations, media outlets and planning structures [6,40]. And yet how people engage with the new installations may involve unknown iconographic ideations [45] constructed in part by psychic mechanisms discussed in Section 3.4. In order to create more level public engagement, we added photographs of local fabric as well as some generic images that signified potential themes of interest. The photographs were designed to both defuse the professional visualisations' affective narratives whilst also enacting as research tools for discovering what kinds of intensities and interrelations between infrastructural objects were lively in the locations.

4.3. Workshops and tasks

A full-day workshop was delivered in both Port Talbot and Pembroke Dock. Prior to each workshop we conducted research into local stakeholder visions and discourses in media and social media outlets. We made photographs of local objects and met with local industrialists and council officials. We recruited participants through an academic field research company. Both workshops had fifteen participants recruited to reflect the socio-demographic makeup of the area in relation to gender, race, religion, profession, age, and interests. Hence, in each group there were a few people who worked in relevant industries, some retired people, and some young adults starting out in life. In both groups we ensured that participants lived or worked locally, and with some having strong family ties over generations to the area. We developed workshop tasks outlined in Table 1. We divided some tasks (table1. tasks 1, 3, 4, 5, 6) into 3 smaller groups with one facilitator, and we also came together as one group to share summaries and discussion points (Table 1, tasks 2, 7).

In task 1 we settled into the workshop with mapping tasks (Table 1). In task 2 we presented the industrial decarbonisation plans as an interactive PowerPoint discussion tailored to each workshop setting. We presented images and infographics designed by both the local industry and the South Wales Industrial Cluster alongside related media reports and activist and NGO responses. We aimed to reframe and situate the professionally made visions to construct open engagement with change scenarios. Task 3 returned to the mapping activity to include future visions.

Table 1
Workshop tasks.

Task	Description	Data type
1. Individual Mapping tasks: A3 maps of local area past and present.	Annotate everyday routes, object attachments, import of past. Desires in place: framed as 'what must stay?' and 'what can be let go?'.	Ice-breaker. Locating infrastructural ecologies spatially/and to changes over time.
2. PowerPoint - Stakeholder Visions Information and Discussion.	Decarbonisation stakeholder visions, media reports.	Discussion/responses to stakeholder visions.
3. Future Map: 2060 size A0.	Annotate/imagine area 10 years after NetZero target 2050.	Extended responses to vision-plans in relation to future mapping.
4. Pack of photographs - new technologies, industry, town objects, theme signifiers.	Individual ascriptions of photographs: 1) definition, 2) meaning, 3) association/ feeling.	Affective responses and personal themes emerge through ideations, emotions and affective expressions.
5. Constellation - most meaningful photographs selected and positioned on A3 paper.	Select and position photographs, annotate relations between image-objects.	Image-objects and interrelations evident as affective flow constellations.
6. Return to the Future Maps in small group.	Discuss the future, add in most meaningful image-objects and annotations.	Deepening into shared plans after internal engagement with photographs/personal situated values.
7. Discussion.	Open discussion aligned to themes that emerge over day.	Generative interpretative data

The visual tasks (Table 1, tasks 4, 5, 6 and see also Appendix 1 Fig. 1) involved using packs of photographs attending to types of objects (industrial, leisure, amenity, civic, etc.) with the aim to evoke aspects of the everyday (temporal referents, activity signifiers etc.). Images of future technologies were introduced such as a hydrogen tanker alongside existing industrial installations. Other images suggested potential matters of concern, for example a Covid sign and a foodbank image. Firstly, individuals ascribed each image with a definition (denotative object), next the image meaning (signified) [46], and lastly an associated feeling invoked (affect). Next, participants were asked to select images they found meaningful and to then position them into a constellation with annotations to explain the image-object interrelations. The images and expressions operated within affective and cognitive registers. Bringing together image and ascriptions reflexively offered ways for participants to portray their visions rather than us, as researchers, constructing top-down narratives. Our method could be critiqued for imposing images upon people rather than inviting them to bring along their own [47]. However, we were careful to gather participants' *own* responses to specific image-objects (especially of the industrial installations) in situ. Moreover, we took time to select a range of images that held both tight and loose signifiers across both generic issues (Covid, food crisis, hydrogen) as well as location specific image-objects.

5. Analysis

The mapping task data was used to materially locate peoples' involvement in the area. We then reviewed data captured from visual tasks. We coded ascriptions and expressions thematically. In some cases, people also added in new objects, or redefined objects. In this way the

images provoked affects that could not have been anticipated. Following the affective flows of the image-objects provided a layer of intensity (something Ash Amin refers to as 'atmosphere of place' [12]) and produced data that originated from a more internalised experience than the discussion data that had inevitably been cognitively processed into publicly shared verbal discourse. We made *spidergrams* (Appendix 1. Fig. 2) to track and code how images were ideated and what types of experiences and emotions were expressed. The analysis had to consider an individual's dataset in order to decide what registers were active and how. From combining the data in this way, it became apparent which image-objects were lively and how relations between objects were embedded in temporal and spatial contingencies. The task processes foregrounded how people navigate their lives, as constellations of relations between internal and external material and psychically coded objects. We identified themes characterised as shared experiences, and those that were frequently returned to. Psychosocial interpretation of the mechanisms that were active in how people- as fluid subjects - formed identifications and ideations provided deepened comprehension of the discussion outcomes [48]. Thus, the layered expressions of the themes and processes involved in how participants engaged with the decarbonisation visions were illuminated as multiple and contingent portrayals of public responses to change in place.

We present the findings as two layers of the data analysis: firstly, from following visual tasks (image ascriptions and positionings) to build an understanding of emotional affects that were lively in the infrastructures. Secondly, we present our interpretations utilising object relations theoretical framings to explore the emergent themes from across the data sets. These distinctions were not formal in that often discussion began from photographs, or later during the positioning of the photographs. Moreover, people often referred to images during the following discussion tasks. Therefore, the production of data was generative with each task building on previous engagements, and likewise the analysis grew across tasks to produce multimodally informed interpretations that attended to multiple registers.

6. Findings

The findings are organised in two stages. Firstly, we explain how we read the visual task data affectively through depicting the infrastructural ecologies as *contained* and *wounded*. In this first portrayal we present responses to the image-objects signifying place, industrial installations and future technologies. Secondly, (in Sections 6.4, 6.5, and 6.6) we present a workshop mid-point analysis of the logics involved in decision making processes that informed how people came to their constructions of acceptance. The section is important because it illuminates the active objects in people's ecologies. Identifying and understanding the meaningful objects offers pointers towards how reparative solutions and social justice might be achieved through collaborative design with local people. In Section 7 we extend the discussion on the final acceptances people arrived at generatively underpinned through the workshop process.

6.1. Reading infrastructural ecologies through affective registers

Drawing on the visual tasks data we firstly provide an explanation of how the Port Talbot workshop was interpreted as presenting a contained, resilient infrastructural ecology. We found there were enough stabilising good objects for fears and uncertainties to be experienced and contained within the overall psychic structure [34,38,49]. We then explain how conversely the Pembroke workshop presented as a wounded ecology. The wounded portrayal emerged from the overwhelming psychic and material losses ascribed to infrastructure objects we summarise as an uncontained and unstable infrastructural ecology.

6.2. Contained

> "*This was a church when I was younger. It's now changed. I've got the river, and I've got the beach because I love the beach, like everybody else. I love the river 'cause I walk down the river all the time with the dogs or with the family. And then I've got pictures of the guys singing and the bar because that reminds me of family and friends and nights out. And then I've got the steelworks because it obviously – well, the family have been employed there: my father, my son in law and my grandson*".

In Port Talbot there were frequent ascriptions relating to family, friends and community, for example '*my town*', '*home*', '*heart of Port Talbot*', '*family and friends*'. There were also positive attachments to past objects: '*happy memories*', '*happy days*' (as well as nostalgia and sadness about the past). The quote at the top is a verbal account of one person's constellation of images. The constellation reflects the affective rhythms of a contained life [25] and the visual and verbal narrative flow confirms attachments across both space and time; it includes a strong relation to the river, to an embodied connection of walking, to friends, family, and to the industry of the steelworks. The constellation illustrates how objects and experiences exist as a whole- including observations of past change (the church) and the value of relationships as well as work and leisure. Collectively the constellations evidence interrelations between key lively objects (such as the steelworks, the beach, food and shops) and many participants also selected new technology images, for example a combined on-shore turbine and solar image: '*hopeful to have more clean energy*' as well as one of a hydrogen sea-tanker: '*symbol of port and future*'. Both latter images received temporal ascriptions relating to the future: '*the future of energy*'; though also not universally positive as when described as '*danger*', '*hope/worry*'.

Across the dataset we learnt how concerns, fears and uncertainties were embedded into lived experiences and in relation to thinking through the impacts of the industrial vision plans. For example, one person wondered if prices would keep rising: '*Hopefully, they [local businesses] …. can afford the gas bills*'. Other concerns expressed related to health care and the environment: '*Do we really think that the green space is going by 2060?*' generating a response: '*With the amount the world's changed in two years, I've got no doubt that it probably will be gone*'. The logic that, given the 'amount of change' further loss of green space is entirely probable, illustrates how experiences of the new normal of risk informed the anticipation of future change [50]. Our argument here is that such containment produces community resilience through the capacity to integrate hopes and fears with positive aspects within the local infrastructural ecologies. In Port Talbot the collective infrastructural ecology was characterised by stabilising good objects enabling a contained spectrum of experiences that related to local and global events, past as well as future hopes and fears.

6.3. Wounded

Pembroke in contrast was wounded, with fissures apparent between past and present industrial lineage evident by the abundance of derelict maritime and navel fabric and the loss of everyday objects such as the many closed shops and nearby hospital. There were negative expressions ascribed to much of the material infrastructure: the oil and gas refineries and the Pembroke Power-Station were typically described with terms such as '*pollution*' '*eyesore*' '*spoiled*', '*vigilant*', '*uneasy*' '*fearful*' albeit with some more instrumentally framed ascriptions that either related to fossil fuel dependency: '*need power*', '*but I need it for my car*' or jobs: '*employment important*'. In a similar trajectory much of the townscape areas were negatively ascribed: '*wasted space*', '*lost generation*', '*run down*', '*congested*' or '*for tourists*'. Furthermore, in Pembroke we found a *hidden objects* strategy, operative as a mechanism to make things invisible in order to manage 'bad objects' frequently articulated as 'eyesores' and 'wasted space'. Some workshop participants even physically hid the Valero refinery and the Pembroke Net Zero Centre images underneath

others during the visual constellation task. As Hannah Knox explains: "attention to these embodied, affective engagements with infrastructure allows us to unpack something of the unstable … projected forward into forms of pressure, resistance, and a calling forth of a response from the powers that be." [44:368]. The focus on how things look was part of a strategy of wanting to hide things that enact affective registers to past rupture and loss [37]. Gugg has argued that making things invisible functions as a form of coping defence mechanism, enabling denial of what is unbearable [37].

A further way that 'seeing' enacted as a coping strategy was evident in some of the positive ascriptions. Rather than engage with the images through their 'brute- thingness' [43:156] for some, there was a need to maintain a safe distance - to not 'be affected'. For example, the photograph for Milford Haven Waterway is an aerial shot depicting the blue estuary, with the river shape almost animate winding out to sea, and with the land either side dominated by industrial installations. The waterway ascriptions sat between ideating a vision of pollution, or industry, and landscape expressed in poetic experiential framing: '*future-time*' '*calmness*' '*beautiful by night*'. So where positive, the ascriptions did not connect to anchoring community experiences, but rather related to dreamscapes. From a psychosocial perspective this can be explained as a coping strategy [38] involving a disassociation from visceral engagement with the material-thingness of the industrial installations and waterway towards dream-like ideations. The Milford Haven marina development, the Pembroke Dock Memorial Park, and Pembroke town high street images attracted the most anchored positive ascriptions in recognition of spaces that are good for socialising and having '*fun for everyone*'. However, the negative ascriptions were still dominant overall, signifying loss, wasted space or spaces only for tourists. In sum the visual tasks portrayed a wounded infrastructural ecology with shared expressions of rupture and loss. Material spaces signifying loss were articulated as 'bad' objects, with far fewer images receiving positive 'good' object ascriptions. Overall, we considered the Pembroke portrayal to be a wounded infrastructural ecology.

6.4. Deliberating change through psychic splitting

We have demonstrated how workshop tasks orientated participants to consider meaningful material and psychic aspects of their everyday lives and how local industry featured in the selected image-objects. In the following sections we present data from across the tasks that evidences how people processed proposed future visions situated within the infrastructural ecologies. Drawing on object relations splitting mechanisms elucidates the processes involved in how people later arrived at acceptances of the decarbonisation plans. Firstly, we explain how residents in Port Talbot formed an idealised position regarding onshore wind and solar power as a solution to future energy requirements. Secondly, we provide an explanation of idealisation in the form of arguing that industry is essential in Pembroke Dock. Attached to the second example is a coping strategy involving the desire to make industrial objects invisible, apparent in the ascriptions of the image-objects discussed above.

6.5. The idealising constellation: on-shore wind and solar with wellbeing

In Port Talbot one frequently selected image depicted a tray of food tins. Most ascriptions described the tray as a food bank referent, and associated signifiers included terms such as '*poverty*', '*crisis*', '*Government!*'. During the constellation task the food bank image was often positioned in relation to three other images depicting a sunflower, a garden, and a river that in turn were often ascribed with positive concepts relating to happiness: '*Good*', '*summer*' '*happy times*' and nature and wellbeing: '*peace*' '*better taste*', '*nature-enjoyment*', '*calm relaxing*'. So, these constellations identified food scarcity as a problem and attached the sunflower/garden/river images with their more positive signifiers. Following the affective flow of relations further we found that the food/wellbeing/nature constellations often included the onshore wind and solar installation image too, articulated as a clean safe form of energy generation: '*good-clean!*', '*future*', '*hopeful to have clean energy*'. In many ways this affective flow of objects is not surprising as it speaks to many current global culture discourses on wellbeing, nature, and healthy food [50] and further ideating onshore wind and solar as clean, safe energy also follows cultural discourses promoted across media [51–53]. The discussion expanded to both the existing wind turbines on nearby hills and imaginary future ones ('*Well, this will become turbine central as well, effectively*') that were not part of the professional visions that we had introduced. Arguments were put forward in favour of reliance on wind and solar as a clean alternative to current and future energy supply for the steelworks. The steelworks were a central subject of both concern and community identity, with anger over lost jobs and reliance on current precarious jobs as well as concerns about pollution. The steelworks photograph attracted ascriptions including: '*pollution*', '*dirty*', *bad*, '*hard work-hard life*', '*extremely important*', '*beautiful to look*', '*means I'm home*', '*jobs*'. Some participants argued that the works should (or would anyhow) close: '*Now it's a blight on the landscape. Means nothing to me*'. Others wanted the works to stay: '*The works is Port Talbot's identity*.' The alignment of onshore wind/solar with wellbeing as a vision to address food and deprivation is idealising because it could not resolve of itself concerns about food insecurity locally. More broadly, the constellations articulate onshore wind/solar affectively as 'clean' energy without consideration of wider global impacts such as the manufacture or material origins of the installations. The lack of consideration of the scale of power supply requirements locally for industry to replace its current fossil fuel consumption, which would be substantial, as well as the impacts of industrial scale solar farms and onshore turbines, further suggests that this is an idealisation. The idealising position is problematic because it is unstable. As John Keene further elucidates 'the illusory clarity it promises is much prized. It is, however, inherently unstable because only one bad element changes the ideally good into the unmitigated bad' [36:148]. Choosing solar and onshore wind over hydrogen and CCS does not address the scale of the local industrial decarbonisation problem and, if there were a future scenario following this route, it could lead to greater psychic instability as well as material energy supply infrastructure issues.

6.6. Idealising industry as essential and the make it invisible coping strategy

> '*There is no infrastructure down here. There's no transport system. There's no health system. There's no – the county council don't give two flying whatsits about the county. There's nothing down here*'.

In Pembroke we found idealisational splitting embedded into the belief that industry is essential, situated in stark contrast to much of the data that suggested wounding (see Section 6.3) alongside lost jobs, lost land access, living without a hospital but with risks of oil and gas pollution and fears as well as direct experience of industrial accidents. As one person stated, '*you only have to have a major explosion, [for there to be] a major incident here*'. But alongside the fears and disappointments ran a feeling that without the refineries there would be catastrophe: '*You know, if that did go, that would be like a hammer blow, and that would have like ripple effects not just for jobs but for like housing, services…it would just be catastrophic really…And then just the estuary as a whole*'. This belief was a strong thread throughout the workshop, and the quote suggests that the belief in reliance upon the companies stretched beyond the towns to the 'estuary as a whole'. The main justification was that without jobs people would have to leave the area, and so they felt completely dependent on the oil and gas companies. However, there is a fracture in the logic that industry is essential because we were told both that jobs had reduced significantly '*used to be more jobs*' and that many people had left the area already. Protecting the remaining jobs against the overwhelming descriptions of loss did not appear to us to stand up. There was

a belief that because the oil and gas companies are international, they do not care about local people. '*They're not particularly bothered about how it affects the local area*'… '*you know, obviously, they're going to represent their own interests, and they're based in Texas, so…*'. Arguing that the companies are essential did not hold weight given the cumulative emotion-based expressions of neglect and loss summed up by one person in the quote at the top of this paragraph.

Returning to the image-object ascriptions we were struck by the number of ascriptions that related to how things look. For example, spaces were frequently described as '*eyesore*' or '*looks untidy*', '*ugly*', '*good-invisible*'. Of course, it could be argued that in both workshops there was a focus on 'looking' due to the visual tools. However, the Port Talbot ascriptions had little emphasis on how the things 'look'. Moreover, as we will explain, in its ruptured form the *looking* was as much about enacting a desire 'not to see' [37] as a form of protection against engaging with the 'brute thingness of the photographs' [43]. Furthermore, the ascriptions of industry as '*beautiful by night*' provided a means of coping through a disavowal of pollution and spoiled ground and air [54]. As Weintrobe explains, "disavowal involves radical splitting and a range of strategies that ensure that reality can be seen and not seen at one and the same time" [54:72]. This form of coping strategy, she argues, differs from denying something, which can lead towards facing up to what is difficult. Disavowal can instead escalate [54], developing from a deep-rooted disillusion that is more difficult to overcome. Here it involves splitting away the daylight version of the industrial installations (experienced as dominating socio-material life, producing economic dependence, pollution and land degradations) and shifting over to the poetic version of the infrastructures as beautiful by night.

7. The reasoning underlying the social acceptances

In this section we firstly explain how the Pembroke group embraced the plans for offshore wind, despite having deep concerns and fears. We then discuss how the Port Talbot group re-purposed the Associated British Ports (ABP) vision to construct an inclusive and acceptable vision of the future. Our argument here is that achieving understanding of social acceptance requires analysis of the psychic mechanisms (i.e. splitting, and denial) involved in the articulations of hope and idealisation. Lastly, we illuminate how decarbonisation of industry could develop with shared goals amounting to a future that attends to civic needs in place.

7.1. The Celtic deep and embrace of off-shore wind

In many ways there is enough evidence to explain why people in Pembroke were lacking enthusiasm and trust in relation to the decarbonisation vision proposals because there appeared to be difficult circumstances across so many aspects of everyday life (see Sections 6.3 and 6.6). The infrastructural ecologies portrayed living with risk, loss, and distrust in (global and local) others, that cumulatively can be understood as a 'sacrifice zone' where everything is lost or under threat from outside interests [10]. We have shown how coping mechanisms including denial and forms of 'not seeing' emerged in the workshop. The embrace of the Celtic Freeport offshore wind farms proposal was aligned to the coping defence mechanisms that involved the selective poetic seeing and the making things invisible disavowal strategies as discussed above in Section 6.6. What made the proposal acceptable was its perceived invisibility, something regarded as a positive reason to embrace this form of installation:

> '*I think people will be happier that the fact that it's, like you say, 40 kilometres or 40 miles into the sea, where it ain't an eyesore. I mean, …. What you can't see, you don't think about sort of thing… So I think that going into the water is a bonus for that kind of scenario, you know*'.

The logic of making things invisible works in the same way as choosing only to see industry as '*beautiful by night*' because both strategies ignore or 'turn a blind eye' to what is unbearable [37]. A minority did want to embrace the new technologies, arguing that there would have to be infrastructural improvements to transport, health and housing in order for the construction of the installations to be feasible. But overall, instead of resilience through integration and containment what held the people together [25,55] were the shared coping practices, evidenced by the identification of eyesores (bad objects) and the hope that bad objects might in turn be invisible. These people managed the unbearable through a hope of things being hidden and through a form of splitting away that involved removing themselves from the material infrastructure and only engaging with it as dream or eyesore. This form of containment strategy rather than providing stability and the possibility of integration, instead produces instability [36] and leads potentially towards disillusion [54]. There is an irony here in that it is the infrastructural wounding and coping strategies that made the decarbonisation proposals acceptable rather than an integrated form of reparative acceptance. But on a more positive note, there are clues as to how trust and hope could be materially built into the decarbonisation pathways through taking restorative steps. Attention to existing and future local material infrastructure, such as the need for a hospital, solid local jobs, housing, shops, and fundamentally to experience being cared for, could lay the groundwork for developing trust and stability.

7.2. Port Talbot Super-Town: reaching a reparative position

Thus far we have shown how the people in the Port Talbot workshop embraced an idealising solution utilising onshore wind and solar (Section 6.5) that was not part of the stakeholder visions we had introduced through the workshop. As the workshop progressed the discussion threads came together in an agreement that any Port Talbot decarbonisation change pathway should involve civic areas too and '*Make it a proper Super-Town*'. This position succeeded because there was a recognition that for the steelworks to have a future it needed to eventually cease its emissions. The ABP vision involves the development of the dock area for hydrogen and captured carbon transport that were initially met with resistance (in favour of tidal energy generation or the discussed solar and on-shore wind turbines), but that gave way when configured with the wider idealising logics that included making other aspirations possible - such as local economic growth and more healthy lifestyles. Earlier we argued that to use onshore wind and solar as a solution to industrial decarbonisation did not engage with the scale of energy required and was thus an idealising position. Accepting the hydrogen and carbon capture proposals involved an integration of goods (clean living, prosperity) with *bads* (fears about unknown technologies and marine pollution).

The ABP development plan for the docks portrays a vision of a Super-Place transformed and ready for the next generation of a re-industrialised economy [2]. However, the participants were quick to notice a lack of attention to the prosperity and transformation of civic areas of their town. From a resilient and contained community position the group embraced the ABP vision conditionally via an appropriation and repurposing of the concept of Super-Place to fully include the town. Thus, they re-purposed the term Super-Place to 'Super-Town': '*Yeah. That would be like a Super-Town then, wouldn't it*'. The idealising vision that earlier was dependent on utilising onshore wind and solar, was reformulated when the inclusion of the steelworks was re-envisioned as clean: '*Cause they go together, and that could be an answer for lower emissions in the future*'. Even those who had wanted it to close now agreed it should stay if it stopped polluting. It was understood that the current proposed ABP vision plan presented that opportunity - albeit with the contingent demand that the developments included improvements across the townscape.

We were interested to observe how participants' ideation of solar and wind energies - as clean and green - engendered responses to the newer technologies of blue and green hydrogen and carbon capture and the carbon capture reuse and storage combinations proposed by the SWIC

and ABP plans. It has been recognised that there is a danger of idealising renewable energies [56] and that this risk is closely aligned to concerns about how energy companies may be greenwashing their activities [52]. Through the successful embrace of 'clean' solutions to fossil fuel emissions, there is concern that newer technologies aiming to tackle climate change directly may be less popular [52]. However, in Port Talbot we found that the relatively familiar onshore solar and wind enacted rather as gateway technologies to the less known and understood newer proposals. Although concerns were initially articulated through risk and uncertainty discourses, the idealising constellation that incorporated addressing food insecurity became connected to the ABP vision – broader technology deployment became acceptable contingently alongside potential civic benefits and because it possibly ameliorated job precarity and pollution issues with the steelworks. So to arrive at an acceptable position on the new energy technologies - where there is uncertainty and a lack of knowledge - trust and reparation were also key strategies [7,57]. The townsfolks' perspective and sense of agency in relation to global matters extended their civic transformation vision to become a Super-Place '*Because it would be in the eyes of every country in the world as something to emulate*'. This last position was arrived at because the overall infrastructural ecology provided enough stability for people to reach a contained position integrating good and bad aspects to produce a possible future for their town. Moreover, in recognising the lively objects in the infrastructural ecologies it became clear what was required to produce a just transition for local people.

8. Final thoughts: psychosocial engagements and infrastructural ecologies

Our research findings offer opportunities for policy and industry to attune to how industrial decarbonisation plans were received by local people. We have provided an explanation of noticeably different responses to decarbonisation of industry plans during deliberative workshops conducted in Port Talbot and Pembroke Dock. Our analysis has demonstrated that surface acceptance of new technologies is not enough to guarantee positive outcomes from industrial change and, moreover, does not necessarily support the goals of just transitions. In order to understand how public perceptions of industrial decarbonisation are impacted by contemporary conditions we argued for the need to attend to the mobile, partial and cross temporal aspects of everyday life. Drawing on object relations theories, community trauma research, urban and geographical infrastructure literature and environmental studies has enabled us to produce a conceptual framework to understand responses to change as complex constellations of global, local, and cross temporal aspects. We consider that transdisciplinary approaches offers the opportunity to develop holistic research practices that utilise expertise across the humanities and social sciences. We developed an innovative methodology that captured affective registers analysed to gather emotion-based portrayals of the ecologies that were later augmented through the discussion tasks. The portrayals of place as contained and wounded along with the deepened comprehension of the discussion illuminated how past experiences are enfolded within the activated cognitive logics (i.e. ones that make sense) when deliberating future change as something that involves both industrial aspirations and broader experiences of needs in place. Our analysis argues that achieving acceptance(s) requires engaging with how people come to decisions, and to know what is at stake. In this way change can provide social justice orientated solutions that make good, and repair, past problems. For example, in Pembroke there is a need to hear local people and to build in civic solutions alongside the planned hydrogen and port installations. Potential solutions to precarity and resistances could be through developing industrial pathways with awareness of the wider infrastructural ecologies and lively objects. The research demonstrates how elucidating the psychic processual pathways people utilise provides important information about how places are experienced and ideated. Restorative justice is usually understood to mean material repair or reparations. From the object relations perspective there is a need to construct ecologies that are both material and psychically fair and reparative in order to encourage states of integration and containment, Material change, itself, can also have beneficial psychically reparative impacts, especially when installations are co-visioned by local people. Earlier we pointed out that the new techno-installations are likely to have loose signifiers- and this presents an opportunity because, where the future visions materialise through collaborative and restorative actions, they may come to signify a reparative future.

On one hand it could be argued that the reported findings reveal only what emerged on the days of the workshops. However, we would contend that the findings demonstrate constellations of relations that were and are actively present in these places. Working with image-objects in particular, enabled us to see key active interrelations and with more sustained use the methods hold further potential. The findings suggest that in the making of future infrastructures paying attention to the albeit transitory meanings objects hold, whether future or past, will illuminate how to create environments that build and nourish psychic resilience.

CRediT authorship contribution statement

Harriet Smith: Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Karen Henwood:** Writing – review & editing, Supervision, Conceptualization. **Nick Pidgeon:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Professor Karen Henwood reports financial support was provided by Engineering and Physical Sciences Research Council. Professor Karen Henwood reports financial support was provided by Welsh Government ERDF Flexis Project. Professor Nick Pidgeon reports financial support was provided by UK Energy Research Centre. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix 1

Fig. 1. Photographs of workshop tasks.
Top row: task 1. Individual mapping, task 2. Images from stakeholder presentation, task 4. Selection of some of the photographs. Below task 4. How the photographs were ascribed, task 5. Example of a constellation depicting a participant's meaningful image-objects, 6.Example of a group map annotated with meaningful objects and visions of future in 2060.

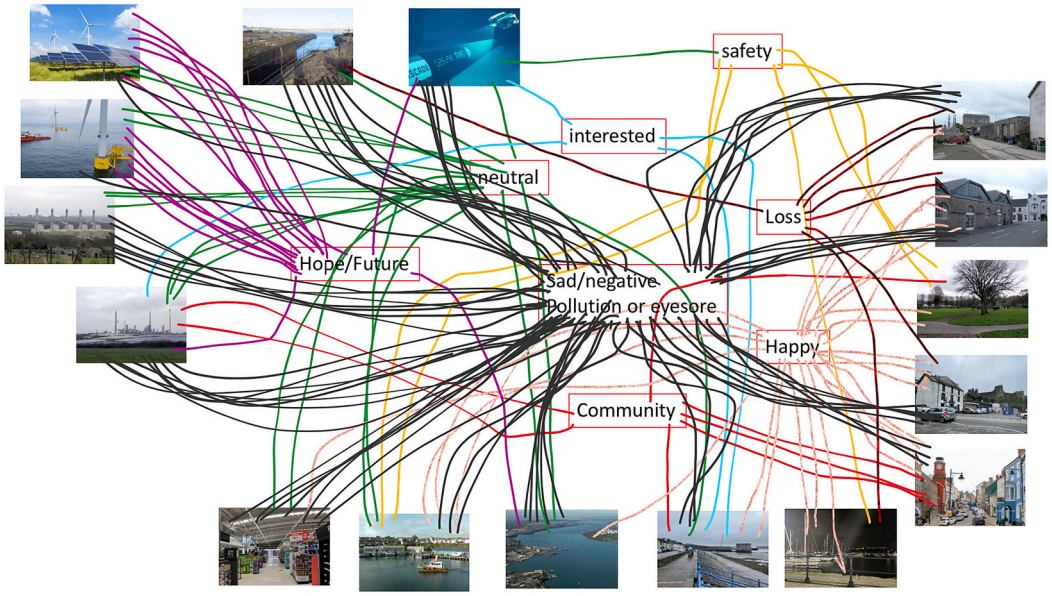

Fig. 2. *Spidergram* example of how we tracked and coded participant selected image-objects with ascriptions to understand the affective weight within the infra-structural ecologies.

Data availability

The data that has been used is confidential.

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