



# The global energy transition and place attachment in coal mining communities: Implications for heavily industrialized landscapes

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## ABSTRACT

The global energy transition could usher in major changes to the production and supply of coal. While key aspects of this transition agenda are fashioned at the global and national levels, crucial decisions relating to mitigation measures need to be undertaken regionally and locally. As the energy transition agenda intensifies, understanding the composition and balance of motives among residents in coal regions will be critical to designing and activating regional scale policy incentives. At this scale, factors such as place attachment become relevant to the design, planning and resourcing of transition pathways. This paper examines recent scholarship on place attachment and contributes a conceptual framework (PAHIL) for its application to heavily industrialized contexts. The development of the framework is supported by a case study where we demonstrate how place attachment is formed, expressed, localized, and transferred across the life of mine in two coal communities in the Czech Republic.

## 1. Introduction

The global energy transition promises to usher in major changes to the production and supply of coal [1,2]. This movement is driven by a range of mostly convergent factors including: energy security [3], health impacts from air pollution [4], climate change mitigation [5], and consumer demand [6]. While these factors are fashioned at the global and national levels, crucial decisions relating to mitigation measures need to be undertaken regionally and locally. A recent study by Everingham et al. [7], for example, found that across 554 resource regions globally, 102 mining regions could expect one third of its mines close in the next decade. Twelve percent of these regions predominantly extract coal with another 32% of regions engaged in the supply of energy transition metals (i.e. metals listed by Lèbre et al. [11]). Authors such as Cha [8], Scott and Powells [9], Skoczkowski et al. [10], Spencer et al. [11], and Evans and Phelan [12] have signalled a vast range of disruptions associated with the global energy transition that could occur at the regional and local level. The extent and nature of these disruptions depends on the efficacy of government interventions [13,14] and the adaptive capacity of resource communities [15]. These capacities differ markedly between communities, regions, and countries. Given the highly localised nature of the expected effects, an understanding of

residents' willingness to stay or to migrate, in particular the social, economic, behavioural, and psychological motivations behind these decisions, is important to succeed in the global transition policy. Moreover, the mounting discourse on the need to phase-out coal emphasizes the need to connect global scale policy developments with the people and places that are most likely to be affected. For these reasons, place attachment is central to the design, planning and resourcing of transition pathways.

This paper examines recent scholarship and contributes a conceptual framework for the application of place attachment to heavily industrialized contexts (PAHIL). The development of the PAHIL framework is supported by a case study where we demonstrate how place attachment is formed, expressed, localized, and transferred across the life of mine in two coal communities in the Czech Republic. These communities have been wholly shaped by the legacies of large-scale coal mining for over half a century. Based on a mixed methods study design using in-depth interviews and participatory value mapping, our findings suggest that place attachments form as dynamic bundles. This finding marks a departure from the conservative mainstay of the literature that connects people to places in typically positive and predictable ways. One unfortunate consequence of the literature has been the exclusion of heavily industrialised landscapes on the simple basis that they are too ruinous

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for people to form attachments towards. By contrast, our research confirms arguments made from the critical edges of the place attachment literature, where scholars have insisted that attachments must be considered as having both positive and negative potential (e.g. [16,17,18,19]). A further finding is the extent to which positive attachments were actively expressed in relation to landscapes severely impacted by mining and actively transferred via personal experience or kin networks over the life of mine. This finding opens new pathways for place attachment research marking a shift away from idealised landscapes. In this paper we argue that a more nuanced conceptualisation of place attachment provides the research and policy community with an improved basis for understanding the individual and collective drivers behind decisions to invest in a location, or to cut ties and move on. As the energy transition agenda intensifies, understanding the composition and balance of motives among residents in coal regions will be critical to designing and activating regional scale policy incentives. Given potential changes in the make-up of future markets, both in post-coal mining environments and elsewhere, the implications extend across a range of heavily industrialised landscapes where similarly large-scale transformations are predicted to occur.

## 2. Theory

People-place relationships are a common theme across different branches of the social sciences such as environmental psychology, sociology, human geography, anthropology, gerontology, demography, urban studies, leisure sciences, ecology, forestry, architecture and planning, or economics (see literature review by Lewicka [27]). Despite this long-term and versatile interest in place-related research, core concerns about the underlying theory and conceptualization of place attachment remain unresolved. In the following two sections, we highlight critical aspects of place attachment and the question of its application in heavily industrialized settings.

### 2.1. Place and place attachment

The scholarly understanding of ‘place’ is reflected in the literature in at least two opposing ways. There is the ‘classic’ representation, that depicts places as stable, bounded and historically continuous entities [20,21]. More recent constructions by authors such as Massey [22–24], and Harvey [25] define place using their relational characteristics rather than fixing them exclusively based on their physical properties. From this perspective places are expressed as nodes or networks that are interlinked through scales of human interaction. Low and Altman’s [26] usage aligns with Massey’s understanding: places form as sites and context within which interpersonal, community and cultural relationships occur. On this framing, place is a medium or milieu which embeds and is a repository of a variety of life experiences. It is central to those experiences, and it is inseparable from them. Because notions of place are multifaceted, arriving at a workable or singular definition of ‘place attachment’ has proven difficult.

Lewicka’s [27] and Raymond et al.’s [28] review of the place attachment literature confirms the extent and diversity of thinking; and consequently, that it can be differentiated not only by the assumptions carried in key concepts, but through the use of methods and tools. One example, for instance, is that some studies have examined place attachment as a single outcome variable (e.g. [29–31]), while others consider place attachment as either a predictor or intervening factor for a wide range of social processes and outcomes (e.g. [32,33]).

Clearly, place attachment is a complex phenomenon. Some of the more careful theorisation efforts indicate that place attachment is unlikely to be a single or discretely bounded phenomenon. Our analysis of the literature suggests that place attachments consists of contingent points of experience, obligations, and resources. For example, Low and Altman [26] argue that place attachments differ in their aspects, origins, and purposes; and can incorporate many inseparable, integral, and

mutually defining features, qualities, or properties. Three decades earlier, David Lowenthal [34] advanced a similar proposition: that people-place encounters are a function of people’s direct experience, memory, fantasy, present circumstances, and future purposes. Scannell and Gifford [35] in their tripartite framework define place attachment as a construct of three interrelated dimensions, namely person (individually or collectively constituted), psychological processes (affective, cognitive, and behavioural components), and place (symbolic aspects and physical environment). According to Low and Altman [26], place attachments can be symbolic and carried through possessions and property. At one level, place attachment provide a sense of daily and ongoing security and stimulation, with places and objects offering predictable facilities, opportunities to escape formal roles, the chance to be creative and to control or distance aspects of one’s life. On another level, place attachment can be described as a conduit that links people with friends, partners, and kin.

We maintain that all places have the potential to stimulate meaning and connection. The current stock of research contains a strong bias towards certain types of landscapes: protected and heritage sites [36], rural landscapes [37], recreational places [38], urban natural areas [39], wilderness [40], among others. These environments not only represent ordinary, and sometimes, idealised “folk” landscapes, but a “tendency to presume stasis rather than dynamism as the default when conceptualising place attachment” [41]. Fewer authors, by comparison (only e.g. [42–45]), have paid attention to massively changing industrialized landscapes. While these ‘less pretty’ and contentious environments may appear less attachment worthy, that are nonetheless, where such attachments may be most impactful.

Place attachments are dynamic and dialectic. The majority of studies define place attachment as an implicitly positive construct, assuming that to hold attachments is a universally good thing. In this light, place attachments are shown to stabilize communities during periods of disruption [46], provide a heightened sense of safety [47,48], encourage long-term planning and use of public spaces [49], or become a driver of adaptation in new conditions [50]. Scholars have similarly noted links between place attachment and quality of life [51], better psychological and physical health including conceptions of self-worth [52], in addition to more satisfying social relationships, and higher level of satisfaction with the physical environment [53].

There is, however, empirical evidence that raises doubt over the exclusively positive link between people and places. For instance, Chawla [54] has intimated that place attachment can entrap or create territorial conflicts. Researchers have suggested that place attachments can make innovative planning and development [55] and civic engagement [56] more difficult. In cases of environmental disaster such as hurricanes, floods or earthquakes, place attachment may cause long-term feelings of loss and alienation [57]. These same attachments may commit people to stay in life threatening and hazardous environments [47,58]. It is for these reasons that Bauman [59] argues that emotional attachments to place can form as the result of an absence of life alternatives, rather than through some form of conscious choice.

### 2.2. Coal mining communities as places of attachment

Place attachment in mining communities is evident in the existing sociological and historical literature; but not explicit. The tendency is to focus on communities as places of work, where it is the labour and not the landscape question that takes ultimate priority. Early literature such as Dennis et al.’s [60] “Coal is our life”, has shaped the direction of numerous research studies, for instance [61–63]. These authors emphasize the relationship between capital and labour using mining companies and communities as proxies. Peter Ackers [64], reflecting on this pattern, speaks about the ‘romantic historicism’ that surrounds labour in the industry. There has been, as he describes, “the constitution of a stereotypical coalminer, an ideal-type figure who, in reality, existed barely anywhere” [64: p.162].

Alongside these efforts, there have been endeavours to develop a more reflective and nuanced conceptualization of mining communities. Simpson's research [65] emphasizes the transitory nature of the labouring process introducing an example of a single West Yorkshire miner who over the course of a sixty-year career as a miner worked in 23 different mining pits. Strangleman's work [45] distinguishes four types of networks in coal mining communities: (i) occupational, (ii) place-based, (iii) class-based, and (iv) kin-based. Across each of these network types coalfields can be viewed as industrial districts that house and generate distinct norms and values. Strangleman's findings suggest that while networks in coal mining communities are directly dependant on mining, at closure, communities will revert to place-based and kin-based networks as a means for support and continuity.

In contrast, Mah's [43] analysis of place attachment in areas of industrial decline draws attention to the social and psychological impacts of uncertainty, disruption, and stress during periods of socio-economic transition. Mah's study shows the potential for internal conflicts to occur within place attachments where notions of "home" co-exist with the experience of "devastation". According to Hay [46], place attachment may serve as a defence mechanism against the type of identity crisis that form around the internal conflict described by Mah.

Studies on place attachment in mining landscapes [43,45] exclusively focus on place-based ties through the lens of economic transition. Similarly, the study by Goin and Rymond [44] examines place attachment between mining booms and busts. While mining lifecycles run through booms and busts, it is nevertheless important that researchers pay closer attention to the lifecycle itself in order to understand attachments across the entire life of mine. We posit that place attachments will not simply change with the pending boom and bust cycles of the market, but that with each stage in the mining lifecycle both landscapes and the wider network of socio-economic relations are drastically altered. The implications are especially prescient for communities at the back end of mining projects, or for those communities where global energy norms threaten to impact directly on the function and future of their landscapes. We argue that the inclusion of these severely altered landscapes and the range of possible attachment outcomes provides a renewed basis for theorising 'place attachments' and their influence over post-mining futures. In this following section, we present a comparative study of two coal mining communities at different industrial stages.

### 3. Geographical and socio-political context of the case study

The Czech Republic, formerly Czechoslovakia, was part of the Eastern Bloc from 1948 to 1989. As a member of the former Council for Mutual Economic Assistance (Comecon), Czechoslovakia shared a common ideology and resources under the complete governmental control of the Soviet Union. Coal was regarded as the national 'black gold' in a centrally controlled economy dominated by heavy metallurgical and energy-intensive industries [66]. In that forty-year period, the production of lignite as the main source of energy increased five-fold, with electrical power generation increasing twenty-fold [67]. This rapid increase led to an enormous change in the scale of open pit mining and resulted in a permanent reconfiguring of the of the country's topographical character [68]. As communist planners continually ramped up coal production between the 1950s and 1970s, an estimated 100 villages and towns were destroyed, resulting in the displacement of about 90,000 residents. Much of this activity was concentrated in two brown coal mining regions of Most and Sokolov [69].

After the fall of communism in 1989, the newly established democratic government prepared programs to restore the environment and to create a balance between economic, social, and ecological interests of the state and coal mining regions. As part of these programs, restrictions related to mine rehabilitation were implemented in the National Mining Act [70] in 1993. Since that, brown coal mining has been significantly reduced and intense large-scale reclamation has been progressively applied. The transformation of mining regions has been accompanied by

new rehabilitated landscape features such as pit lakes, rehabilitated tailings and water streams, and new routes. Following the emerging trends of a post-productivist orientation towards service provision, leisure, and the commodification of rural landscape directed at recreational use [71], post-soviet mine rehabilitation efforts target to increase recreational areas and natural values in coal regions [72,73]. Since Czech Republic became a member of European Union in 2004, the standardized system of policies and development programs have been applied in further transformation of Czech coal mining regions.

Dependence of the Czech Republic on coal is high. For its energy needs, the country relies mostly on domestic reserves of brown coal that include eight active open pit mines located in the mining regions of Most and Sokolov. The annual production of brown coal was 39.3 Mt in 2018. Coal production came from three companies: 70% state-owned-30% private Severoceske Doly (21.7 Mt) and two private companies, Sokolov Mining (6.9 Mt) and Sev.en Group (10.7 Mt). In 2019, the shares of energy sources on electricity generation were dominated by brown coal (40%) and nuclear (35%), followed by renewables (12%), gas (3%), and hard coal (2%) [74]. According to the State Energy Policy [75], the government expects coal to account for 30.5% of energy production in 2030, despite the European Union's call for exit coal by that year.

The legal context framing coal regions in the Czech Republic is given by the National Mining Act [70]. Based on this act, coal deposits in the country are exclusively owned by the state. When mining companies lease the land above the deposits, they must pay an annual rent to the state and to the landowners. To compensate for the direct impacts of mining, the state transfers approximately 35% of the rent to the municipalities directly affected by mining. This makes their annual operating budget approximately three times higher than budgets of other municipalities in the country [76]. In addition, mining companies have a legal obligation to rehabilitate all areas affected by mining activities at full cost. To guarantee the quality of mined land rehabilitation, companies pay a fee from every tonne of excavated coal to a bank account owned by the state supervised by National Mining Council (NMC). The fee is calculated as part of the licencing application process and is based on the size of resource and an estimation of the extent of planned rehabilitation works. NMC conducts annual onsite reviews to evaluate success of rehabilitation to release budget for the next year. This leads to relatively immediate rehabilitation outcomes, which together with above mentioned compensations and historical socio-political contexts significantly shape relationships between affected municipalities and operating mining companies.

Mining regions and local communities in the Czech Republic has been studied by e.g. Klusáček et al. [77], Kunc et al. [78], and Frantál [68]. Frantál's [68] study of two local communities from the Most region, a region with the longest prognosed coal mining in the country, found polarized attitudes to coal mining. While 55% of participants (i.e. 110 residents) were strictly anti-coal, 13% were supportive to coal mining and another 32% have neutral opinions. As Frantál showed, place attachment was the strongest predictor of the negative attitudes toward mining and residents' involvement in protests against continuing mining. However, this region is the only coal region considered (and partially approved) by the Czech government for future expansion of mining behind the current mining limits, including the resettlement of two communities [79]. Other coal mining regions in the country are

expected to phase-out according to planned closures of their mines.

## 4. Methods

### 4.1. Study area

The case study is located in the Sokolov region in the border area with Germany. This borderland was part of the so-called 'Sudetenland'<sup>1</sup> where the extent and variability of social changes between 1938 and 1990 caused by national economic and political turbulences were extremely high [80,81]. As demonstrated by Klimeš [82] and Boček and Cibulka [83], 'Sudetenland' regions have the highest poverty rates in the country, accompanied by the highest unemployment rates, the highest rates of violent crime, the highest concentration of ethnical minorities, the lowest rates of education, and the lowest turnout in national elections in the country since 1990. Moreover, due to high industrialized character of the region, effects of pre- and post-socialist administrative reforms and planning, including the decentralisation and privatisation of coal mines had pronounced impacts on socio-economic character of the region [84]. High levels of dependency on mining together with EU's demands on coal-free future could bring further disruptive changes to this region [79].

The study investigated two communities in the Sokolov region, namely Habartov and Lomnice (Fig. 1). While Habartov lies in the centre of about 20 years old mine rehabilitation including forest, agriculture land and pit lakes Boden and Medard, Lomnice is surrounded by active mining and reclamation works.

The Sokolov Mining company (SUAS) operates all coal mines in the region. SUAS became a private joint-stock company in 2005. It is the smallest brown coal mining company in the Czech Republic in terms of workforce, and the second biggest producer of electricity in the country [85].

Habartov has a population of approximately 5000 people. More than half of the town's cadastre (11.16 km<sup>2</sup> out of 21.39 km<sup>2</sup>) remains under the lease of SUAS. The former town of Habartov was displaced due to mining in 1950s and a new town was established 1 km North in 1976 (see Fig. 2a, b). The Boden mine located in close proximity to a new town (West) was closed in 1992. The mine pit was rehabilitated and transformed into a lake. The Litov tailings area was converted into multiple land uses (720 ha). The Medard mine operating to the East side of the new town was closed in 2003 and rehabilitated to include a large recreational pit lake, also surrounded by multiple land uses (5 km<sup>2</sup>). The use of the lakes is mainly for water sports, swimming, and fishing. Inline tracks, a golf course, volleyball, and tennis courts were built by the local council in the Litov rehabilitated area.

Lomnice has a population of 1300 people. SUAS still operates on 70% of the town's cadastre (9.18 km<sup>2</sup> out of 13.12 km<sup>2</sup>). The municipality has remained in its original location and size (see Fig. 2c, d), located between the Jiri open pit mine and its Podkrusnohorská tailing. The mine has been operating since 1949 with an average annual production of 8 Mt. Its closure is planned to 2035 with rehabilitation to a pit lake surrounded by forests. The Podkrusnohorská tailing area has been reclaimed to forests and agriculture land with a total area of 19.57 km<sup>2</sup> and height of 120 m. The north and central parts of the tailings area are under ongoing reclamation works.

<sup>1</sup> These originally German speaking areas went through critical historical events such as (1) the withdrawal of the Czech minority in 1938 as an indirect consequence of the Munich Treaty, (2) population turbulences in the end of World War II, (3) the forcible displacement of most Germans from Czechoslovakia (1945–1948; ca. 2.8 mil. people), (4) the controlled resettling of Sudetenland by Czechs, Slovaks, Roma and reemigrants of various nations (1945–1989) without experience and knowledge of the land, (5) the installation of the "iron curtain" in parts of Sudetenland ordered by the Communist regime (1951–1989), (6) the abolishment of the "iron curtain" (1989–1990) [80,81].

### 4.2. Sampling, data collection and analyses

The study utilised a mixed methods approach as shown in Fig. 3, based on triangulation design, a variant of data transformation, by Creswell and Clark [88]. Quantitative and qualitative methods were applied at the same time and with equal weight in data collection and data analyses activities. The rationale for mixing data types was so that the complexities of interactions among natural and human systems could be more thoroughly explained [89]. Spatial maps were used to connect geographic changes with participants' reflections of place, and to provide contextual understanding to the relationships uncovered between variables in statistical analyses.

When selecting respondents for the study, purposive sampling was applied. Participants were selected based on achieving a gender-balanced sample of adult residents who had resided at least 10 years in the study community.

Qualitative methods of data collection included face-to-face semi-structured interviews, and questionnaires and participatory value mapping were part of quantitative data gathering methods. The data collection comprised of three parts. During the first part, respondents completed a questionnaire that collected information on their socio-demographic characteristics including their age, highest education level, occupation, length of time in the community, etc., the full list of which are shown in Table 1 (predictors of place attachment with categories and coding).

The second part of data collection used open-ended questions to examine interviewees' relationships with the community and their perception of their mining and post-mining landscape neighbourhoods. The third part aimed to map geography of their place attachments using a participatory value mapping technique, known as participatory GIS (PGIS) or public participation GIS (PPGIS) [90–92]. PGIS combines a variety of geo-spatial information management tools to represent peoples' place-specific knowledge and values [93]. Using printed topographic maps and coloured pencils, respondents were asked to identify places of their daily activities, places with high aesthetic and natural values, places important for future of the community, and localities where they relax. Participants also identified places with negative values such as frightening and dangerous places, places that had been destroyed by human activities, and those that needed remediation.

Forty residents of Habartov and Lomnice communities participated in the study (20 per community with the timeframe of approximately 60 min per participant). The basic sample characteristics are shown in Table 2.

The survey was conducted between January and March 2017. To protect participants' privacy and rights, the standard ethical procedures of written informed consent and anonymization of published excerpts were applied. Respondents received codes such as HAB001 (i.e. an interviewee number 1 from Habartov) or LOM001 (i.e. an interviewee number 1 from Lomnice).

Each session with an interviewee was recorded and transcribed in full. The transcripts were analysed using qualitative focus coding, including labelling and defining categories for every theme identified in the survey. Repeated readings of the transcripts and initial coding led to a thematic organisation of data based on themes predefined by the place attachment literature (e.g. [16,27]) and the development of new themes and emerging categories covering major determinants of place attachment.

Themes emerging from participants' responses, such as sense of security, family ties, or proximity to nature, among others, were termed *determinants* of place attachment (dependent variables). Twenty-two determinants were identified and organized into six thematic groups (constructs) and two major dimensions (A 'person' and B 'place'), as shown in the Results sections in Table 3. Determinants were coded as "1" (identified) and "0" (unidentified) for each participant. This transformation from qualitative to quantitative data allowed us to test relationships between the different datasets. *Predictors* (independent

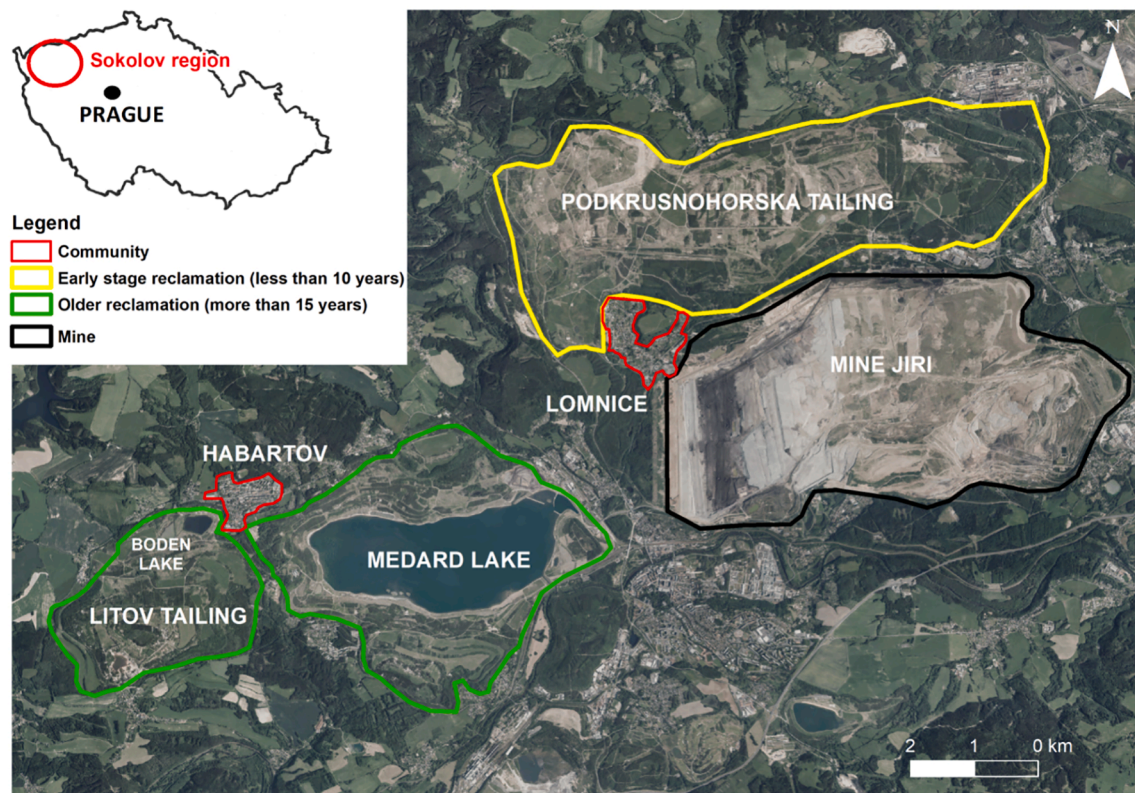


Fig. 1. Study communities Habartov and Lomnice.

variables) were socio-demographic characteristics of participants, such as current community of residence (Habartov, Lomnice), birthplace (Habartov, Lomnice, elsewhere in region, other), and proportion of time residing in current community of residence (%).

The Mann-Whitney  $U$  test and the Kruskal-Wallis test were used to identify statistically significant differences between the 'predictor' and 'determinant' variables, with the latter test used where the predictor had more than two levels. The Dunn-Bonferroni post hoc method was used following a significant Kruskal-Wallis test to identify differences within levels. Non-parametric tests were used due to the non-normal distributions of the determinants. The Spearman's Rho correlation test was used to identify associations between the variables.

Participants' PGIS value maps were scanned and manually transferred to shapefile formats in ArcGIS. To identify places with prevailing values among participants, an overlay analysis was applied using Union and Intersect ArcGIS tools.

## 5. Results in the context of the case study

Our findings are based on mixed multi-method research study where qualitative and quantitative data were combined and analysed. All 40 interviewees for this study articulated points of attachment. These attachments differed between the two study communities Lomnice and Habartov. In the following three sections, we summarize our key findings.

### 5.1. Place attachments differed with different determinants

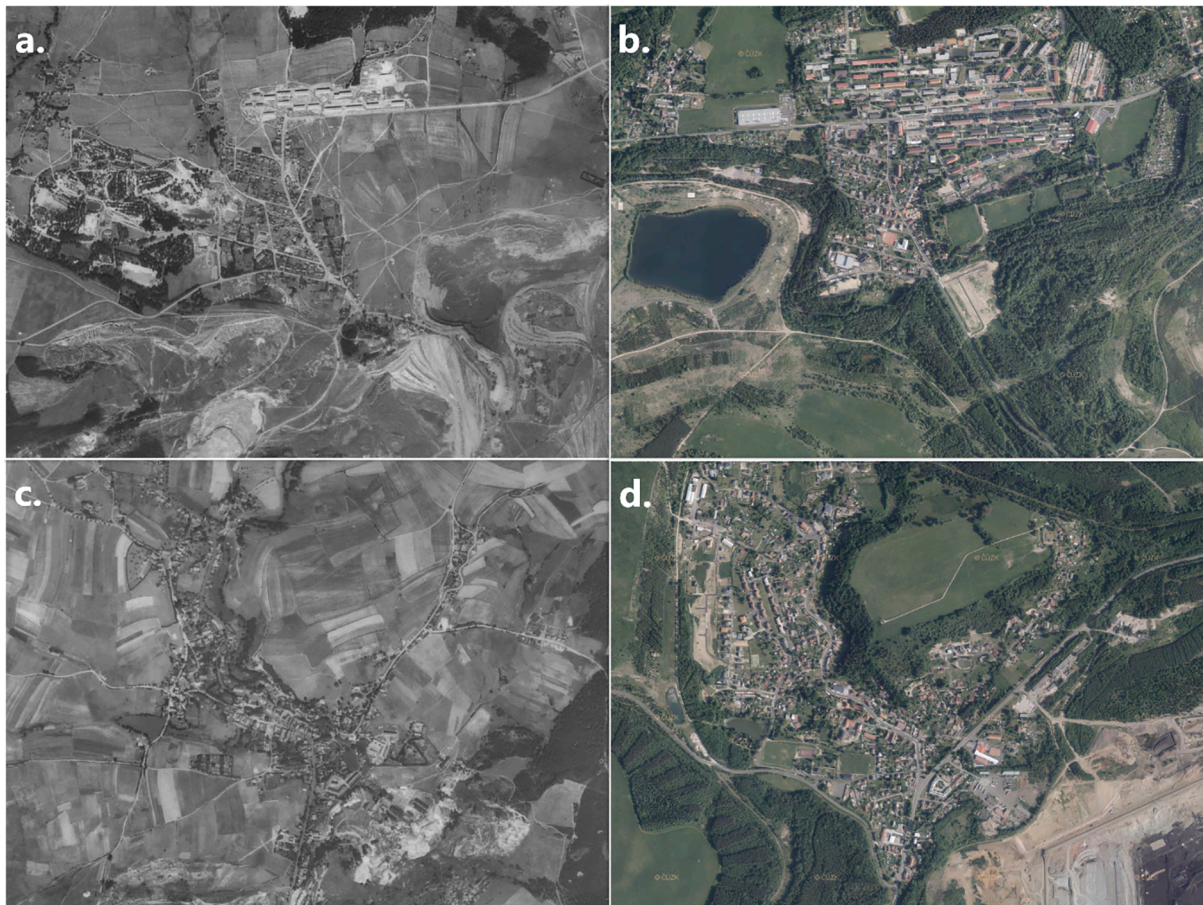
As shown in Table 3, we found 22 determinants of place attachment. These determinants appeared 271 times across the sample of 40 participants. The determinants were aggregated into six constructs according to similarity of theme, which were then grouped into two higher order dimensions: (A) 'person' and (B) 'place'. Person dimensions represented internal factors, such as the community forming part of their

childhood memory or having feelings of belonging about the community. The place dimension represented external factors, that relate to the characteristics or opportunities associated with that community.

Based on qualitative analyses of the data, determinants were found to have both positive and negative functions. Although positive effects of the determinants (attractors) were commonly expressed by participants, we identified 5 determinants with negative effects (detractors). The detractors represented 13 from a total of 271 identifications (9 in Habartov, 4 in Lomnice). Some of the cited negative effects included family ties, structure of the community, small size of the community, amenities, and urbanism of the town. While these determinants can add to a person's sense of attachment, changes in their shape and function can likewise detract from that attachment. For example, the quality of family ties must be considered, rather than assumed, and there are threshold questions about the size of a town, its ability to attract services, and its overall liveability.

Quantitative analyses showed that participants from Lomnice reported significantly more determinants of place attachment than residents from Habartov. When all 22 determinants were aggregated, the Mann-Whitney  $U$  test confirmed that Lomnice residents presented significantly more determinants ( $Mdn = 7.00$ ) than residents from Habartov ( $Mdn = 4.50$ ,  $U = 318.50$ ,  $p = 0.001$ ). Analysing the individual dimensions and constructs, we found that the number of times Dimension A was identified by those from Lomnice ( $Mdn = 3.50$ ) was statistically higher than for those from Habartov ( $Mdn = 2.00$ ,  $U = 315.50$ ,  $p = 0.001$ ). Similarly, the number of times Construct 3 was identified by participants in Lomnice ( $Mdn = 1$ ) was markedly higher than for those from Habartov ( $Mdn = 0$ ,  $U = 283.5$ ,  $p = 0.023$ ). Construct 3 is the summation of four themes - childhood memories, family ties, friendship ties and structure of the community. These results indicate that residents of Lomnice were more likely to report these feelings about their community.

Further tests determined whether the community in which a participant was born imposed a material difference on the reporting of



**Fig. 2.** Land use changes in the study communities between 1950s and 2019. (a) Habartov in 1950s. (source: Historic orthophoto map 1950–1959 [86]). (b) Habartov in 2019, after mine mine closure (source: orthophoto map 2018–2019 [87]). (c) Lomnice in 1950s (source: Historic orthophoto map 1950–1959 [86]). (d) Lomnice in 2019. (source: orthophoto map 2018–2019 [87]).

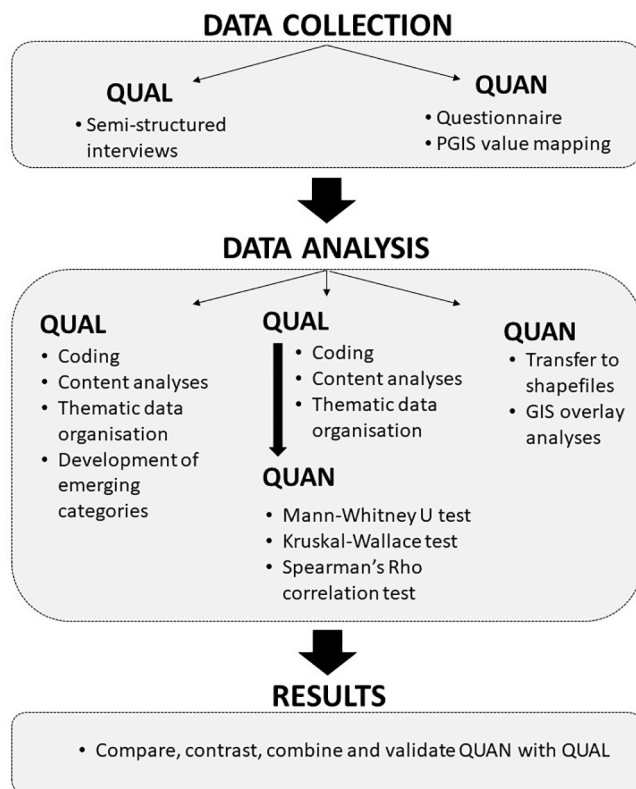
attachments. A Kruskal-Wallis test confirmed that the community of birth affected how commonly Dimension A determinants were reported ( $H(3) = 13.53, p = 0.004$ ). Subsequent comparisons showed that respondents born in Lomnice (Mdn = 4.00) reported more Dimension A attachments than those born outside the mining region (Mdn = 2.00,  $p = 0.004$ ), Habartov (Mdn = 2.00,  $p = 0.044$ ) and elsewhere within the mining region (Mdn = 3.00,  $p = 0.032$ ). Similarly for Construct 1 ( $H(3) = 9.51, p = 0.023$ ), respondents born in Lomnice (Mdn = 2.00) were found to report more attachments than those born in Habartov (Mdn = 1.00,  $p = 0.022$ ). Construct 1 included the town as their birthplace, their place of residence and their home. Similar to the previous outcome, those born in Lomnice reported more ‘person-related’ attachments than those born in Harbotov. Using Spearman’s Rho correlation test, we further identified a significant relationship between proportion of participants’ life in the community and their perception of the community (Construct 1;  $R = 0.392, p = 0.012$ ). Using Spearman’s Rho correlation test, we further identified a significant relationship between proportion of participants’ life in the community and their perception of the community (Construct 1;  $R = 0.392, p = 0.012$ ). As relative time lived in the community increases, perceptions of the community as home, place of residence and birthplace also increases. None of the other sociodemographic characteristics (predictors) were found to cause a statistical difference in the number of predictors reported by participants.

We found that historical disruptions can affect attachment bundles by removing or changing determinants. When attachments are disrupted, individuals struggle to rebuild them. This was apparent in Habartov, where a mine-induced resettlement in the 1950s strongly influenced attachments and their root determinants. HAB019 stated, for

example, “*I don’t like the structure of our community. It is, to a certain extent, caused by its location and former mining, and especially displacement and forced immigration of mining workers and gypsies during the communist regime. We live in a new agglomeration that has absolutely no history. It all disappeared in the pit. This bothers me a lot here. There is a maximum of two historical buildings in Habartov. Other towns can rely on their own history, but we can’t. Our main square used to be a parking lot ... no one thinks about it as a public square, a representative centre of the town. Habartov has no traditions, no cultural centre, nothing ...*”. By contrast, even though the residents of Lomnice have witnessed the displacement of surrounding settlements, the community has not experienced major disruptions of its own. The difference between the character of attachments was expressed by one resident of Lomnice (LOM017): “*This town is my life. It is close to my heart. I have loved it since my childhood. When Germans lived here before the war and then mine workers in Communism, we all got along very well. Most of them were displaced to other places in the region ... There have been huge changes in Lomnice, but I still love it so much.*”.

## 5.2. Place attachments were identified in heavily industrialized places

Using quantitative PGIS value mapping, we identified spatial patterns of attachment that shows exact locations and values associated with specific places. The findings showed attachments formed across industrialized and non-industrialized areas as shown in Fig. 4. New industrialized landscape features of tailings and pit lakes were associated with positive social functions such as high aesthetic, natural and recreational values, as previously determined by Svobodova et al. [94]. Participants perceived older mine rehabilitation sites as important for



**Fig. 3.** Mixed methods design of the research study. Quantitative and qualitative methods of data collection and analysis were implemented at the same time and with equal weight. Qualitative methods of data collection included face-to-face semi-structured interviews, and questionnaires and participatory value mapping were part of the quantitative data collection. Collected qualitative and quantitative data were analysed separately. Part of qualitative data was transformed into quantitative data. Quantitative statistical results and qualitative findings were directly compared to identify areas of corroboration and contradiction.

**Table 1**  
Predictors of place attachment, their categories and coding.

Predictor	Categories (coding)
Community	Habartov (HAB), Lomnice (LOM)
Other family members living in the community	Yes (1), no (0)
Born in the community	Habartov (1), Lomnice (2), elsewhere in the region (3), others (0)
Proportion of life in the community	%
Age	Years
Having children	Children (1), without children (0),
Occupation in the community	Work in the town (1), work in mining (2), others (0)
Income level	Low; including retirement and maternity leave (1), medium (2), high (3)
Education	Lower – elementary, vocational (1), high school (2), university (3)
Relationship to SUAS	Positive (1), neutral (0)

their community and its future development. In contrast, the active Jiri mine was exclusively associated with negative functions such as destruction, danger and in need of revitalization. However, two participants from Lomnice, pointed out the uniqueness of their community, noting its location at the edge of the mine, with one saying: “When friends or relatives arrive to Lomnice, I take them to the viewing area to see the pit. They are crazy about it. The pit is sort of an attraction here” (LOM007). The other one stated: “When we go on a family trip, we go to see

**Table 2**  
Characteristics of 40 participants in the study communities of Lomnice and Habartov.

Characteristics	Habartov	Lomnice
Average age	49 years	48 years
Education	University 6 (15%)	University 2 (5%)
	High school 9 (23%)	High school 13 (33%)
	Lower 5 (13%)	Lower 5 (13%)
Number of employees of the mining companies	2 (10%)	6 (30%)
Average time spent in the community	43 years	40 years
Born in the community	11 (55%)	9 (45%)
Family members in the community	19 (95%)	17 (85%)

**Table 3**  
Determinants of place attachment, number of their identifications in the survey, and their groupings to constructs and dimensions of place attachment.

#	Determinant	Number of identifications	Construct	Dimension
1	Perception as a birthplace	13	Construct 1	A ‘person’
2	Perception as a place of residence	11		
3	Perception as Home	25	Construct 2	
4	Feeling of belonging	26		
5	Knowledge of the area	4	Construct 3	
6	Sense of security	2		
7	Childhood memories	4	Construct 4	B ‘place’
8	Family ties	10		
9	Friends ties	7	Construct 5	
10	Structure of the community	13		
11	Property ties	6	Construct 6	
12	Job ties	6		
13	Small size of the community	22	Construct 6	
14	Location of the town	6		
15	Proximity to nature	9	Construct 6	
16	Proximity to the regional town	6		
17	Amenities	17	Construct 6	
18	Cultural events	11		
19	Beautiful place	7	Construct 6	
20	Cleanliness	7		
21	Quiet place	9	Construct 6	
22	Urbanism of the town (housing)	5		

the pit where the viewing area is ... It’s very stunning and in the evening it’s even more stunning. We just stop there and watch... It’s like our local Las Vegas” (LOM014).

Qualitative results showed that codes such as “hole in the ground”, “dust”, “depressive”, “dirty”, “ugly”, “ecological burden” or “lunar landscape” associated with the Jiri mine were repeatedly identified across the participant cohort. Codes, such as “oasis of peace and calm”, “nature”, “relax” and “beautiful” were used by participants in both communities when talking about rehabilitated tailings and pit lakes.

### 5.3. Place attachments are dynamic and transferable

Through qualitative coding, place attachment transferability was determined across different phases of the life of mine (LoM). Codes identifying the transfers differed between the study communities and across three stages of LoM (pre-mining, mining, post-mining; see Table 4). Two mechanisms of the transfer were recognized: direct via participant’s own experience and memories, and indirect through stories and shared memories.

While Habartov has been in its post-mining phase for about 15 years,

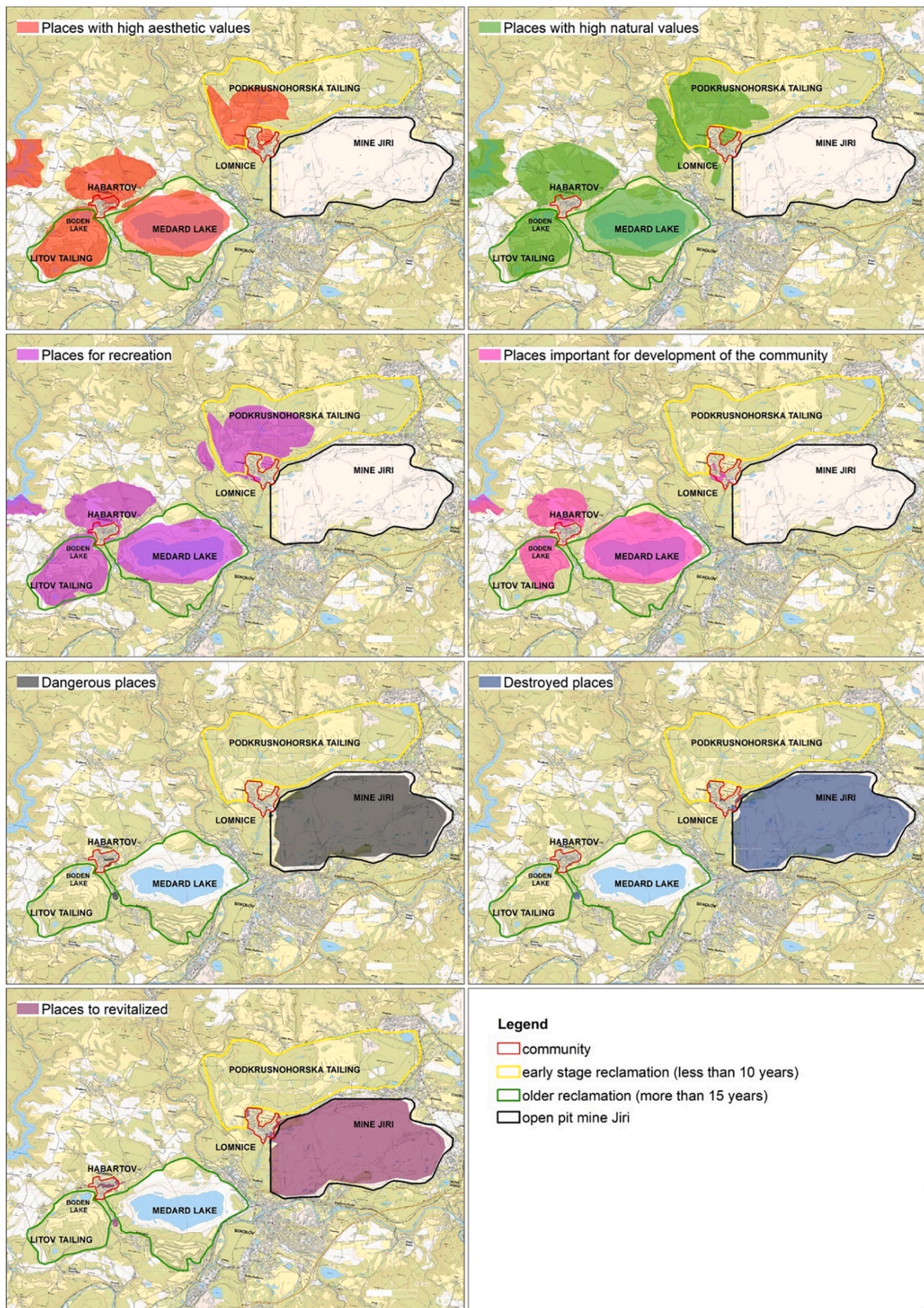


Fig. 4. Results of PGIS value mapping demonstrating participants' attachment to industrialized and non-industrialized places. Both positive and negative values associated with these places were identified.



**Table 4**

Codes characterising place attachment across three phases of the life of mine. Two mechanisms of the place attachment transfer were identified: direct via participant's own experience and memories, and indirect through stories and shared memories. The first part of the table shows results from Habartov, the second part demonstrates findings from Lomnice. In Habartov, 12 participants (60%) remembered the study area before mining. Their memories were positive and related mainly to the Boden mine. 17 participants (85%) reported their experience with mining, having exclusively negative memories. 8 participants (40%) did not experience the study area in its pre-mining and mining stages and their perceptions were shaped by stories and shared memories. In Lomnice, 4 participants (20%) remembered the area before mining started with positive memories. Another 10 participants (50%) reported their knowledge of the pre-mining stage based on stories and shared memories.

HABARTOV	Pre-mining	Mining	Post-mining *
<i>Own memories</i>	- Beautiful natural place - Lakes - Forests - Soccer field - Walking trails - Houses with fruit trees in gardens - Childhood memories	- Dust - Noise - Lunar landscape - Stopped going to the area when mined	- Huge change - Beautiful - Nature - Landscape diversity - Clean water in lakes - Swimming - Fishing
<i>Stories/ shared memories</i>	- Learn how to ski, play soccer, swim in the lakes, ice skate - Positive memories - Visits of the places	- Life was uncomfortable - Destroyed area - Theft of a beautiful land and dwellings of people - Mining did not pay it all off	- Oasis of calm - Place to rest - Leisure time activities - Mine rehab fits well to the surroundings
<i>Own memories</i>	- Memories of villages and towns that have been demolished and activities related to them - Childhood memories - Walking trails - Safe place	- Jobs - Dust - Noise - Environment burden - Inevitability evil	- Belief in the return of their beautiful landscape - As soon as the mine rehab areas turn green, it will be nice again - Expectations for hydric reclamation and afforestation
<i>Stories/ shared memories</i>	- Positive memories - People liked visiting the place	- Property loses value - Appreciation of SUAS's work	

\*Current phase of the life of mine in the community.

Lomnice has been in the mining phase for more than 70 years. Pre-mining place attachments in both communities were determined by memories and stories. The presence of nostalgia was apparent in both communities. In Habartov, memories of mining were highly negative, both from direct individual experience and as result of memories shared and conveyed through others. The current post-mining environment was characterised by terms like: "huge change", "beautiful" or "nature". In Lomnice, "environmental burden" and "jobs" were the most common terms used when referring to mining. Post-mining futures generated positive descriptions, based on the prevalence of codes such as "return of landscape", "expectations" or "beliefs". Perception of mining as a temporary 'inevitability evil' between the positive past and positive future was apparent.

## 6. The PAHIL conceptual framework

In this section we introduce a conceptual framework based on discrete observations from the research literature and our case study findings. As we have noted, there are at least two biases fashioned into the academic literature. These biases are counter-productive in terms of emerging policy challenges around local level responses to reconfigurations in global energy mix, and counter-intuitive against what 'place attachment' has come to represent as an ecological construct. To engage the question of what fixes people in place, and to what effect, the literature must move beyond simple, normative constraints. This means including all types of factors that contribute to place attachment and removing the notion that only certain kinds of landscape are worth examining.

The PAHIL framework operates on the following four assumptions:

- (i) Place attachment is most constructively conceptualised as a bundle of determinants in the form of attractors and detractors. While some determinants can attract to a sense of attachment, the same determinants changed in their shapes and functions can likewise detract from that attachment. This conceptualization allows for the content of that bundle and for the function of individual determinants to change over time.

- (ii) All places have the potential to attract attachments or detract from attachments being severed. This enables researcher to examine attachments in less idealised landscapes and the far less examined phenomena of *place detachment*.
- (iii) The configuration and balance of attractors and detractors are essential for understanding the practical implications and limitations of place attachments.
- (iv) The substance of place attachment, that is the individual attractors or detractors, may be transferrable in the sense that they can be re-established in another locale. Transferability is highly contingent.

A theoretical shift is needed in order to transcend the historic impasse embedded in the place attachment literature. We argue this shift brings in the good and the bad in terms of the relative function of place attachment, and lifts the veil on otherwise unsightly landscapes, such as one might find in and around industrial installations. The current manifestation of this impasse is one in which place attachment is rendered inapplicable for understanding how positive and negative attachments influence decisions to remain in contexts that, for the most part, appear to be disadvantageous or even harmful to individuals and their families. To respond to global calls for national level action on reconfiguring their energy mix to a balance of more sustainable sources [2,11,95–97], countries will encounter several challenges caused by place attachment. Energy transitions of the scale posed by global emissions targets will disrupt the make-up of many regional and local economies. Coal regions in particular will face considerable pressure to ramp-down, demobilise and adapt to new economic modalities [98–100]. In any of these scenarios, the willingness and ability of people to move, and re-establish social and economic connections will be central to the inevitable success or failure of the transition agenda. This applies not only to post-mining communities but to any landscape that is heavily impacted by industrialisation.

Our PAHIL conceptual framework depicted in Fig. 5 contains three layers of identification, categorisation, and analysis. By examining local conditions and the attributes of individuals, we argue that it is possible to predict the character and composition of place attachment 'bundles', or in other words, the balance of which particular set of attractors or

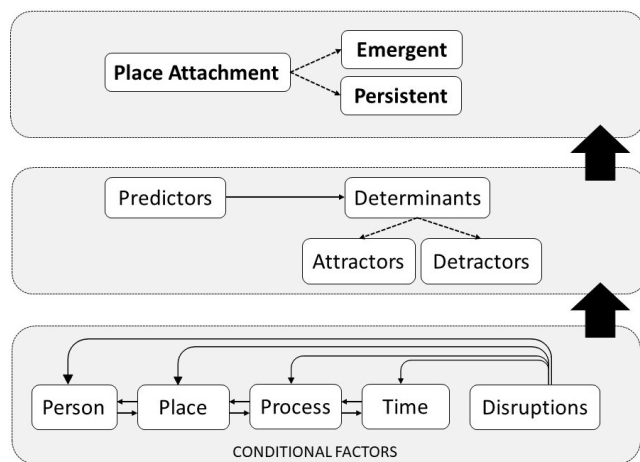


Fig. 5. The conceptual framework of place attachment in heavily industrialized landscapes (PAHIL).

detractors. This set can be regarded as determining the type or types of place attachment that one may find amongst individuals in a given place. For our purposes and based on the analysis of the case study sites, we distinguish two types of place attachment: *emergent* and *persistent*.

*Emergent types of place attachment* tend to have fewer attractors and detractors contributing to an overall smaller bundle of determinants. Determinants are directly linked with the activities of the mining development which in the initial stages register as “positive” (i.e. attractors) but as their value decreases with the general prospects of the mining economy, these same items in the bundle can become ostensibly “negative” (i.e. detractors). Despite their negative quality, detractors can function to fix people in place with the same structure and force as attractors and should, for this reason, be considered to be of equal significance in understanding place attachment. One obvious example of a negative determinant is property debt, where an individual’s or a household’s mobility can be impaired as a result. We refer to this type of place attachment as *emergent* because attractors most commonly surface around discrete developments and opportunities, such as large manufacturing plants or mining projects.

*Persistent types of attachment* can be built from the same general set of determinants. The fundamental point of difference is that the ‘bundle’ is noticeably more diverse in its composition. The diversity of attractors and detractors creates resilience in the face of sudden change and means that the sense of place attachment held by a person is not dependant on a single entity or economic activity. In the case study we examined for our research, the majority of determinants existed prior to the development of the mining project. A key observation is that while individuals with a persistent type of attachment shared otherwise important attractors and detractors, such as employment or property ownership, these determinants were markedly less influential compared to individuals with emergent place attachments. The conditional factors: person, place, process, time, disruption provide the circumstances that can shape the function of individual determinants. In short, these factors serve to *condition* the quality and contributing value of the determinants. It draws a clear distinction across these factors between spatial, temporal, individual and processed based dimensions that are otherwise present in place attachment theory, but not effectively mobilised or explicit in their purpose.

Our findings suggest that both attractors and detractors can persist as a bundle over time and place. Transferability was demonstrated in two novel ways through the participant responses. First, participants who were born in the places of interest held attachment bundles that were remarkably close in content and description to those of their older relatives. Many of the references made to the aesthetics and use of space were not encountered first-hand but were transmitted through

socialisation and kin networks. Primarily these were expressions of nostalgia. Second, participants born outside of the places of interest carried notions of attachment with them. For people who previously resided in a nearby town with similar cultural, linguistic, historical, and economic characteristics, these notions were easily trans-fixed. In some instances, migrants from nearby towns from within the same regions, demonstrated persistent attachments akin to the intergenerational cases mentioned above.

## 7. Significance for sustainable transition

Transition outcomes are contingent on a wide range of variables. Local acceptance and willingness to change is largely untested but should be regarded as one of the defining factors with respect to the feasibility of transition proposals. The economics of energy transition policies materialise locally in ways that have immediate consequences for policy makers and corporations who may be planning at regional or national scales [101]. Place attachments are a key variable at local scale. Much of the foregoing research has served to understate the potential for negative attachments to form and their lock-in effects over time. These insights are of increasing value for researchers given the likely ramifications of global energy policy on local settings, like coal-mining towns. Our framework provides the conceptual basis for understanding the positive and negative motivations for continuing residency or a reluctance to migrate. This level of conceptual differentiation is pivotal to achieving the types of policy outcomes touted in the international arena. Whatever inherent qualities a transition policy may have, the overarching determinant in democratic societies is whether initiatives can attract the necessary buy in from those citizens who are most likely to be affected by the change.

The findings from this article demonstrate the importance of disaggregating place attachment bundles as a means of establishing the balance of attractors and detractors that influence individual mobility and decision making. In the first instance, the composition of place attachment determinants reveals how individuals trade off specific place-based advantages and disadvantages. Second, by disaggregating attachment bundles it is possible to identify “push” and “pull” determinants and their effect on leave-remain decisions. Third, place viability is not only shaped by population size, but economic mix. Avoiding boomtown-ghost town scenarios must be prioritised as part of the overarching sustainability logic. Our collective ability to predict changes in population and activity thresholds is enhanced by examining conditional factors and place attachment determinants.

Energy transition will involve a re-orientation of market activities that will inevitably require people to move and adapt [102]. The content of place attachment bundles provides insights into critical questions, such as: who is inclined to remain and who will leave, and under which circumstances? The configuration, and timing, of incentives was prominent in our findings; and is a key piece of the sustainability puzzle in terms of matching individual and social constraints with long-range policy goals.

## 8. Conclusion

Notions of place attachment are central to many, if not all, of the key themes present in the current just transition debate. Changes that affect the economic foundations of a region will ultimately test the substance and strength of place attachments. At the same time, regional and local scale initiatives aimed at either promoting, resisting – or responding to the negative effects of transition must account for these highly localized sets of attachments. Globally, the energy transition movement seeks to promote awareness of the environmental constraints present in the international economy, in particular those related to fossil energy use and climate change. Forging change beyond the global and national levels will require policy makers to tackle some of the most difficult aspects of the just transition question: the social, economic, behavioural, and

psychological dimensions of individual decision making.

The transformation of coal mining regions, as part of this movement, will inevitably involve exploring a range of economic alternatives. In the current age, it is highly unlikely that all industrial alternatives will be dismissed, and that towns will be forced to “return to nature”. Our research findings indicate that place attachments are dynamic and transferable, meaning that under the right conditions, people can positively adapt to industrial alternatives, even when such alternatives introduce major disruptions to their surrounds. Likewise, our findings reveal the novel importance of negative attachments, or detractors, and the constraints they impose of individuals, households and ultimately planning efforts when viewed at scale.

The case study example presented in this article demonstrates the resilience of attachment bundles to near-proximity industrial change, but also through the tale of two towns, shows the threshold limits of change and their impact on individual attachments and collective quality of life. Further research in other jurisdictions, and indeed in other sectors, is needed to more fully appreciate the function of attachments in the face of major structural adjustments. This includes the testing the dynamics between individual determinants over time as a means for establishing the influence of conditional factors and the contribution that particular kinds of industrial activity have in driving specific attachment outcomes. Finally, the PAHIL conceptual framework highlights the extended utility of place attachments once long-held biases about ‘types’ and ‘places’ are removed. This shift engages both “the good and the bad” in terms of the functionality of attachments, and brings a range of heavily industrialised landscapes, such as coal mining installations, into the picture.

#### Declaration of Competing Interest

The authors 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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