Life after Coal

by Kateryna Martovytska

Submission date: 30-Aug-2019 03:04PM (UTC+0100)
Submission ID: 110385936
File name: 64493_Kateryna_Martovytska_Life_after_Coal_1212390_1790619645.pdf (22.36M)
Word count: 21956
Character count: 159404

Major Research Project

LIFE AFTER COAL

Exploiting the above and below ground legacy of mining to give former mine locations a reviewed role at the heart of former mining communities.

Student: Kateryna Martovytska
Supervisor: Colin Haylock
UCL
Barlett School of Planning
MSc Urban Design and City Planning
2019

UNIVERSITY COLLEGE LONDON
FACULTY OF THE BUILT ENVIRONMENT
BARLETT SCHOOL OF PLANNING

MAJOR RESEARCH PROJECT

Exploiting the above and below ground legacy of mining to give former mine locations a reviewed role at the heart of former mining communities.

MARTOVYSTKA KATERYNA
(BSc International Business; BSc Economics of Enterprises)

MAIN TEXT WORD COUNT: 8250
VISUAL MATERIALS WORD COUNT: 2130
APPENDICES WORD COUNT: 400

Being a Major Project in MSc Urban Design and City Planning submitted to the faculty of The Built Environment as part of the requirements for the award of the MSc (course – Urban Design and City Planning or Sustainable Urbanism) at University College London, I declare that this project is entirely my own work and that ideas, data and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

Date: 02/09/2019

Signature:

ABSTRACT

Areas of coalfields suffer from social, economic and environmental issues caused by the legacy of the industrial era. Despite the numerous attempts to regenerate those areas- the substantial amount of jobs to replace disappearing coalfield employment was not achieved and high dependence on the single industry did not support fast and efficient relocation (Foden et.al. 2014). In addition to that, demographics of coalfields was also affected and currently, the population growth is significantly below the UK average. Riva et.al. (2011) in their research pointed on the lower health status of coalfields associated with higher mortality rates and higher long-term illnesses rates.

Environmental issues are also considered as a negative legacy in former mining areas. Key environmental challenges may include the mine accidents, wastewater damages, mining waste disposal, land movement and subsidence, air pollution and others (Zhengfu et.al. 2010).

The main purpose of this study is to exploit mining legacy elements and to give a renewed purpose to the post-mining areas, as well as achieve socio-economic growth and environmental recreation.

Such outcomes are aimed to be achieved by the development of designated use of new energy facilities in place of the former mining site. In addition to that, the paper emphasises the vital importance of the preservation of the physical environment, that will help to save the mining culture, which is meaningful for the local community and can be shared with visitors.

Drawing on the extensive analysis of issues, literature, case studies, and technologies - this research aims to develop a toolkit, that will help to transform existing issues in the post-mining areas into a series of opportunities, outcomes of which will be celebrated by various groups of stakeholders.

ACKNOWLEDGEMENT

Thank you ...

- to my hometown Donetsk, which was founded by Welsh businessmen John Hughes, that has developed a steel and coal manufacturing
- my father with 27 years of experience in mining, who has introduced me to this industry and taught me about the mining culture and miners' pride
- my mum, who has been supporting me throughout this journey
- my supervisor Colin, who have shared my passion and interest in mining and helped me to progress with this research, as well as introduced me to the mining in the UK
- my friends, Omri, Lily, Yuan, Stefan, and Jessi, who shared their knowledge, taught me graphics and always supported me in long days and nights of studies with a great laugh
- UCL for this great experience, knowledge, connections and lifetime friends.
- and thank you for reading this research

CONTENTS

INTRODUCTION 09-24

1-1 INTRODUCTION AND RESEARCH PROBLEM....9
1-2 COAL-MINING IN THE UK....10
1-2-1 About coal-mining....10
1-2-2 History of the coal-mining....11
1-3 PATTERNS OF MINE CLOSURE....12
1-4 ISSUES AFTER THE INDUSTRY CLOSURE....13
1-4-1 Economic issues....13
1-4-2 Social issues....13
1-4-3 Health issues....14
1-4-4 Cultural issues....15
1-4-5 Environmental issues....17
1-4-6 Summary of identified issues....21
1-5 CURRENT ATTEMPTS FOR REGENERATION....22
1-6 ABOUT THE RESEARCH....23
1-6-1 Research problem....23
1-6-2 Research question....23
1-6-3 Research objectives....23
1-6-4 Research methodology....24
1-6-5 Research originality....24

LITERATURE REVIEW 27-30

2-1 INTRODUCTION....27
2-2 LEGISLATION AND KEY STAKEHOLDERS....27
2-3 MINE CLOSURE & RESIDUAL PHYSICAL ENVIRONMENT....28
2-4 REGENERATION STRATEGIES....28
2-5 REGENERATION TECHNOLOGIES AND NEW USE....29
2-5-1 Land Reclamation....29
2-5-2 Mine Water Treatment....29
1-5-3 New energy developments....29
1-6 LITERATURE LIMITATIONS....30
1-7 SUMMARY AND KEY FINDINGS....30

CASE STUDIES 33-40

3-1 INTRODUCTION....33
3-2 CASE 1: DAW MILL COLLIERY,UK....34
3-3 CASE 2: RUHR-AREA REGENERATION, GERMANY....35
3-4 CASE 3: NORD-PAS-DE-CALAIS, FRANCE....36
3-5 CASE 4: IKESHIMA AND HASHIMA, JAPAN....37
3-6 CASE 5: GEN COEL, HEERLEN, HOLLAND....38
3-7 CASE 6: EDEN PROJECT, UK....39
3-8 SUMMARY AND KEY FINDINGS....40

TOOLKIT DEVELOPMENT 43-44

4-1 KEY FINDINGS FROM LITERATURE AND CASE STUDIES....43
4-2 TOOLKIT DEVELOPMENT....43
4-3 SITE-SPECIFIC CRITERIA....44

SITE SELECTION & ANALYSIS 47-58

5-1 SITE SLECTION....47
5-1-2 Selected site....48
5-2 SITE ANALYSIS....49
5-2-2 History of Stainforth....49
5-2-3 Demographics, employment, and health....50
5-2-4 Land Use....51
5-2-5 Movement....52
5-2-6 Green areas....53
5-2-7 Physical and environmental analysis....54
5-2-8 Points of attraction....55
5-3 HATFIELD MAIN COLLIERY....56
5-4 SUMMARY: OPPORTUNITIES AND CONSTRAINTS....58

DESIGN DEVELOPMENT 61-68

6-1 INTRODUCTION....61
6-2 CONCEPT ALTERNATIVES....62
6-3 OBJECTIVES AND APPLICATION OF THE TOOLKIT....63
6-4 CONCEPT MASTERPLAN....64
6-5 DESIGN AND OBJECTIVES....65
6-6 PHASING AND EVALUATION....68

CONCLUSION 70

Objectives, limitations, answering the research question....70

REFERENCES 72-75

A-C....72
D-J....73
K-S....74
T-Z....75

APPENDICES 78-81

1.Social, Economic & Health Statistics for CoalfielDs....78
2. Mine Closure planning....79
3. Transformation of mine into pumped-hydro facility....79
4. Stainforth: Listed buildings....80
5. Hatfield Colliery: Facts....81
6. Stainforth: energy pylons....81
7. Risk assessment....82

List of Figures

1.1. Research Plan....9
1.2. Major Coalfields and Distribution of Coal Resources in the UK 10
1.3. Historic Timeline, combined with production, imports, and employment rates in the coal-mining industry in the UK....11
1.4. The pattern of pit closure in the UK VS Responsible pit closure principles....12
1.5. Major Coalfields....13
1.6. Claimant rate....13
1.7. Comparative Infographics for Socio-Economic Issues 13
1.8. Start-up rate 14
1.9. Life Expectancy 14
1.10. Collage: Culture of mining and its connection to the mining site....15
1.11. Classification of the Environmental Impact of coal-mining activity....17
1.12. Air pollution 17
1.13. Contaminated soil....18
1.14. Mining site explained (the process of coal production) 19
1.15. The process of coal consumption (from coal extraction, transportation to coal combustion)....20
1.16. Summary of identified issues....21
1.17. Analysis of regeneration activities and attempts in former mining towns (Barnsley, Fife, Stanley)....22
1.18. About the research Pt.1 23
1.19. About the research Pt.2....24

2. Literature group 1....27
2.2. Mining: Key Stakeholders and regulation....27
2.3. Types of Conservation/Liquidation....28
2.4. Literature group 2: regeneration strategies....28
2.5. Literature group 3: Regeneration technologies and new use....29
2.6. Key Findings from the literature....30

3.Map of analysed case studies....31
3.2. Case Studies: selection, analysis, and outcomes....33
3.3. Mining site with physical facilities....34
3.4. Land Reclamation 34
3.5. Option 1: Business Park....34
3.6. Option 2: New sustainable residential community....34
3.7. Case 1 against identifying issues....34
3.8 Case 2 against identifying issues....35
3.9. German mining museum....35
3.10. Ruhr culture hub 35
3.11. Essen: Solar panels....35
3.12. Pas-de-Calais: Methane extraction....36
3.13. Mining museum in Lewarde community....36
3.14. Coal Bed methane extraction....36
3.15. Case 3 against identifying criteria 36
3.16. Case 4 against identifying issues 37
3.17. Ikeshima island....37
3.18. Hashima island 37
3.19. The Heerlerheide Centre 'Gen Coel' complex....38
3.20. Geothermal energy and mine....38
3.21. Case 5 against identifying issues....38
3.22. Case 6 against identifying issues....39
3.23. Eden Project: before 39
3.24. Eden Project: after 39
3.25. Eden project's international ambitions in China, Dubai, and Australia....39
3.26. Eden Project: geothermal energy station 39
3.27. Proposed energy system....39
3.28. Case studies: potential change of landscape and key takeaways....40

4. Summary of the Toolkit....43
4.2. Toolkit: Phases and outcomes....44

5. Selection map 47
5.2. Site selection criteria application....47
5.3. Stainforth map 48
5.4. Stainforth: History 49
5.5. Demographics....50
5.6. Household income....50
5.7. Unemployment rate 50
5.8. Social grades 50
5.9. Education and Qualifications 50
5.10. Occupation 50
5.11. General Health 50
5.12. Land use....51
5.13. Vehicle movement 52
5.14. Public transport 52
5.15. Pedestrian movement 52
5.16. Cycle map 52
5.17. Green areas....53
5.18. Flood risk 54
5.19. Methane concentration 54
5.20. Biodiversity and habitats 54
5.21. Topography 54
5.22. Points of attraction 55
5.23. Demolished historic landmarks and people's comments 55
5.24. Attraction point 1: Hatfield Colliery (Social media analysis) 56
5.25. Hatfield Colliery: Physical environment 57
5.26. Summary: Opportunities and Constraints 58

6.. Introduction and aim of the chapter....61
6.2. Concept 1: Local Council's vision....62
6.3. Concept 2: Life after mining....62
6.4. Objectives and tools 63
6.5. Concept masterplan 64
6.6. Concept design for preservation and history....65
6.7. Mining site: Before....65
6.8. Mining site: After....65
6.9. Concept design: methane extraction and geothermal plant 66
6.10. Concept design: Hydro-pumping and energy station 66
6.11. Points of attraction and new employment 67
6.12. Proposed connections....67
6.13. Phasing, character areas, and evaluation....68

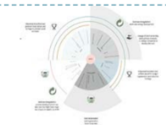
List of Tables

1. Research and methodology 7

01 INTRODUCTION

1-1 INTRODUCTION AND RESEARCH PROBLEM **9**
1-2 COAL-MINING IN THE UK **10**
1-2-1 About coal-mining 10
1-2-2 History of the coal-mining 11
1-3 PATTERNS OF MINE CLOSURE **12**
1-4 ISSUES AFTER THE INDUSTRY CLOSURE **13**
1-4-1 Economic issues 13
1-4-2 Social issues 13
1-4-3 Health issues 14
1-4-4 Cultural issues 15
1-4-5 Environmental issues 17
1-4-6 Summary of identified issues 21
1-5 CURRENT ATTEMPTS FOR REGENERATION **22**
1-6 ABOUT THE RESEARCH **23**
1-6-1 Research problem 23
1-6-2 Research question 23
1-6-3 Research objectives 23
1-6-4 Research methodology 24
1-6-5 Research originality 24

INTRODUCTION

CHAPTER	SUBJECT	SOURCES	METHODOLOGY
INTRODUCTION	History of coal mining in the UK The pattern of pit closure Issues related to pit closure Identifying issues of the project About the project	ONS, The Coal Authority Northern Mine Research Society Digimap	 Contextualisation Problem identification (Literature, data review,current attempts for regeneration) Lifecycle Assessment
LITERATURE REVIEW	Legislation and key stakeholders Residual physical environment Regeneration strategies in post-industrial towns Regeneration technologies in post-mining towns Literature limitations	The Coal Authority World Bank UN Google Scholar EBSCO	Physical environment assessment regeneration strategies regeneration tools site selection criteria
CASE STUDIES	Cases of post-mining regeneration	The Coal Authority Google Scholar EBSCO	site selection criteria development of the toolkit opportunities and constraints
TOOLKIT DEVELOPMENT	Development and presentation of the toolkit Phasing for the application of each tool		 Contrasting tools and issues
SITE SELECTION AND ANALYSIS	Development and presentation of the toolkit Phasing for the application of each tool	Digimap British Geological Survey Breezometer Strava ONS Doncaster Council	 application of site selection criteria

CHAPTER	SUBJECT	SOURCES	METHODOLOGY
IMPLEMENTATION OF THE TOOLKIT	design development phasing evaluation	Case studies Literature review	 Implementation of the toolkit concept plan development
CONCLUSION	summary of the research research limitations research question		

*** There were no ethical issues, nor risks at the time of this research*

INTRODUCTION

Introduction and Research Problem

RESEARCH PURPOSE

The aim of the transformation of former coal-mining towns might be treated as not original, because the majority of people are aware of the issues, specifically about the time when mining unions were trying to save their jobs, families, and pride. However, analysing more and more literature and case studies- it became obvious that successful case of mining transformation, which will help to solve socio-economic and environmental issues, yet retaining and re-establishing culture and sense of ownership within mining community are exceptional cases, rather than common tendency. Mayors, private consultancies, new investors and other stakeholders are rapidly replacing former collieries' sites with new housing developments or business parks. So, if the topic is not novel- why we are ignoring the fact, that new development is not solving specific, yet obvious issues in those areas?

The purpose of this research is to in-depth analyse issues of mining closure and its impact on urban areas, explore alternative opportunities of the use of former mining sites and how they can help to regenerate industrial urban areas, as well as show on selected intervention site, which benefits can bring new design toolkit for towns with similar issues.

RESEARCH QUESTION

The research question has evolved from the general "How can issues that grew from the post-mining heritage be transformed into a series of opportunities,drawing on the existing physical environment, which will promote better living and help to achieve the growth, which will be celebrated in urban areas?" to the final "How can the former mining area, which was a center of the life and economy of mining town be exploited and developed to have a new role as a central focus in the future life and economy of town?"

RESEARCH PLAN AND INTRODUCTION TO METHODOLOGY

Figure 1 illustrates the research plan, which guided the first stages of the development of this project.

The first part focuses on the analyses of issues from various resources, including academic publication, primary and secondary data provided by ONS, The Coal Authority, House of Commons and other sources. As well methodology for the first part includes the analysis of existing practices of regeneration of coal-mining sites, whereby the author has analysed Local Councils' publications, Developers' strategic plans, and international frameworks for sustainable mining closure, such as guide developed by International Council of Mining (2018).

Later on, there was analysed literature and local and international case studies, which helped to develop site selection criteria and form a toolkit.

Finally, the application of the toolkit to the selected site is based on the analysis of site similarly to the analysis of common issues in the introduction part, whereby the same methodology was utilised. In addition to these methods, the author has conducted a site visit and an analysis of social media and a short interview to help to prove the necessity for the intervention.

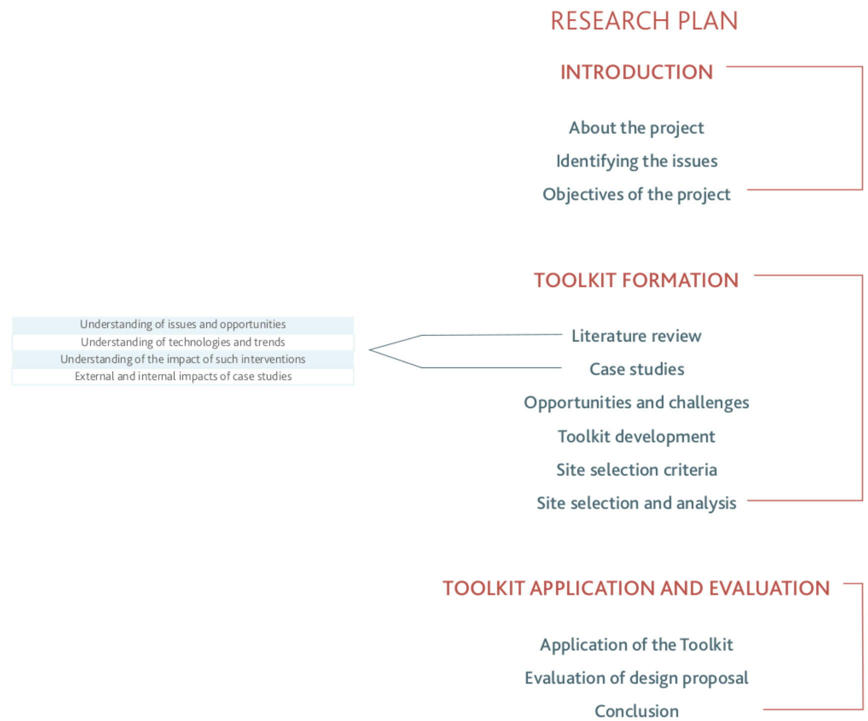


Figure 1. Research Plan

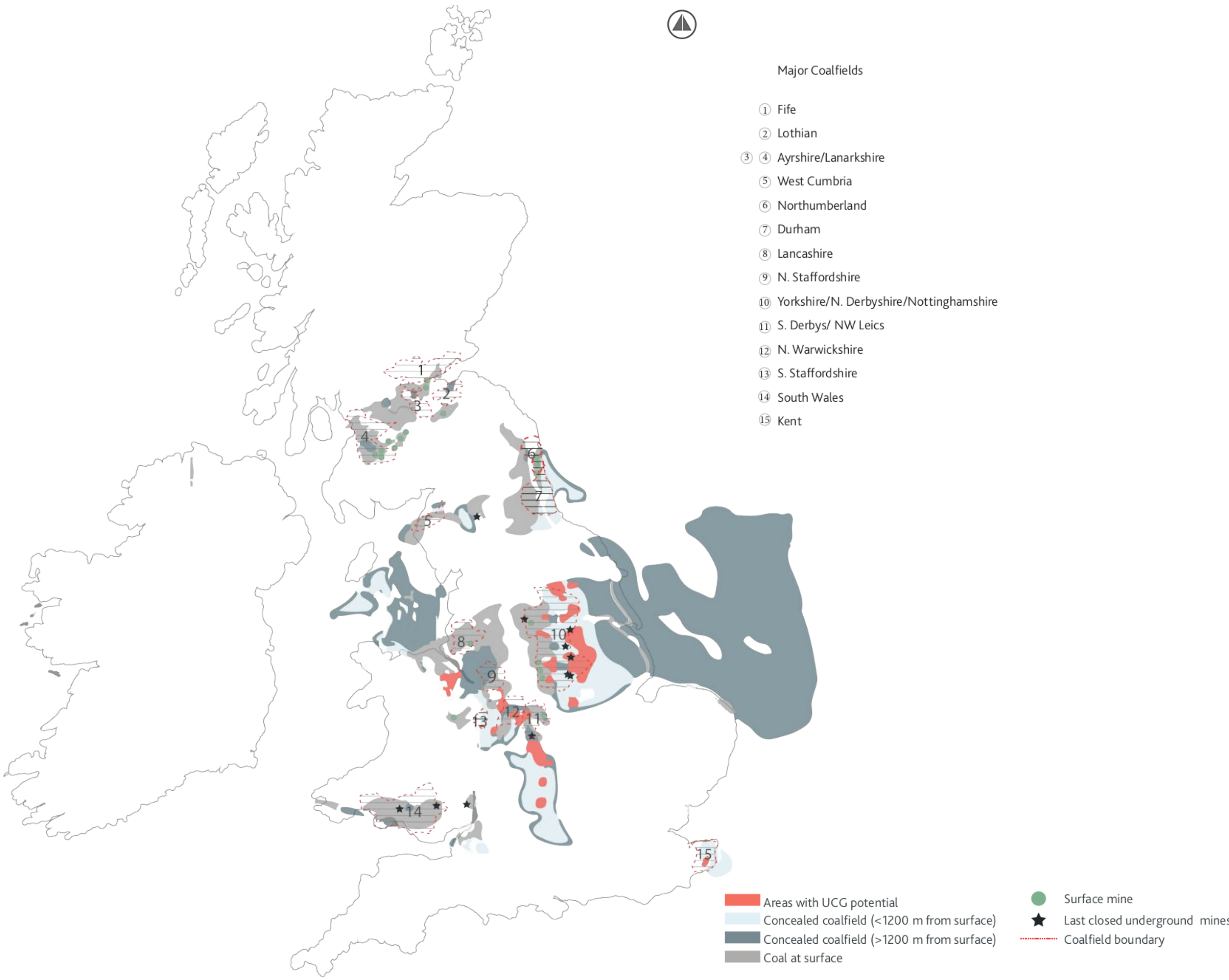


Figure 1.2. Major Coalfields and Distribution of Coal Resources in the UK(Coal Authority 2014; Northern Mine Research Society n.d.)

INTRODUCTION

History of the coal-mining in the UK

British coal mining industry traces its routes to Roman times, whilst in the 17th century, there were already established shaft with trunks and trading ventures to pursue interests' coal-miners, specifically families, who owned them (National Archives 1545-1652). Slowly but steady, by the time of Industrial revolution coal became according to Willian Stanley Jevons (1870) "the factor in everything we do". Such emancipation in natural resources and engineering grew by fuelling steam engines with an even greater amount of coke. Expanding railway network, shipping and availability of heat and lighting from coal gas lead to the creation of largest economy and a whole civilization based on mineral fuel and fuel "hungry" steam engines of iron industry (Hayman 2016).

Peaking in 1913 the UK produced 292 million tonnes of coal, employing 1.11 million people (Ritchie 2019; Coal Authority 2019). The Jevons effect has lasted almost up to the 1960th and coal remained one of the main sources of energy. However, much faster than it became one of the key industries coal was removed by oil. There were several waves of mine closure in the 1950s and 1960s, but the mass enclosure has started in 1984, which led to one of the largest industrial actions in history (The miners' strike 1984-85).

In 2015 Kellingley Colliery was closed ending the history of deep-mining in the UK (BBC 2016). The coal production figure dropped by 100 times, whilst the employment by 2000 compared to the industry peak. Causing the negative socio-economic impacts, rapid mining enclosure caused not simply ghosting former industrial landscape, rather the whole elimination of it, which takes even culture, education and even the language of the "goaf".

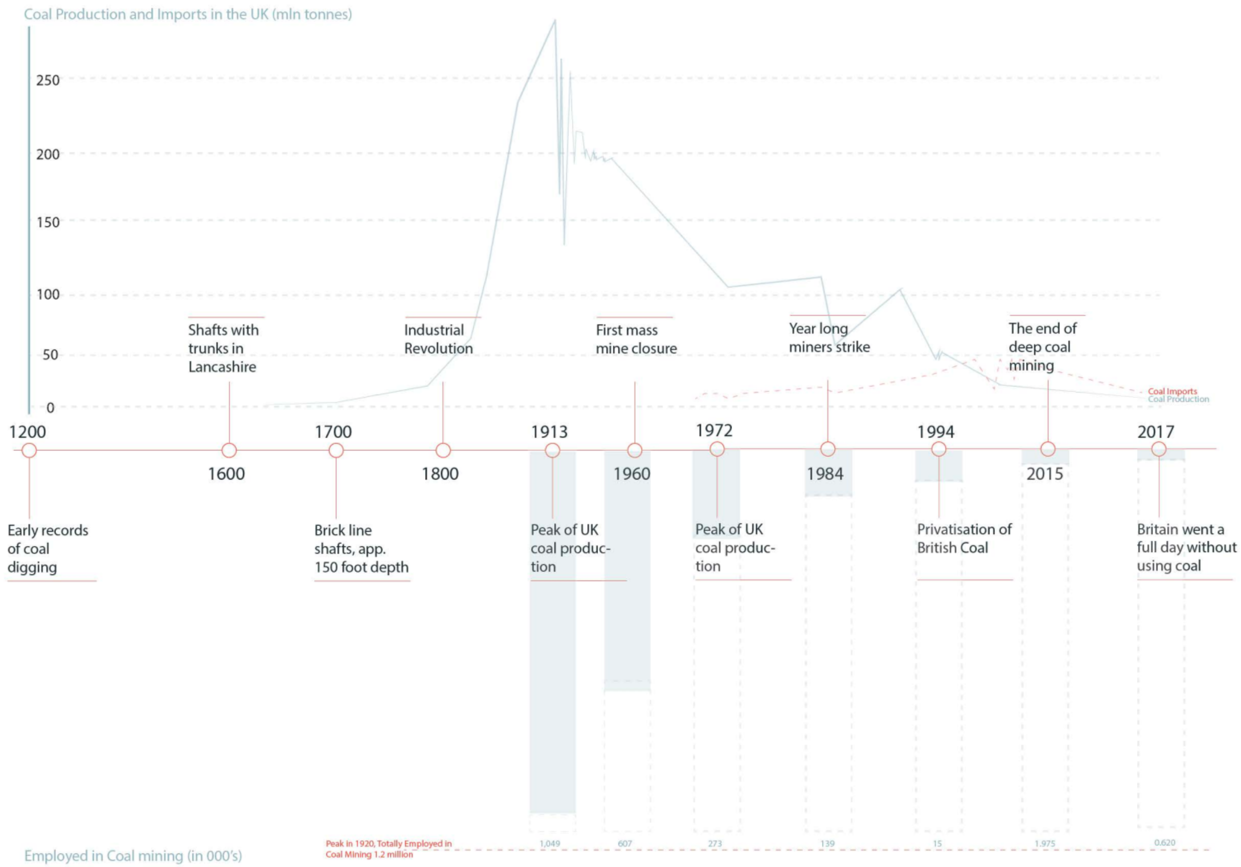


Figure 1.3. History combined with production, imports, and employment rates in the coal-mining industry in the UK (The Coal Authority 2017)W

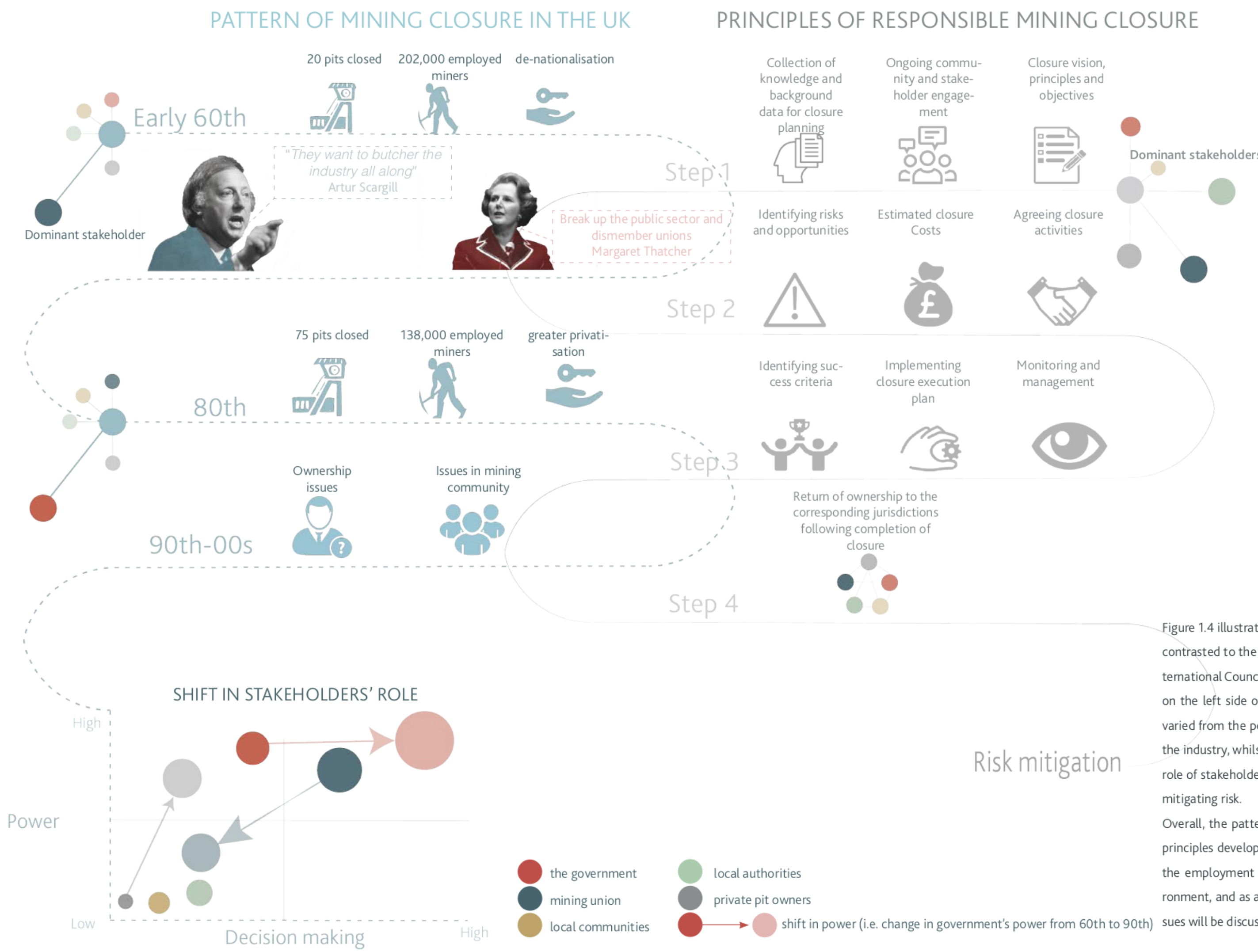


Figure 1.4. The pattern of pit closure in the UK VS Responsible pit closure principles(ICMM 2019)

Figure 1.4 illustrates the pattern of mining closure in the UK, which is contrasted to the mine closure guide, that was developed by the International Council of Mining and Metals (ICMM 2019). As it is shown on the left side of the figure the dominant stakeholder's in the UK varied from the power of unions to the full control of the state over the industry, whilst according to Toms (2014) and Seddon (2013) the role of stakeholders' should be balanced and equal, which will allow mitigating risk.

Overall, the pattern of closure in the UK does not echo with basic principles developed by ICMM, which has resulted in the absence of the employment substitution, demolition of mining physical environment, and as a result deprivation of mining areas. More of the issues will be discussed in the following chapter.

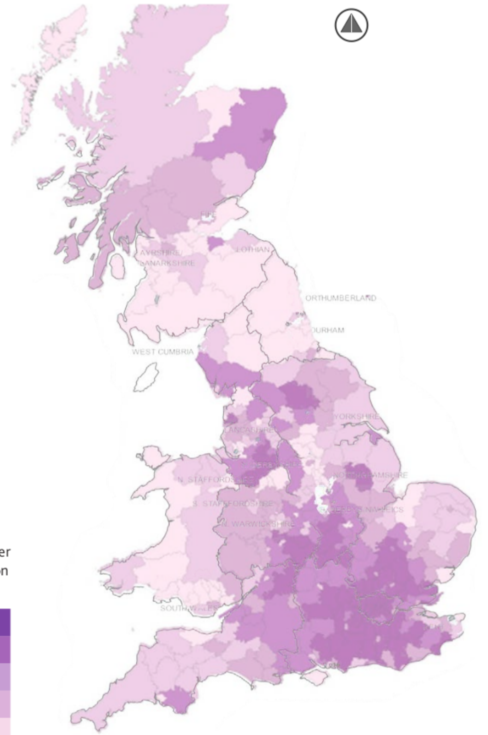


Figure 1.8. Start-up rate (House of Commons 2014)

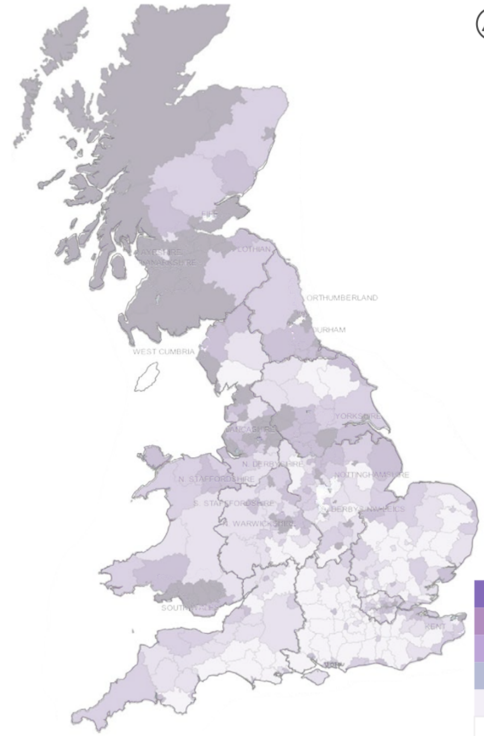


Figure 1.9. Life Expectancy (ONS 2012)

Interestingly, according to Power and Wilson (2000) "clustering is by definition an urban problem", which leads to a greater social and economic issues like poverty. According to the research, the highest poverty rates in London and Great Britain are in industrial or post-industrial areas (2000, p. 6). So, will similar issues be faced by knowledge, tech clusters or cities that currently depend on universities, as a major source of economic activity?

HEALTH ISSUES

Figure 1.9 illustrates life expectancy in the UK, where we see that most of the coalfields tend to have the lowest life expectancy (ONS 2012).

In addition to that Appendix 1 provides an average data for the general health in coalfields, where "bad or very bad health" state is significantly higher in coalfields compared to the UK average. Whilst the percentage of the population with long-term health problems is also higher in coalfields that the UK average (ONS 2012; Census 2011).

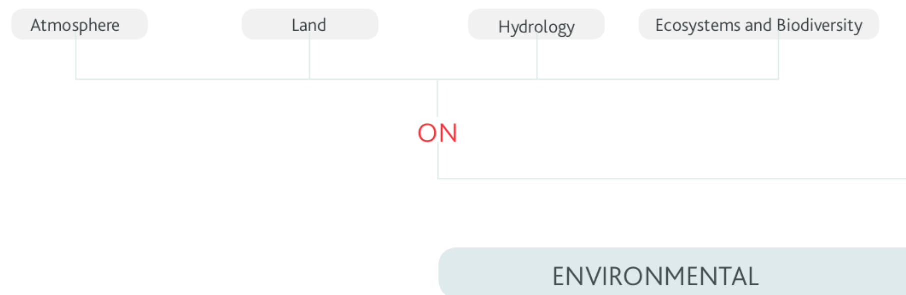
INTRODUCTION

Environmental issues

The majority of the early literature analyses the environmental issues from aroused from coal-mining activity (Chadwick, Highton and Lindman 2013; Younger 2004; Zhengfu, et.al. 2010). Following Chapter will overview environmental issues caused by and left after coal-mining.

*Note: The environmental effects described below are not homogeneous and mainly dependent on the mining closure process and its management.

Based on Chandwick's et. al. (2013)- we can develop two types of classification of environmental issues, illustrated in Figure 1.11. The first classification is based on the impact of coal-mining **on** certain aspects of the neighbouring physical environment. Therefore, the mining activity may cause a negative impact on: atmosphere, land, hydrology, ecosystems, and biodiversity. Other environmental issues arise **from** specific mining activity. For example, those that arise from coal production, which includes coal extraction and transportation and those that arise from coal consumption including coal combustion and conversion.



ATMOSPHERE

Usually dangerous levels of air pollution are spotted in coal-burning areas, rather than the mining site itself. However, still there can be identified some atmospheric issues caused by the coal-extraction activity. The main source of air pollution from collieries is caused by emissions of methane, sulphur dioxide, nitrogen oxides, and carbon monoxide. In addition, Goswami (2015) points on the negative impacts on the atmosphere of underground blasting, which causes noise pollution and increases air pressure.

LAND

The process of deep coal-mining (below 700 meters) is known to have a low impact on the surface. In contract surface mining has a greater effect on land and may lead to land disturbance followed by negative impacts on the environment, as well as a negative impact on the value of land (Chanwick et.al. 2013; Pivnyak 2015).
More specifically underground coal extraction may also lead to land disturbance and in contrast to surface mining the affected land is more difficult to restore due to the specify of industrial activity. However, restored land may be suitable for agriculture, forestry, construction, wildlife habitats and bring a greater amount of socio-economic benefits, which will be overviewed in case studies section, as well as the design proposal itself.

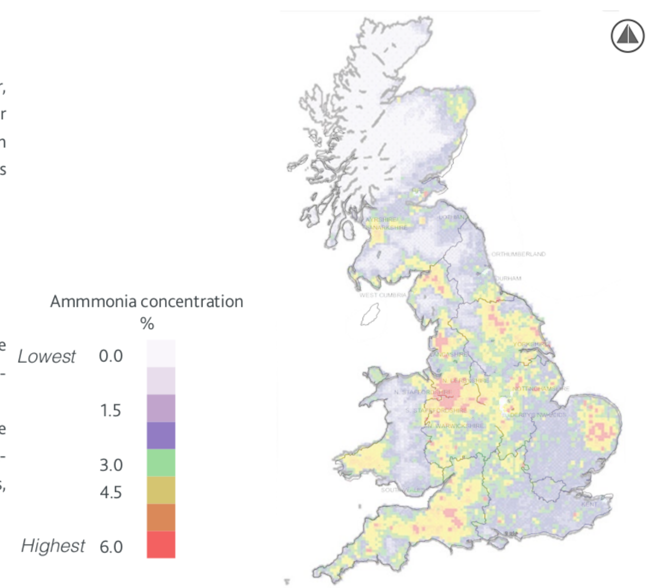


Figure 1.12. Air Pollution (Opal 2018)

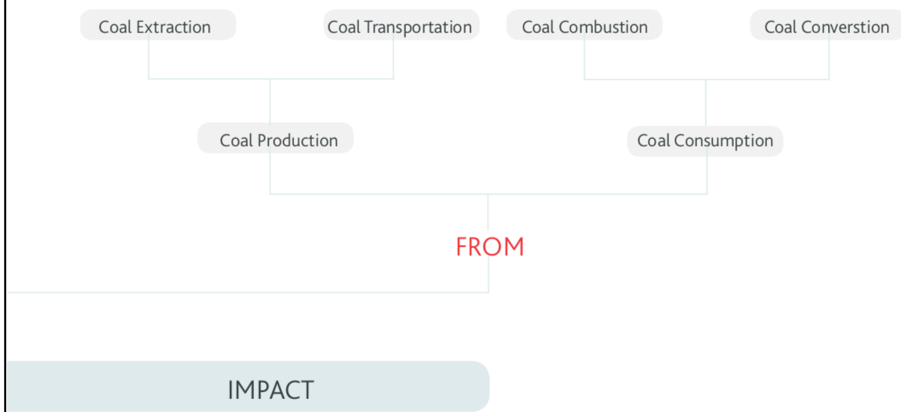


Figure 1.11. Classification of the Environmental Impact of Coal-mining activity

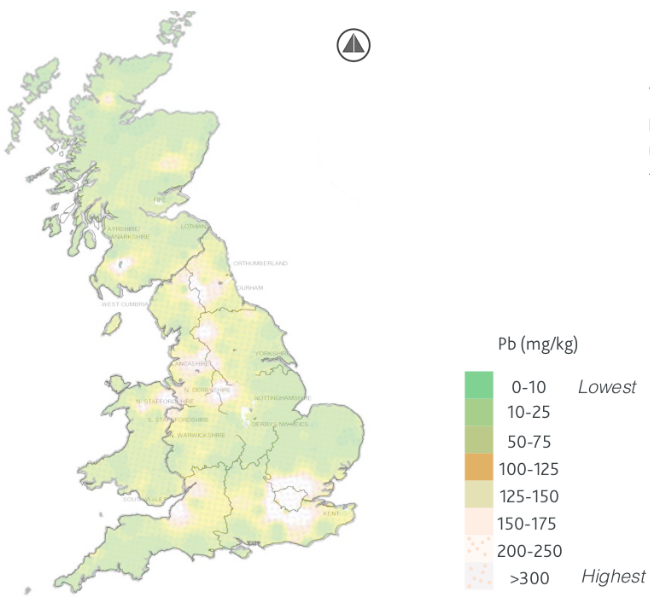


Figure 1.13. Contaminated soil (House of Commons 2017)

HYDROLOGY

Generally, the term "mine water" can be referred to all waters affected by active, abandoned or closed surface or deep-coal mines (Wolkersdorfer 2005). According to the Environmental Agency (2008) report, around nine percent of rivers in England and Wales and two percent of rivers in Scotland are not able to meet Water Framework Directive targets due to former mining activity in regions of presence (European Commission 2016).
One of the biggest issues present in the areas with post-mining activity is the contaminative mine drainage waters, resulted from stopped water pumping, which can cause a major hydrogeological or geochemical problem (Banks et.al. 1996). As the water pumping has stopped- the iron, found in rocks of mine workings mixes with underground water, while at the mine water reaches the surface contacting the air- the iron in the water changes state creating a situation called "acid mine drainage" (The Coal authority n.d.). Another negative impact on the hydrogeological environment may include flooding of the low-lying areas, rapid groundwater pathways, fall of shallow workings and elevated mine gas emissions (Banks et.al. 1997). However, according to Banks (1997) problems of mining water can be addressed through technologies and treatment techniques, which will be discussed in the Chapter of the Toolkit development.

ECOSYSTEM AND BIODIVERSITY

The most significant impacts on ecosystems and biodiversity come from coal residues, while because coal ash contains potentially dangerous substances. The undesirable environmental effects are dangerous for forestry and grassland, natural and semi-natural ecosystems (Adriano, et.al. 1980). Ecosystems and biodiversity are essential for maintaining the life process, provide climate regulation, and regulate proper functioning of the soil structure (Lindeijer 2000).

INTRODUCTION

Environmental issues

Figure 1.12 illustrates the mining production. This research focuses on the deep-coal mining activity and therefore will describe issues associated with this type of coal production.

IMPACT FROM COAL PRODUCTION

The major impact of coal extraction is caused by topography and might cause subsidence of land surface, which results from the collapse of the overlying rock strata (Allgaier 1997). According to Bell at.al. (2001) following negative impacts of coal extraction may include: lowering of the topography, deep pit cracks, as well as steep offsets. However, some of the authors, such as Pivnyak (2015) point that deep coal-mining has a lower impact on the surface, yet still, in the long run, changes the components of the natural environment (Howladar 2016).

Another element of coal production illustrated in Figure 10 is coal transportation. Coal can be transported in various ways including railway, truck, barge, conveyor, etc. According to Martin (n.d.), the majority of transportation methods lead to the release of air pollutants, which in turn leads to health issues including stunted lung development and fatal cardiac rhythm disturbances. The main emissions of concern from coal-mining transportation are greenhouse gases and dust. Overall, coal removal, overburden removal, and transport emissions are the largest contributors to GHG emissions and fossil fuel depletion (Sloss 2011; Appendix 2).

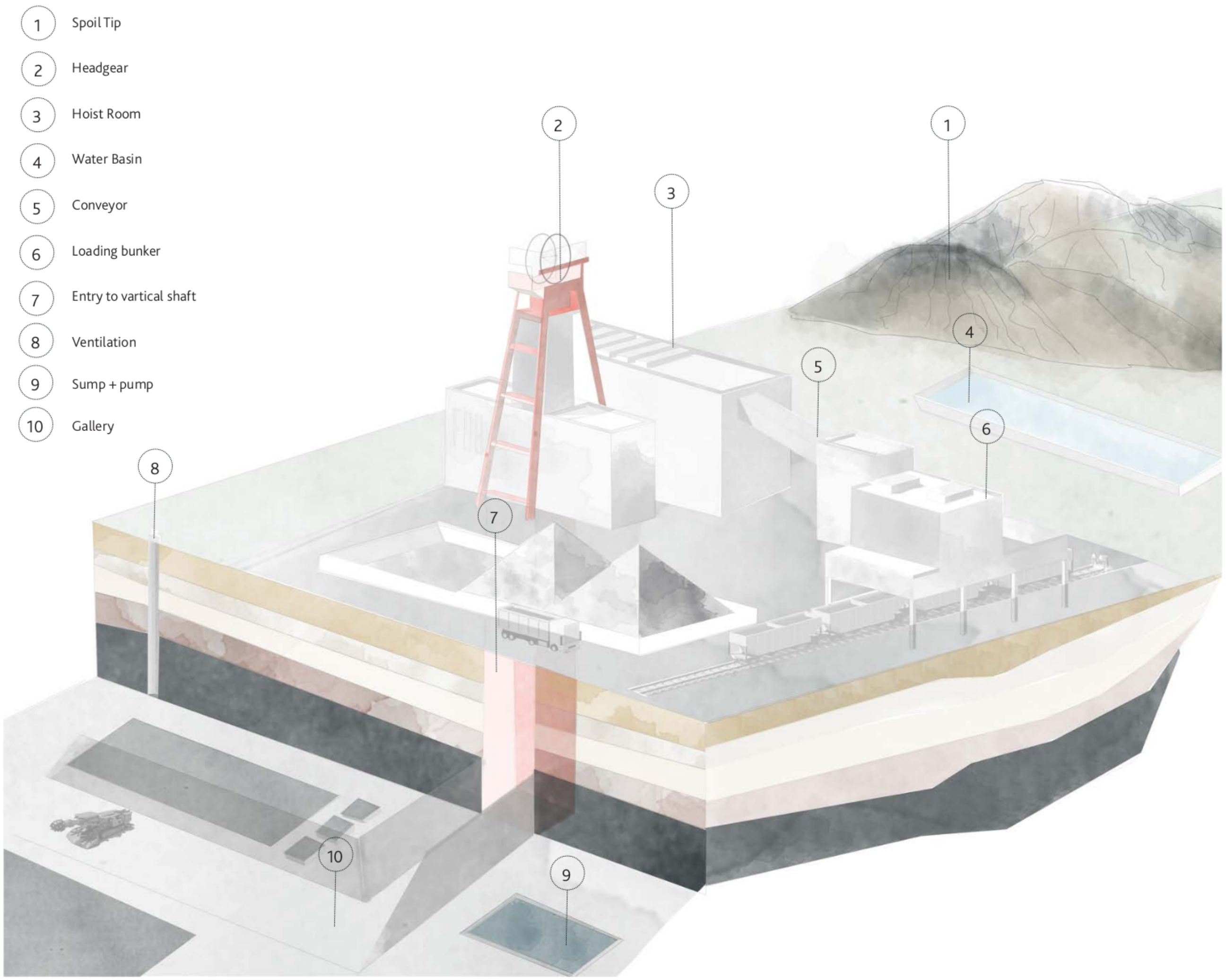


Figure 1.14. Mining site explained (the process of coal production)

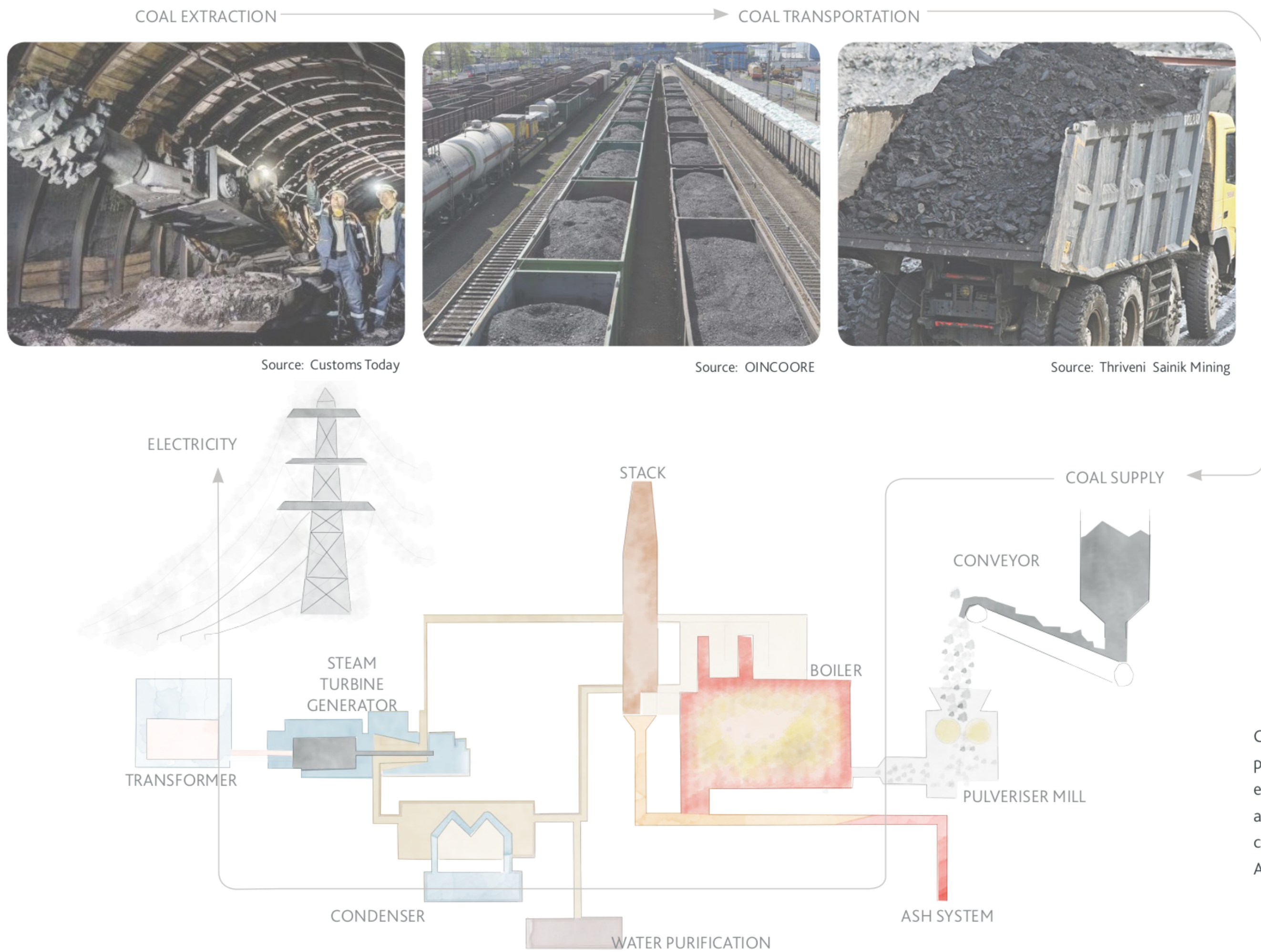


Figure 1.15. The process of coal consumption (from coal extraction, transportation to coal combustion (World Coal Association 2014))

IMPACT FROM COAL CONSUMPTION

Coal combustion also leads to emissions of sulfur dioxide, particulates, which contribute to smog and respiratory elements, carbon dioxide, mercury, and other heavy metals, ash and other residues created by plants that burn coal, and other emissions that go against the Clean Air Act (EIA 2017).

Figure 1.15 illustrates a summary of the identified issues based on the lifecycle impact assessment (later LCIA). If we have mining activity and everything related to it (see figures 1.13 and 1.10) as our inventory results - the mid-point would be issues caused by those activities, whilst endpoint and research intervention will focus on how those issues are experienced in urban areas (Mangena and Brent 2006). Therefore, if these issues become an area of protection- they also become **identifying** for this project and all of the further design interventions, literature and case studies will be assessed against them.

Figure 1.16. Summary of identified issues (Based on research conducted previously)

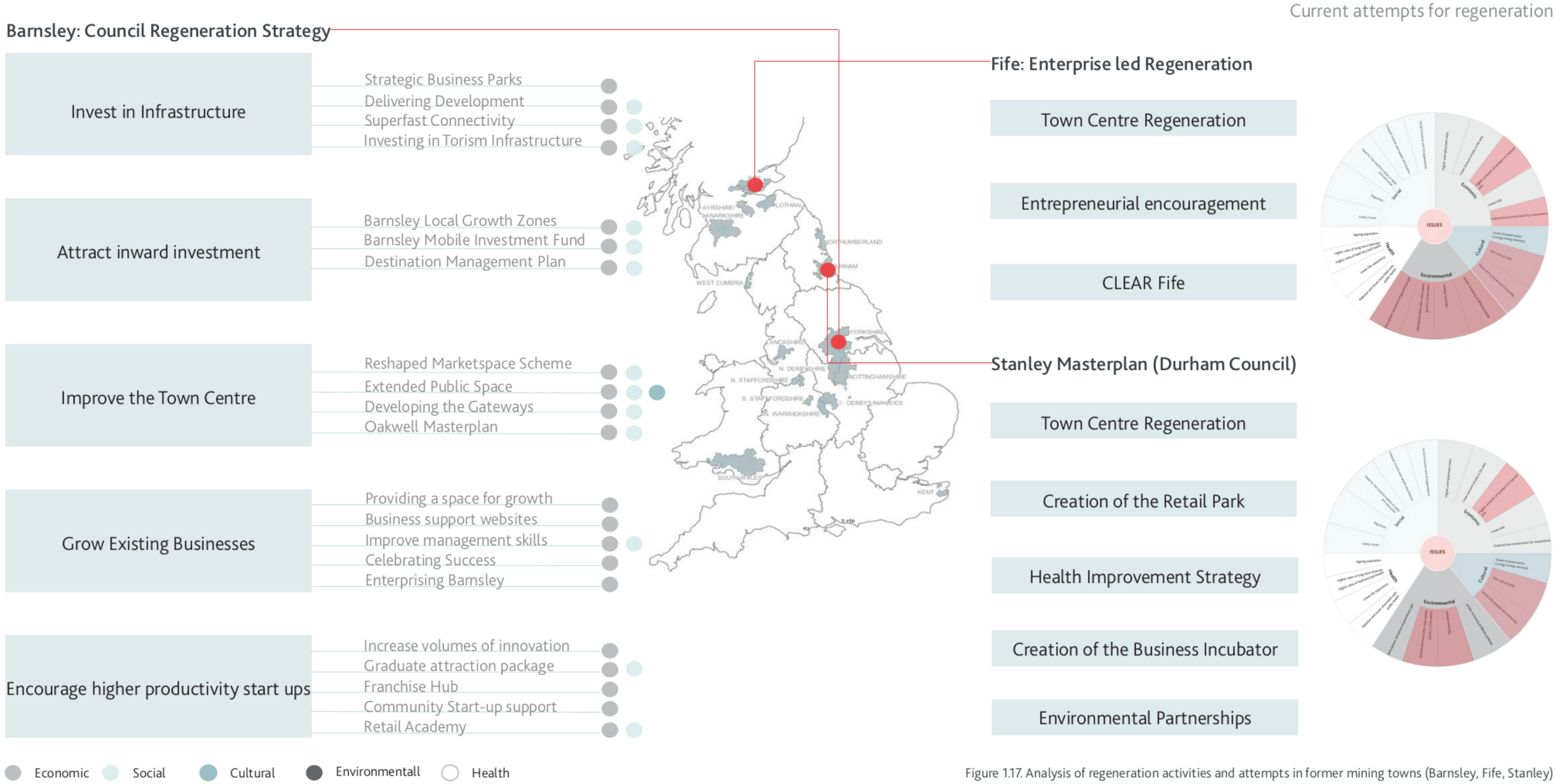


Figure 1.17. Analysis of regeneration activities and attempts in former mining towns (Barnsley, Fife, Stanley)

Current attempts for regeneration can be added as six-issues. Infographics provided at this page illustrates current attempts for regeneration in three former coal-mining towns in various coalfields. These cases overview the regeneration attempts adopted by local councils. None of them is tackling complex identifying issues. Interestingly, none of the strategies solves cultural issues, because of these towns destroying the mining sites and start regeneration from town centers.

INTRODUCTION

About the research

The introduction chapter has overviewed various issues that grew from coal-mining, as well as after the mass mine closure. These issues transformed from "identified" to "identifying" and will be used throughout the whole research as a key indicator for analysis of literature, case studies, the site itself and the proposed design.

Analysis of current regeneration strategies in former mining towns like Barnsley and Fife provided at page 22 of this report shown, that the major problem is the absence of complex interventions and strategies to solve growing socio-economic and environmental issues. Besides factors, that drove the deprivations, such as the absence of sustainable mine closure programs, the slow transformation of skills and employment market are also neglected.

RESEARCH PROBLEM

Regeneration problems neglect factors that cause socio-economic issues and do not use derelict physical environment

IDENTYFYING ISSUES

Economic | Social | Cultural | Environmental | Health

RESEARCH OUTCOMES

- Comprehensive analysis of issues resulted from mining closure and faced by neighbouring urban areas
- Analysis of current trends and their limitations for regeneration attempts in post-mining towns
- Explore alternative solutions for the use of mining site and its role in regeneration
- Develop a comprehensive toolkit based on literature and case studies that can solve identifying issues
- Create a design proposal for selected site

Figure 1.18. About the research Pt.1

Regeneration of post-mining towns is not a novel issue, nor topic in Europe and the USA, whereby we can see lots of innovative transformation and transition of industrial areas, which will be discussed in case studies' chapter and literature review. However, successful practices and strategies are not homogeneous. A variety of mining towns in the UK, USA, and European countries become "shrinking cities" or "ghost towns", whereby the dramatic loss of population and employment, high costs of maintaining infrastructure led to the deprivation of areas(Giovannini 2018).

China is one of the countries that has been heavily consuming coal for energy purposes within the recent decade has announced its Coal transition project (Fei 2018). The Shanxi province is aiming to move 655,000 residents of mining areas, closing around 1000 local mines (Lee 2018), which will lead to the similar issues faced by mining regions in the West. Therefore, this research aims to develop a radically different perspective on currently neglected mining areas, through the transformation of residual industrial facilities below and above ground and achieving positive socio-economic and environmental growth.

RESEARCH QUESTION

How can the former mining area, which was a central of the life and economy of mining town be exploited and developed to have a new role as a central focus in the future life and economy of town?

RESEARCH OBJECTIVES

- Building on existing residual industrial facilities and below ground attributes to **exploit and develop new energy resources**, which will secure **the strategic growth tailored for local areas**
- To develop a design and planning toolkit to promote new technologies to overcome the legacies of mining and generate a **new approach to growth**
- Explore **how new technologies** for the remediation, energy and employment markets **can be utilised in a designed landscape and gathered in an urban centre**
- To present a clear and achievable plan and design toolkit of a renewable energy system and other related technologies
- To **demonstrate the character and potential positive change to similar environments**, which can benefit from the application of the proposed toolkit

PROPOSED INTERVENTION

- Develop a designed environment that will secure urban growth
- Develop new energy facilities in place of mining site, that will have a major economic and social impact, as well as low environmental impact
- Reclaim contaminated land and water
- Preserve physical environment and mining culture through community involvement, as well as the preservation itself

CONTRIBUTION TO PRACTICE

to open up a different perspective on the currently mainly neglected mining areas

Figure 1.19. About the research Pt.2

02 LITERATURE REVIEW

2-1 INTRODUCTION.....27
2-2 LEGISLATION AND KEY STAKEHOLDERS 27
2-3 MINE CLOSURE AND RESIDUAL PHYSICAL ENVIRONENT.....28
2-4 REGENERATION STRATEGIES.....28
2-5 REGENERATION TECHNOLOGIES AND NEW USE.....29
2-5-1 Land Reclamation.....29
2-5-2 Mine Water Treatmen.....29
1-5-3 New energy developments.....29
2-6 LITERATURE LIMITATIONS.....30
2-7 SUMMARY AND KEY FINDINGS.....30

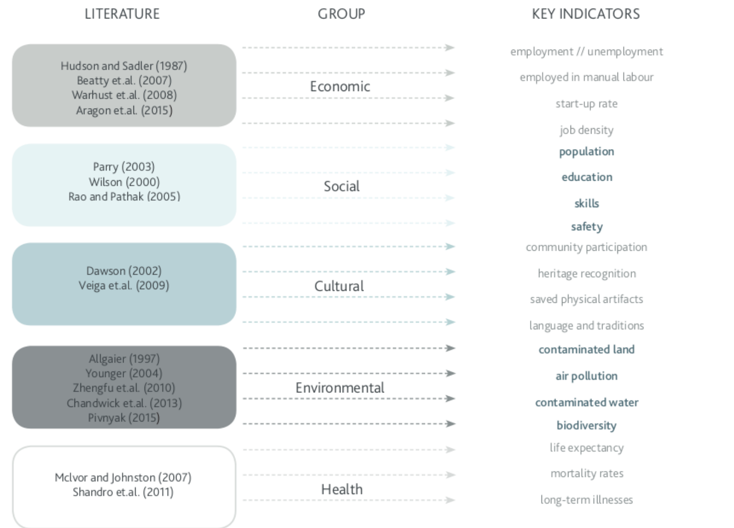


Figure 2. Literature group 1

INTRODUCTION

The collapse of the mining industry has brought a variety of literature to the field of social sciences and engineering. Early literature starting from 70th explains the issues, that was discussed in the introduction chapter. Hence, Figure 1 illustrates literature grouping that focuses on the analysis of various impacts of coal extraction and production activity. From this literature group, we can extract key indicators, that will be used for the analysis of the site. For more detailed information please refer to Chapter 1.

This Chapter will focus on literature that describes technologies, opportunities, and limitations of regeneration of mining areas. First, it will look at the legislative environment and key stakeholders that regulate mining and post-mining activities. Secondly, it will look at the patterns of mining closure and physical environment that can exist after the mining closure. Thirdly, the literature review will examine key regeneration strategies found in the field of social sciences, whilst from engineering and environmental studies there was extracted key technologies for land reclamation and water treatment. Finally, there will be discussed literature limitations and key findings from analysed literature, that will serve as a backbone for the site selection, regeneration strategy, and toolkit formation.

LEGISLATION AND KEY STAKEHOLDERS

Sloss (2017) in-depth analysed environmental effects of coal mining activity and its regulation and key stakeholders. Some of the activities can be used as a methodology for extracting required information about the site. For example, knowing the last owner of the mine and its key principles and CSR activities- we can identify the pattern of closure, that is regulated by national and international institutions, which later will determine design intervention. Whilst national and local institutions guide operating mines, as well as create guidance for the new use of contaminated land. For example, in the UK main owner of former pit sites, as well as key regulatory figure is the Coal Authority, which guides mining closure and posts water treatment, land reclamation, and new developments. Figure 2.2 illustrates key stakeholders and their guidance and operation tools, as well as ownership and regulation, which will be used to assess the site and gain more information about the trends in pit closure to understand opportunities that physical environment can provide.

The next paragraph will look at the literature about the mining closure to help to understand various scenarios and how closure did affect the physical environment.

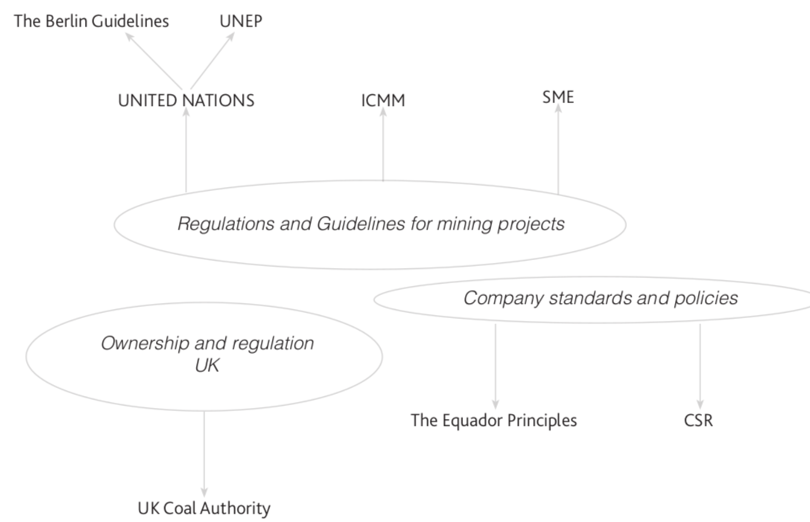


Figure 2.2. Mining: Key stakeholders and regulations

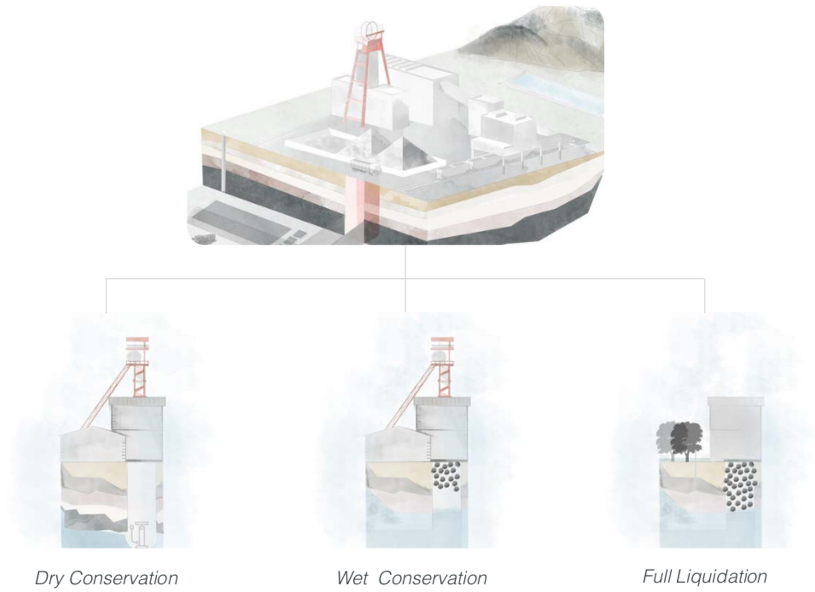


Figure 2.3. Types of conservation/ Liquidation (Pivnyak 2015)

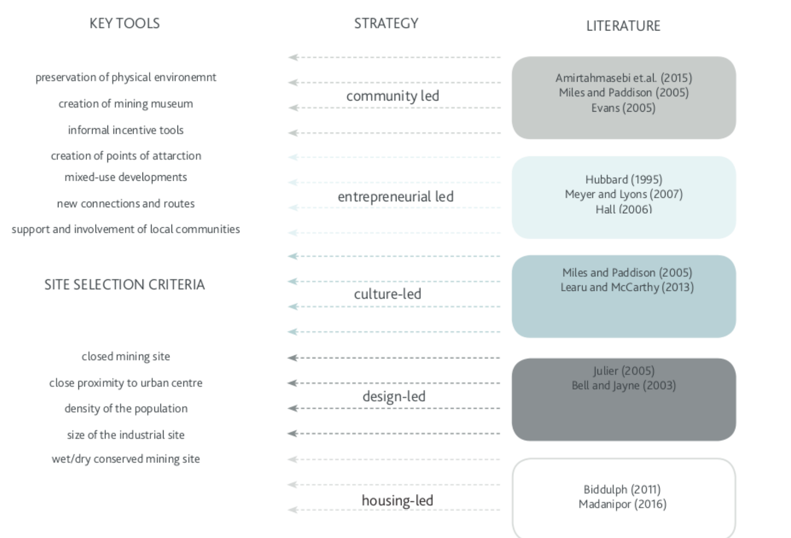


Figure 2.4. Literature group 2: Regeneration strategies

MINE CLOSURE AND RESIDUAL PHYSICAL ENVIRONMENT

This research aims to develop design and regeneration for the area, where the mine has already been closed. Hence, it is important to understand, what is the residual physical environment.

The majority of frameworks for mining closure, such as the World Bank's (2002) "Mine Closure planning" do not show specific patterns of conservation, which makes the development of design toolkit more difficult (Please refer Appendix 2).

According to Pivnyak (2015), there are three ways of colliery conservation. First, dry conservation, when mine water is pumped out and mine is ready to restart operating anytime. Such method of conservation was popular in the UK in the late 90th and early 00s, whilst later we could have faced reopening of mines in mid-00s (The Coal Authority n.d.). Secondly, the mine can be conserved in the "wet" way, when the water is no longer pumping out and mine shafts are filled with mining water. Such a strategy is the most common way of pit closure. Interestingly, the majority of mines are located next to the river. Hence, after such closure mined water is most likely to leak to the local river.

Thirdly, mine could face full liquidation, when the water is no longer pumped out and the entrances to the mine are swamped. In case of such liquidation- it is difficult to implement any regeneration strategy based on the transformation of mining issues into a series of opportunities. Therefore, for this research, the site must have mine either with dry or wet conservation pattern.

KEY REGENERATION STRATEGIES

Urban regeneration is defined as a vision and action that seeks to resolve urban problems and bring a long-term improvement in the general condition of an area that has been subject to change of opportunities (Roberts et.al. 2016). As the regeneration in post-mining towns is highly necessary – it is vital to explore regeneration strategies that can be later used at the design development stage.

The conducted literature search has shown that no literature will describe regeneration strategies specifically for post-mining towns. However, because post-industrial towns share similar issues- regeneration strategies used to solve those issues in post-industrial areas can be translated in the post-mining environment (Evans 2005).

Amirtahmasebi et.al. (2015), Miles and Paddison (2005), and Evans (2005) classified regeneration strategies based on the driver on culture-led, entrepreneurial-led, community-led, design-led, and housing led (Please refer 2.5).

Culture-led regeneration has been discussed by Miles and Paddison (2005), Leary and McCarthy (2013), and Evans (2005) looked at the culture regeneration as the process of saving the culture. Hence, from this regeneration strategy- we can extract several tools, such as preservation of the physical environment of collieries creation of mining museum, informal incentive tools, such as achievement of awards or cultural and historical heritage, etc.

Julier (2005), Bell and Jayne (2003) discover the role of design-led regeneration in post-industrial cities, whereby the vital role belongs to "design scapes" that consist of aesthetic market places and points of attraction. Therefore, from this regeneration strategy, we can extract tools, such as the creation of new points of attraction, provision of new connections and routes.

Both of the strategies can be led by the community or entrepreneurs (Meyer and Lyons 2007; Imrie and Raco 2003; Hall 2006), which allows extracting other tools like involvement and consultation of communities, creation of the mixed-use environment, that will allow small businesses to grow.

LAND RECLAMATION

Topsoil land reclamation is one of the most important attributes of post-mining activity. As the method to treat top-soil there can be used “topsoil removal”. To maximise the efficiency of this tool- removed materials can be used in roadbuilding (Ghose 2000). Afterward, the soil should be strengthened by installing support footings, inground footings or greening the soil, that also helps to prevent land movement (Kinnan 1986).

To improve soil quality and renew natural ecosystems there can be adopted conservation-effective measures, which help to improve soil, as well as mitigate climate change (Lal 2014). This process includes a microbial treatment of contaminated soil, extraction of dangerous chemicals from the soil, as well as the treatment water fields, which will be discussed in next paragraph (Frouz et.al. 2006; Helingerova et.al. 2010).

MINE WATER TREATMENT

Feng, D. et.al. (2000) examined the opportunities to treat mining water with the oxidation pre-treatment, that can help to transform acid mine water into sterilised water.

One of the most discussed wastewater treatment technologies among academics is passive wastewater treatment, which is based on adding organic pollutants to contaminated water (Kalin 2004; Younger 2000; Sapsford et.al. 2007). In-depth treatment of drainage mine waters actively or passively, which may include neutralising and reducing agents, galvanic suppression was discussed by Banks et.al. (1997).

NEW ENERGY DEVELOPMENTS

Deep coal-mining is a capital-intensive process and usually, the physical environment is not used after the closure. However, Hall et.al. (2011) and Gniese et.al. (2013) explored an opportunity to extract the positive value of derelict physical environment through the generation of renewable geothermal energy. To develop geothermal opportunities-mining site should be flooded, whilst the mine itself should be deep enough (below 700 meters). Because the underground water has stable energy it can be used as a source of heating in winter.

Also, coal mining is associated with gas formulations below the ground, as well as those that release over the ground, which allows using underground coal gasification technologies and extracts methane (Karacan 2011). However, depending on topography, mine breeds, and structure of the physical environment- there might be different ways of gas extraction and capturing (2011, p. 5). Extracted gas can be used as a fuel, which counts as a cost-effective way of improving mine economics, that reduces methane release and increase mine safety (Bibler et.al. 1998). Therefore, the access to AMM (abandoned mine methane) is a site selection criterion.

One of the most innovative methods for new energy developments out of closed underground coal-mines is closed-loop underground pumped hydroelectricity geothermal storage system (Strang 2017). This technology is clean and renewable. To apply this technology, mine should have the infrastructure, which includes over groundwater basin and tunnels filled with water, which will allow to pump back water from tunnels at the non-peak times and release when demand is high (2017, p. 15).

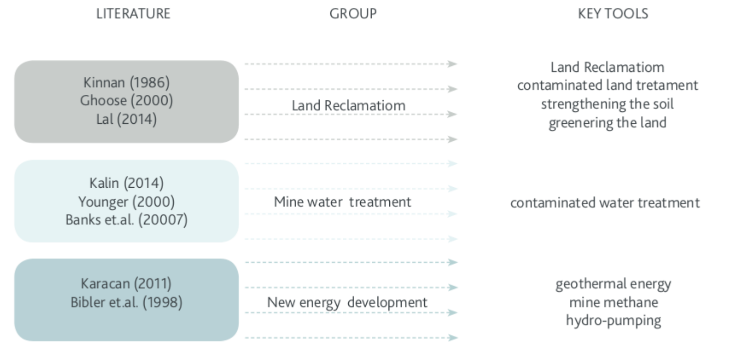


Figure 2.5. Literature group 3 : regeneration technologies and new use

LITERATURE LIMITATIONS

There are several limitations to analysed literature. First, it worth to mention that early literature analyses issues, that mining closure brought. Within the last decade, there is a great variety of literature, that discusses sustainable transition, especially there is a growing number of academics from China, because only recently China has started to decrease the amount of coal consumption, as well as has started mass closure of local collieries (Anglo American 2013) .
It is worth to mention, that literature about the sustainable transition from mining to other industries, that will help to minimize socio-economic and environmental impact on neighbourhood areas is less applicable to the case discussed in this paper. Whilst there are only a few pieces of research in the field of literature, that would discuss alternative opportunities for closed collieries and mono-industrial towns.
Second, in the social-sciences literature, regeneration strategies discussed are quite homogeneous and are difficult to replicate in the physical environment, rather they can be used as a strategic framework to involve or target stakeholders. Also, only a few specifically oriented books distinguish opportunities for the restoration of the physical environment for the deep coal mining, whilst in the majority of literature analysing term mining and the regeneration do not separate deep coal mining, surface mining, clay mining, gold mining, etc.

LITERATURE LIMITATIONS

Figure 2.6 illustrates key findings and takeaways from the literature review chapter.
First part summarised literature discussed in the introduction part, which has formed key indicators that will be used for site analysis and afterward will be used to assess design intervention with "identifying issues" wheel. Whilst to solve those issues and achieve the maximum potential of the regeneration- the site should contain specific criteria listed in figure 2.6.
Also, this figure shows the extracted tool, that can be used to achieve objectives of the regeneration of the selected site.

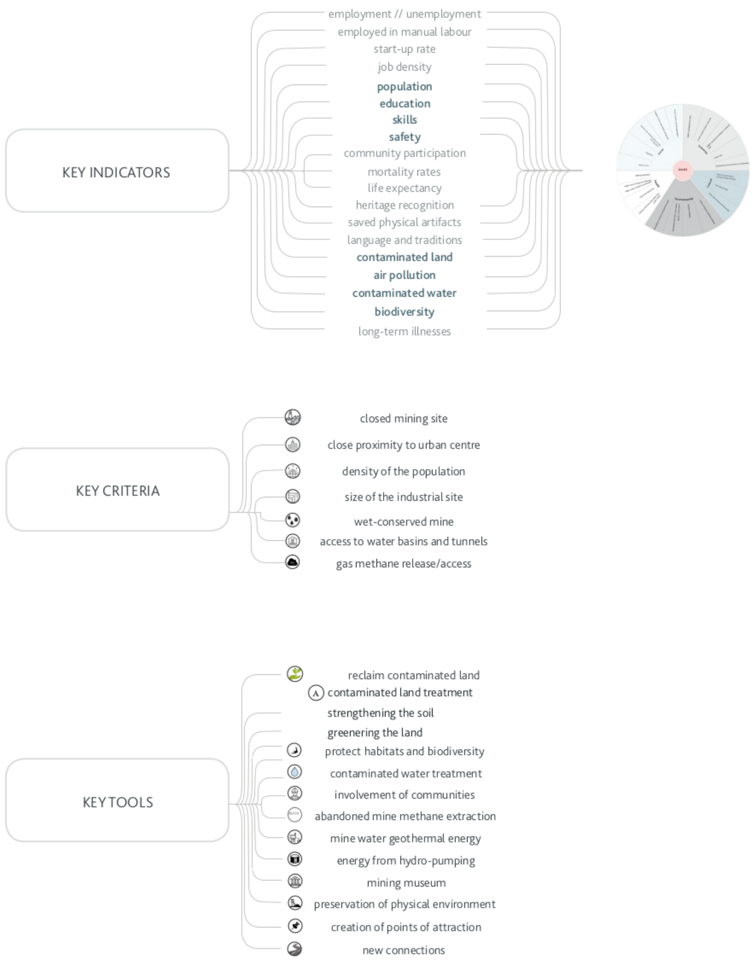


Figure 2.6. Key Findings from the Literature

Figure 3. Map of analysed case studies

03 CASE STUDIES

3-1 INTRODUCTION....33
3-2 CASE 1: DAW MILL COLLIERY,UK....34
3-3 CASE 2: RUHR-AREA REGENERATION, GERMANY....35
3-4 CASE 3: NORD-PAS-DE-CALAIS, FRANCE....36
3-5 CASE 4: IKESHIMA AND HASHIMA, JAPAN 37
3-6 CASE 5: GEN COEL, HEERLEN, HOLLAND....38
3-7 CASE 6: EDEN PROJECT, UK....39
3-8 SUMMARY AND KEY FINDINGS....40

CASE STUDIES

Introduction to the chapter

The aim of "Case studies" chapter is to understand more fully some of the issues and the responses to some aspects of the issues that this research seeks to address. Therefore, each of the selected case studies describes opportunities for regional development with a change in operations within the pit site, for example from coal extraction to mine water geothermal plant.

As far as the analysis of case studies is qualitative and focuses on the gathering o the information about achievable solutions for the mining sites and neighbouring urban areas- main case study selection criteria include: similarity of industry closure and shared issues, positive impact on urban areas, provision of new use/opportunities for derelict physical environment.

Each of the case studies will be evaluated against identifying issues, which were presented in the Introduction chapter, which will allow to form the toolkit and summarise the site selection criteria.

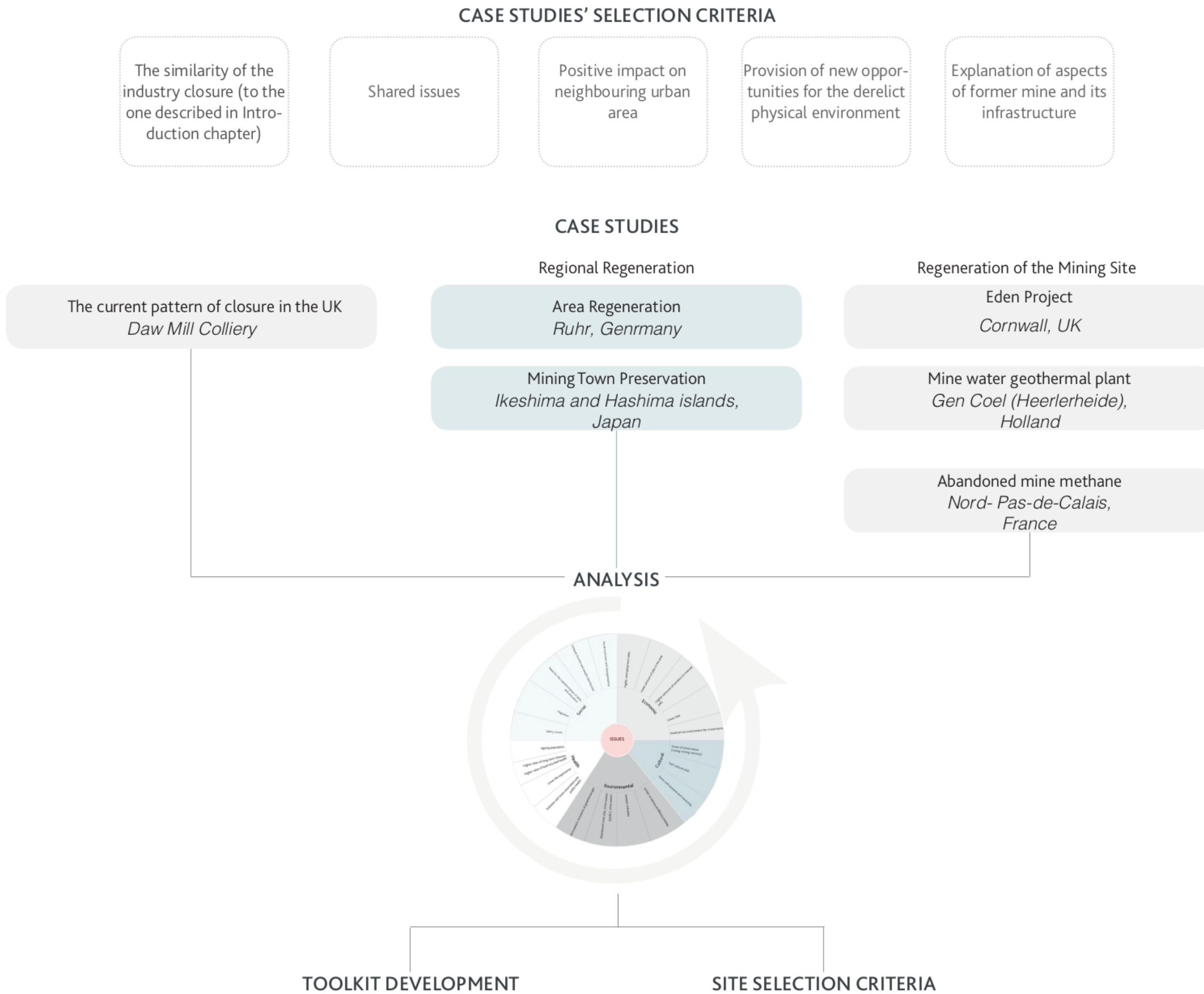


Figure 3.2. Case studies: selection, analysis, and outcomes

Daw Mill Colliery


Figure 3.3. Mining site with physical facilities (Harworth Estates n.d.)


Figure 3.4. Land Reclamation (Harworth Estates n.d.)


Figure 3.5. Option 1: Business Park (Harworth Estates n.d.)

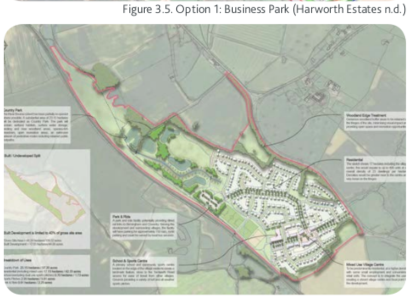


Figure 3.6. Option 2: New Sustainable Residential Community (Harworth Estates n.d.)

Location: Arley, Warwickshire, UK
Date of establishement: 1956-2013 (mine)
Context: ownership of the land; regeneration of the mining site

Opportunities

- Provide a new use of the area
- Land Reclamation
- Create new employment opportunities
- Improve health
- Improve the quality of the environment

Constraints

- Demolition of the physical environment and culture
- Low economic benefits
- Did not replace jobs
- Funding issues

Daw Mill colliery has been closed in 2013 when ownership of the land transferred from UK Coal to private company Harworth Estates.
After the closure urban area has lost approx 680 jobs, which supposed to be replaced by the business park proposal (Eccleston 2018). However, the quality of those jobs and for whom they will be provided, as well as who is the main investor is not stated within the proposal of the Estate company. Whilst "new sustainable residential community" aims to provide around 200 flexible working space, which is not enough to solve economic issues (Harworth Estate n.d.).
According to CoventryLive (2018), residents value mining heritage and do not support any of these proposals.
Therefore, such design intervention partially solved health and environmental issues but does not provide great socio-economic growth, demolishing existing mining heritage and shared culture.
To be able to implement similar options potential site should have a mining site, railway connection (for the industrial park).

Figure3.7. Case 1 against identifying issues

SITE SELECTION CRITERIA

- closed mining site
- size of the industrial site
- railway connection

KEY TOOLS

- recreation of land
- creation of points of attraction, i.e. business park
- new residential developments

Figure 3.12. Pas-de-Calais : Methane

Figure 3.13. Mining museum in Lewarde community(CestenFrance n.d.)

Location: Pas-de-Calais, France
Date of establishement: 2008-onwards (methane extraction)
Context: area regeneration
methane extraction
culture preservation

Opportunities

- Transform the "problem gas" into an energy source
- Quick recovery after the pit closure
- High profitability and efficiency of the project (up to 90%)
- Avoid the release of methane into the atmosphere, which has a great impact on global warming

Constraints

- Lower efficiency if power generated alone from AMM (around 43.4%)
- Low calorific values (max. 25%)
- Ownership and legislation issues
- Should not be located close to urban areas

Figure3.15. Case 3 against identifying issues

The UK has approximately 900 abandoned mines, out of which 400 release methane into the atmosphere (Hu et.al. 2018). However, abandoned mine methane (AMM) can be transformed into a new opportunity. For example, Clarke Eenergy (2019) uses AMM o produce energy (thermal and electrical). Hence, the issue that is present at the mining site for years after the mine closure- provides an excellent source of medium to high-quality methane extraction. Besides, such intervention helps to create employment, reduce atmospheric emission of methane, as well as brings technological development and new knowledge to the area.

Additionally, area regeneration has a cultural element, which can be described as an informal incentive tool. The area of the Nord-Pas-de- Calais is part of the World Heritage List of UNESCO for its "remarkable cultural landscape". It has the country's biggest museum of mining, where you can also explore underground tunnels, as well as walk down the mining sites, spoil tips, etc.

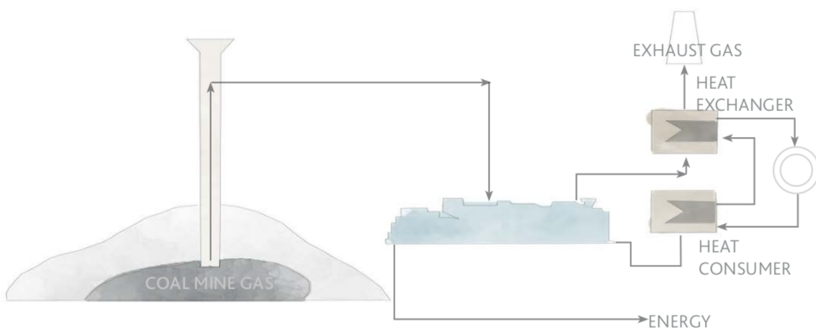


Figure 3.14. Coal Bed methane extraction (Clarke Energy 2018)

SITE SELECTION CRITERIA

- closed mining site
- size of the industrial site
- close proximity to urban centre
- density of the population
- gas methane release/access

KEY TOOLS

- recreation of land
- contaminated water treatment
- informal incentive tool (UNESCO)
- creation of mining museum
- create new employment opportunities
- abamdoned mine methane extraction
- preservation of physical environment

Figure 3.17. Ikeshima island (Onegai-kaeru 2016)

Figure 3.18. Hashima island (Onegai-kaeru 2016)

Gen Coel, Heerlen, Holland

In 2008 the municipality of Heerlen launched Minewater program, which aimed to transform unused water reservoirs into first mine water geothermal plant in the world (Gen Coel in Heerlenheide).

After the closure of mine thousands of people were left without employment. In early 1970th tunnels were filled with groundwater, which was naturally heated by Earth. The deeper the mine- the higher temperature of the water, which naturally provides an opportunity for geothermal energy production (Renewables Networking n.d.).

The project was funded through a financial trust. Besides, this project has high social and historic value, because Mijnwater (operating company) used to involve old mineworkers at the planning and consultation stage.

The neighbouring town has benefited from the renewable energy source, that serves as a heat source (for heating) and heat sink (for cooling). Moreover, this project received the "European Geothermal Innovation Award" in 2015, which allowed increasing attention and funding opportunities for the region.

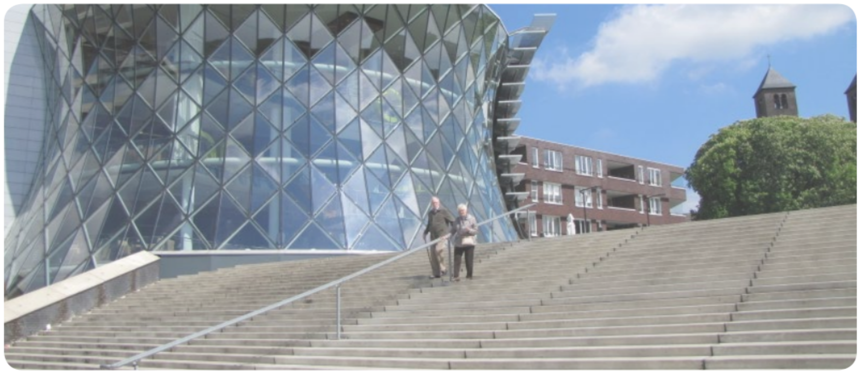


Figure 3.20. Geothermal energy mine (ODNR Geological Survey n.d.)

CASE STUDIES

Eden Project

This project is internationally awarded and was mimicked in China (to regenerate former mining area), Australia (to restore surface mining land) and New Zealand (in areas affected by the earthquake) (Blooloop 2018).
Recently Eden partnered with Cornwall-based EGS Energy to create deep Geothermal Energy Project. Figure 3.17. illustrates proposed a system, which operates by injecting the cold water down the borehole and picks up the heat from granite rocks and is pumped back to the surface at about 180 °C, while the water runs through a binary cycle turbine and generates electricity. In the context of this research similarly, geothermal energy or hydro-pumping can be iterated in mining sites. According to EGS (2019), geothermal energy can provide up to 20% of the UK's current electricity demand and a large amount of heating (Eden Project 2019).

Location: Cornwall, England, UK
Date of establishement: 1998-onwards (regeneration program)
Context: land reclamation
ecology restoration
internationally renowned

Opportunities

- Environmental and Biodiversity restoration
- New land use
- Energy production
- Tourism inflows
- Agriculturing production

Constraints

- The lower amount of cultural preservation
- High costs
- Ownership issues

Figure3.22. Case 6 against identifying issues

SITE SELECTION CRITERIA

- closed mining site
- size of the industrial site
- access to water basin and tunnels

KEY TOOLS

- recreation of land
- contaminated water treatment
- protect habitats and biodiversity
- mine water geothermal energy
- creation of point of attraction
- energy from hydro-pumping
- promoting industrial heritage

Figure 3.23. Eden Project: before (Eden Project 2018)

Figure 3.24. Eden project: after (Eden Project 2018)

Figure 3.25. Eden project's international ambitions in China ,Dubai and Australia (Blooloop 2018)

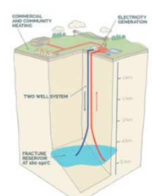


Figure3.27. Proposed energy system (EGS 2019)

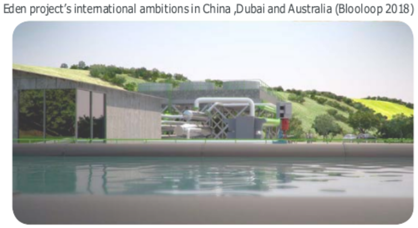


Figure 3.26.Eden project: geothermal energy (Eden Project 2018)

CASE STUDIES

Summary and key findings

Different interventions and regeneration attempt to change the physical appearance of the mining site, as t is shown in Figure 3.28. However, we can identify some common patterns in tools used for regeneration in various geographic areas.

It is worth to mention that utilisation of each tool on the selected site, requires site analysis, as some of the intervention like geothermal energy or methane extraction can not be conducted everywhere.

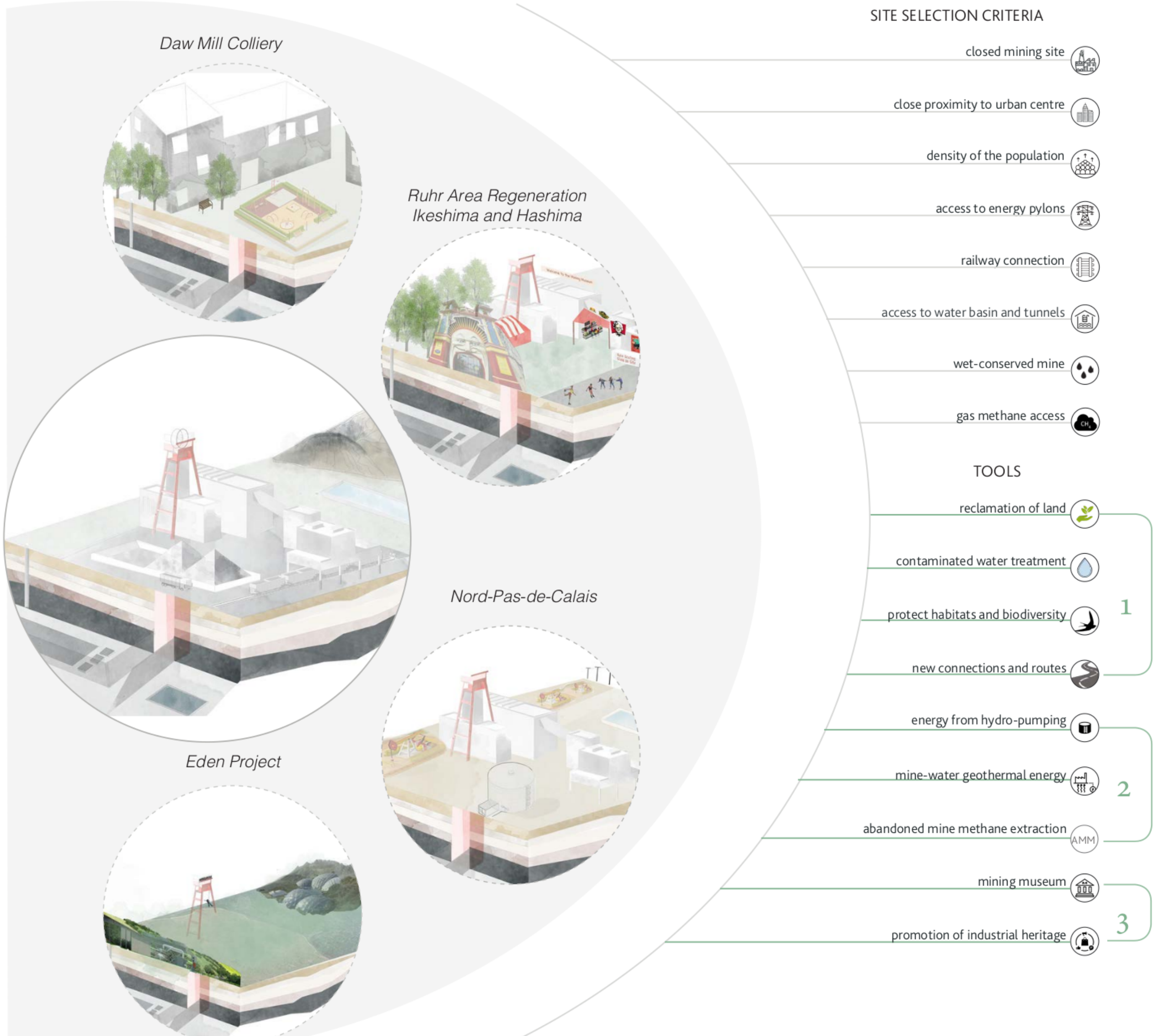


Figure 3.28.Case studies: potential change of landscape and key findings

First of all, the reclamation of land, water, and the protection of biodiversity are the most common interventions, that conducted at the early stages of regeneration, that indeed allows to solve common environmental and health issues, solved by mining activity. Also, such tools are imposed by the government and are compulsory in most of the case studies.

Secondly, to achieve efficiency and solve socio-economic problems most of the sites analysed in case studies are transformed into new sustainable energy production sites, which allows to maximise the efficiency of regeneration and demolish negative association with post-mining areas, as an area with high pollution and fossil fuels dependency.

Thirdly, it is vital to promote culture and regeneration itself through the creation of mining museums and the promotion of industrial heritage, which will allow achieving awards, such as UNESCO "Industrial heritage" award, which was also awarded by some of the case studies.

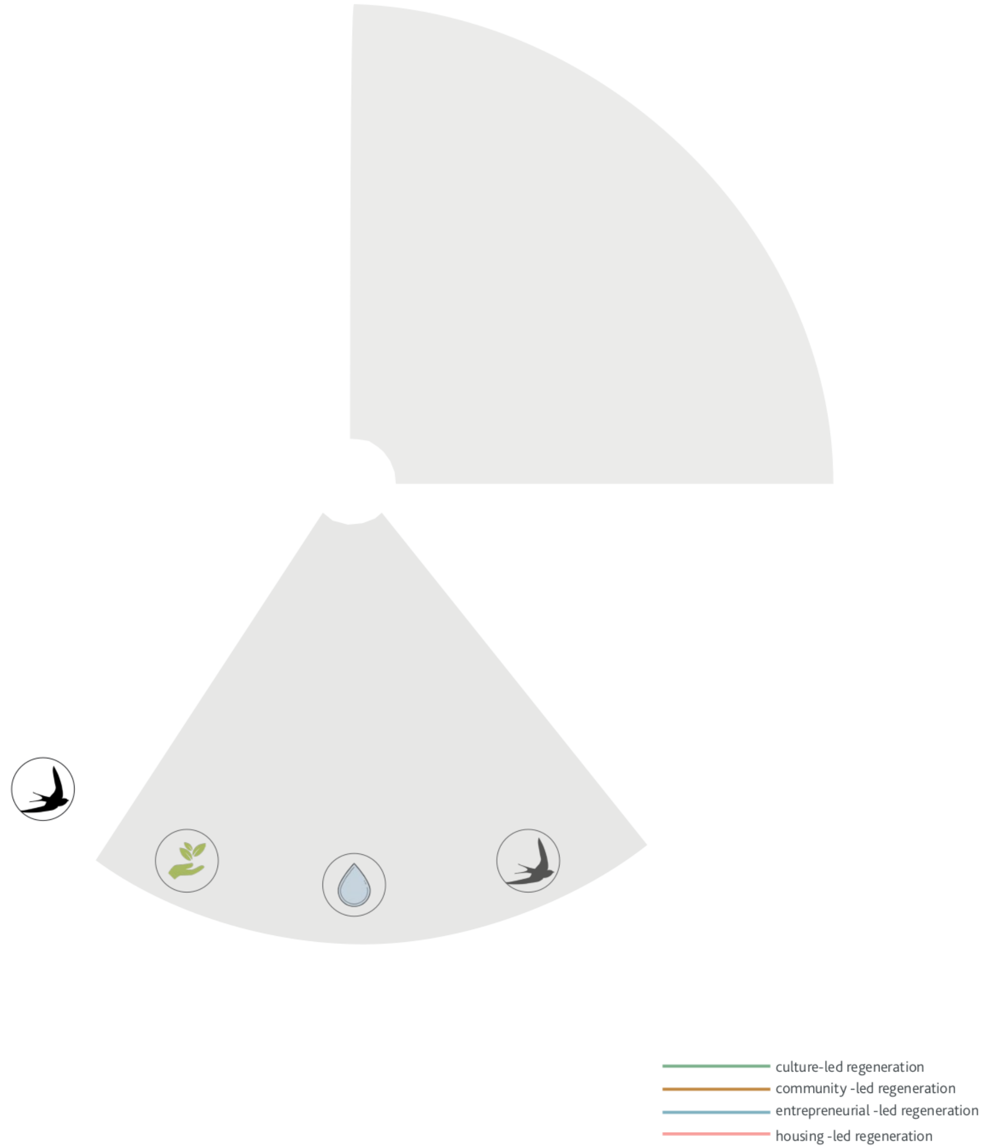
04 TOOLKIT DEVELOPMENT

4-1 SUMMARY OF KEY FINDINGS FROM LITERATURE AND CASE STUDIES....43
4-2 TOOLKIT DEVELOPMENT....43
4-3 SITE-SPECIFIC CRITERIA....44

TOOLKIT DEVELOPMENT

FINDINGS FROM LITERATURE & CASE STUDIES

The study of literature and case studies has allowed identifying common issues, which will be solved with the help of toolkit in the selected site. One of the biggest limitations within academic literature, and design and planning practice is that there are not that many examples of complex solutions, that can help to tackle identifying issues. Hence, extracted tools and design strategies from literature and case studies will be examined against identifying issues (wheel in the centre of Figure 4). Whilst to implement extracted tools- there was developed a site selection criterion, which will allow to examine the complex solution for post-mining regeneration and answer the main question "Is there life after coal?"



TOOLKIT DEVELOPMENT

The analysis of case studies and literature has shown that none of the regeneration strategies or interventions can solve the complex issues grew from coal extraction and mining closure. Hence, as it is shown in Figure 4 they should each of the tools can be used to solve particular identifying issues. For example, land reclamation and contaminated water can help to achieve positive environmental and health impact, whilst the creation of new points of attraction or energy sites can boost economic growth.

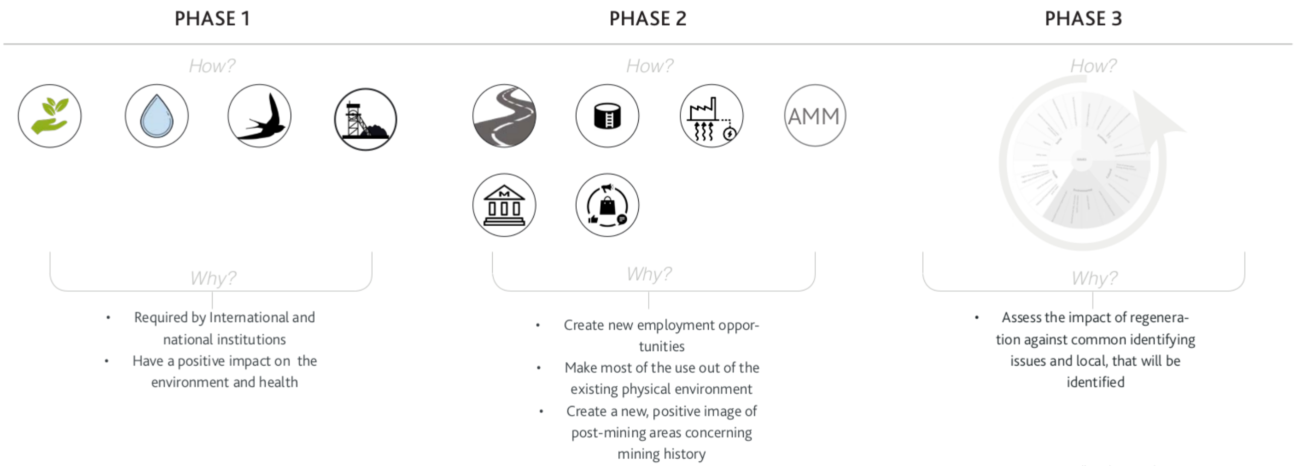


Figure 4.2. Toolkit: phases and outcomes

In addition to that, the literature review has analysed key stakeholders and legislation environment, which shows the priority and stage of the application of selected tools, as it is shown in Figure 4.2. Land reclamation and the mitigation of negative environmental impact caused by mining activity is the priority and the most common tools used in analysed case studies, as well as the key priority set by national and international institutions (please refer pages, 12 and 27). Whilst preservation of the physical environment and culture is the most required intervention determined by people affected by rapid mining closure, which in turn can help to promote the history of mining and solve social and cultural issues.

The most successful case studies, like Ruhr and pas-de Calais shown that to tackle employment issues and kick start economic regeneration former mining sites can benefit from the creation of various energy sites, which are determined by the access and availability of physical environment for methane extraction, hydro-pumping or geothermal energy.

Additionally, it is important to monitor the progress and evaluate each intervention and regeneration process itself, because even UNESCO awarded sites like Hashima and Ikeshima can be attractive for tourists, but so not bring positive socio-economic growth for residents.

SITE-SPECIFIC CRITERIA

Key findings from literature and case studies show site selection criteria, which will be applied at the beginning of the next chapter and includes 9 specific requirements for the site, that will allow exploring the maximum positive outcome of the developed toolkit to achieve desired outcomes set at the beginning of this project.

05 SITE SELECTION AND ANALYSIS

5-1 SITE SLECTION....47
5-1-2 Selected site 48
5-2 SITE ANALYSIS....49
5-2-2 History of Stainforth....49
5-2-3 Demographics, employment, and health....50
5-2-4 Land Use....51
5-2-5 Movement 52
5-2-6 Green areas 53
5-2-7 Physical and environmental analysis....54
5-2-8 Points of attraction....55
5-3 HATFIELD MAIN COLLIERY....56
5-4 SUMMARY: OPPORTUNITIES AND CONSTRAINTS....58

SITE SELECTION AND ANALYSIS

Site selection

For this research, there was decided to narrow the selection to South Yorkshire coalfield, where there were found four cities that share negative consequences of mine closure. However, as it is shown in Figure 5.2. not all of the sites have the required specific criteria for the development of regeneration strategy, whilst only one site has all nine required physical facility to proceed with the site analysis and application of the toolkit. Hence, the next two chapters will analyse and develop regeneration toolkit for Stainforth.

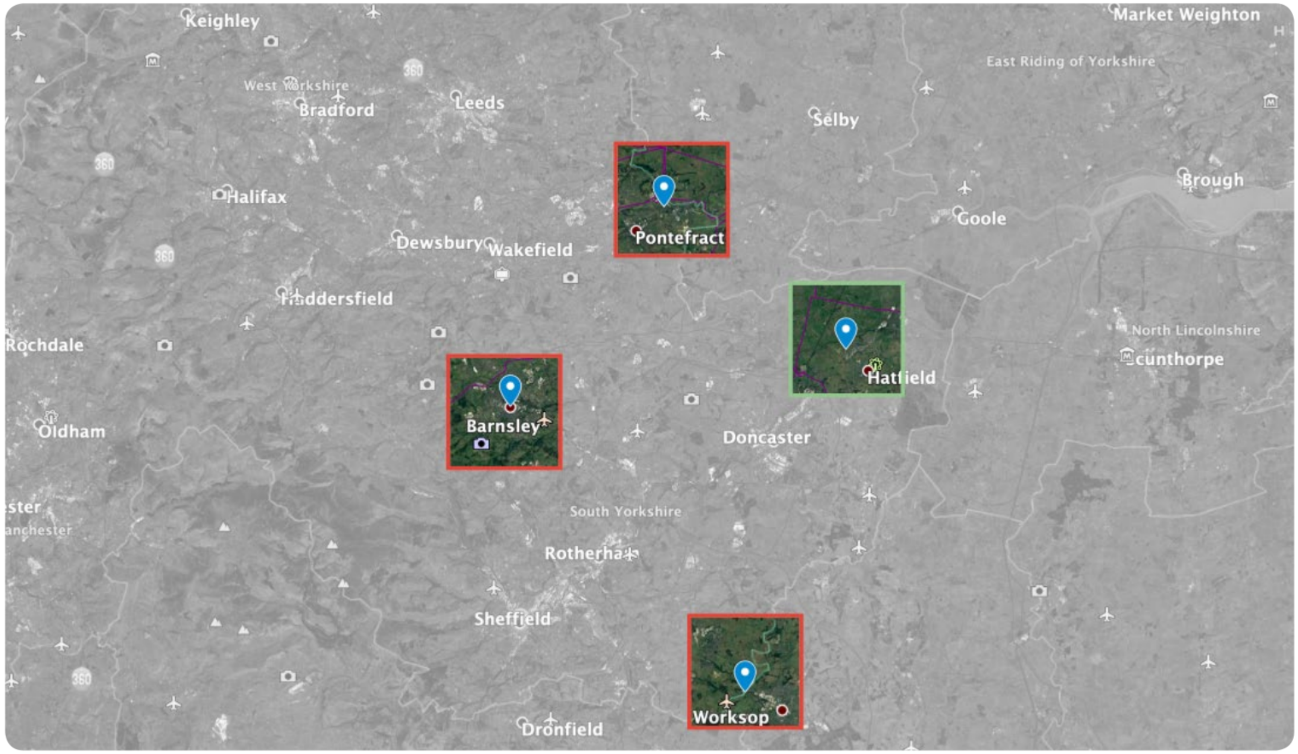


Figure 5. Site selection: map

	closed mining site	close proximity to urban centre	density of the population	access to energy pylons	railway connection	size of industrial site	wet-conserved mine	access to water basin and tunnels	gas methane release/access
Barnsley	✓	✓	✓	✗	✓	✗	✗	✗	✗
Ferrybridge	✗	✓	✓	✓	✓	✗	✗	✓	✗
Stainforth	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shireoaks	✓	✓	✓	✗	✗	✓	✓	✓	✗

Figure 5.2. Site selection criteria application

History of Stainforth

Figure 5.4. presents key dates and growth of Stainforth, whilst most notably maps presented in the figure show that the growth of the city was proportional to the growth of the industrial site of Hatfield colliery, which indicates the vital role of the mine to the city.

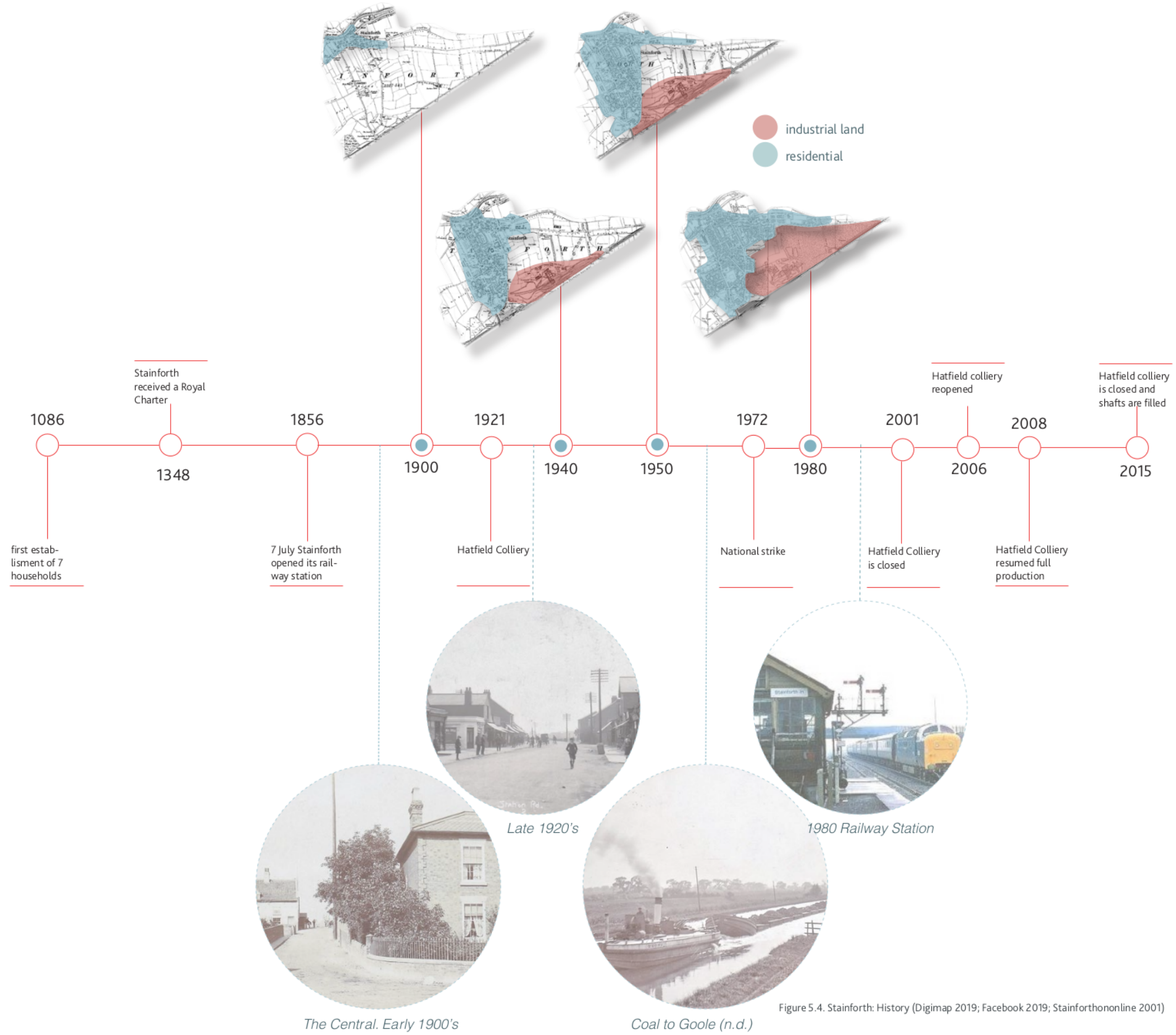


Figure 5.4. Stainforth: History (Digimap 2019; Facebook 2019; Stainforthononline 2001)

DEMOGRAPHICS

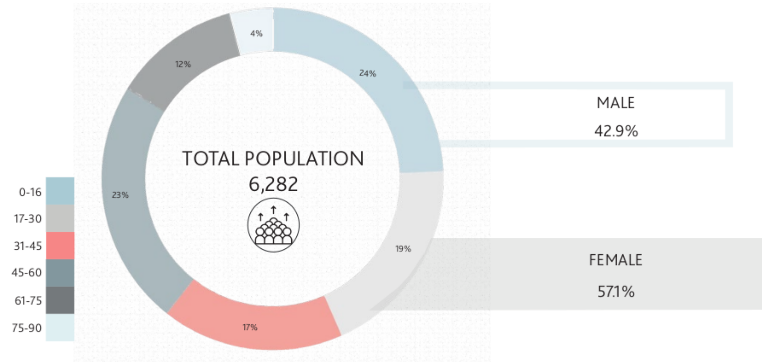


Figure 5.5. Demographics (Census 2011; PostCode area 2019)

SOCIAL

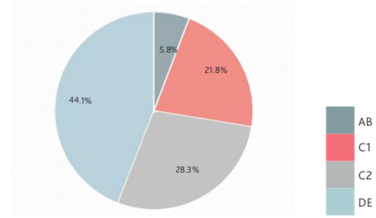


Figure 5.8. Social Grades (Postcode area 2019)

Figures from 5.5. to 5.11. show the socio-economic and health statistics for the city. Most notably that the comparative analysis of some indicators, like the unemployment rate, household income, education, and health show that the city has lower indicators that UK average. In some cases like the unemployment rate this distinction is extremely high (8.7% in Stainforth to 3.5% in the UK). Therefore, the regeneration and tools should prioritise the positive impact on socio-economic and health status of residents to achieve sustainable growth.

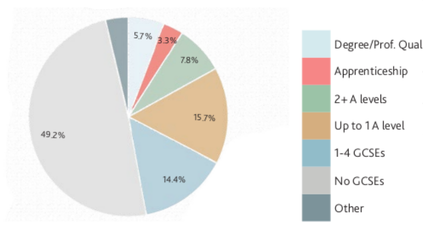


Figure 5.9. Education and Qualifications(Postcodearea 2019)

EMPLOYMENT

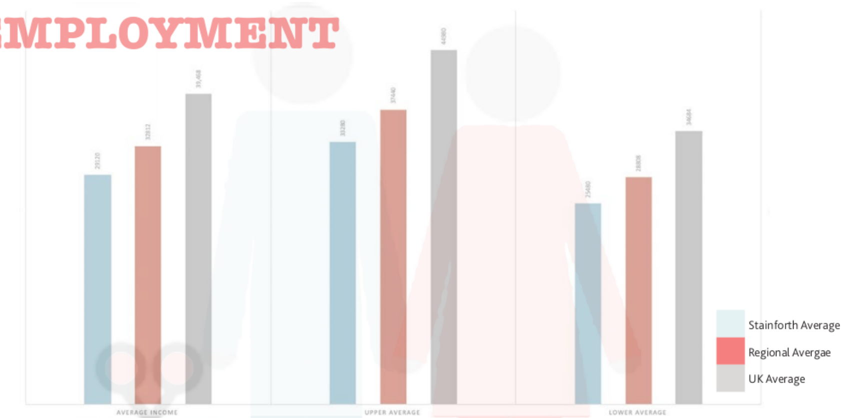


Figure 5.6. Household Income (Census 2011)

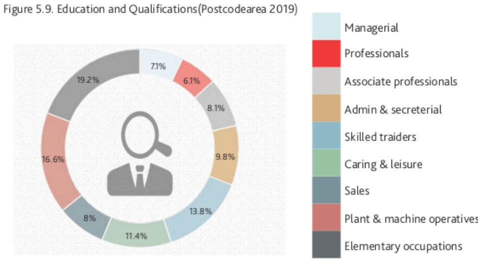


Figure 5.10. Occupation (Postcode area 2019)

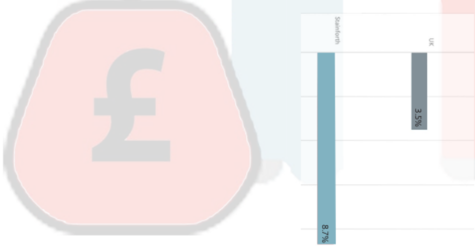


Figure 5.7. Unemployment rate (Cesnsus 2011)

HEALTH

Very Good	43.6%
Good	34.1%
Fair	15.1%
Poor	5.6%
Very Poor	1.6%

Figure 5.11. General Health (Census 2011)

Figure 5.12. shows the land use in Stainforth. The city is surrounded by crops and allotments. Whilst within the city the dominant land use is residential with a relatively low amount of commercial activity. Also, the big proportion of the city is taken by the industrial site of Hatfield Colliery, which takes around 90 ha (Doncaster Council 2019).

This analysis shows that the provision of new commercial activity and employment, as well as the use of the industrial site, is important.

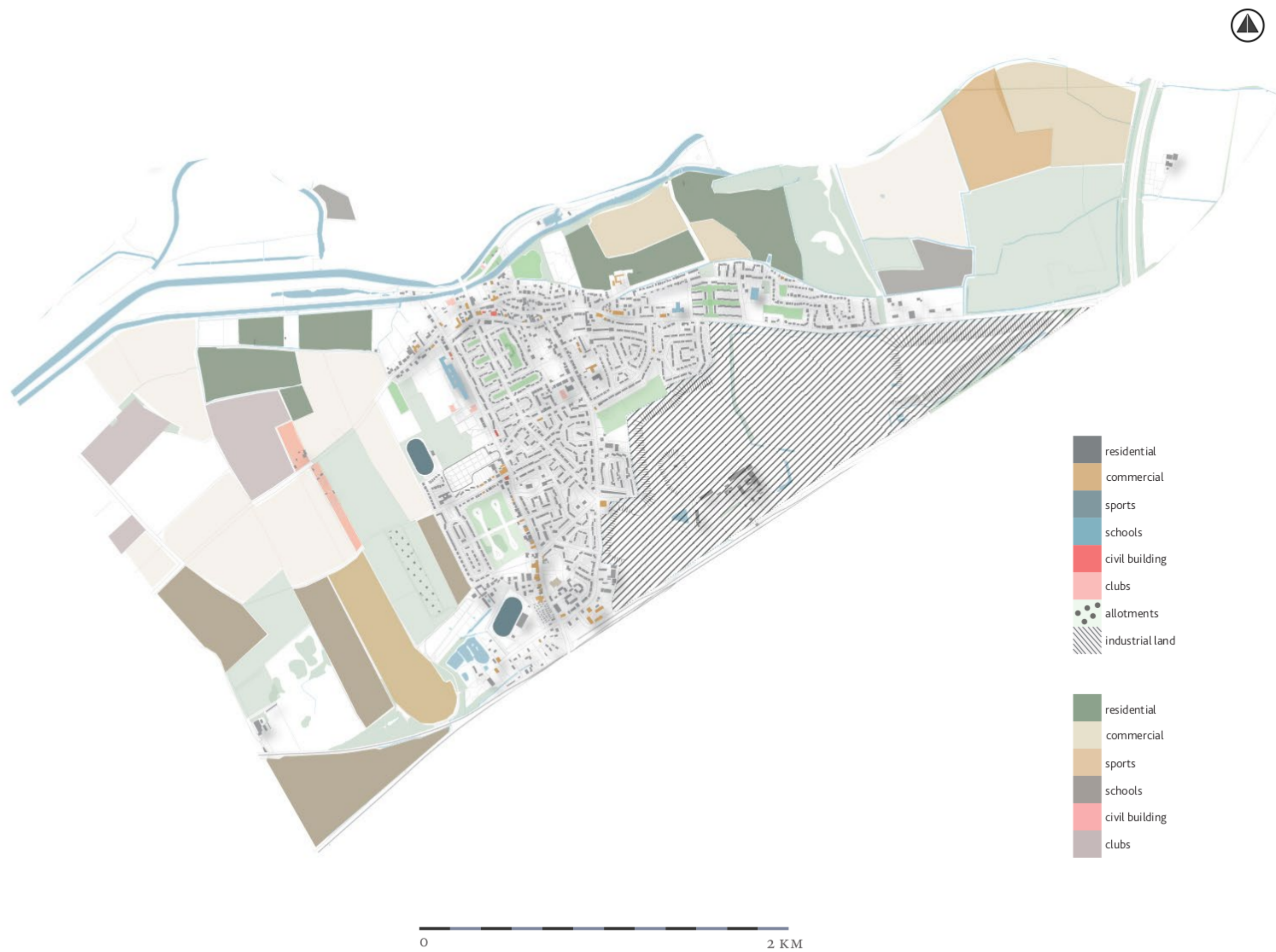


Figure 5.12. Land Use

Figure 5.13. Vehicle movement (Open streetmap 2019)

Figure 5.14.Public transport (Open streetmap 2019)

The movement analysis has shown that the city has proximity to the larger urban area of Doncaster, as well as it is well-connected with railway and Yorkshire motorway M18, which provides a good opportunity for growth and creates an attractive environment for investment. Interestingly, the analysis of the heat map (Figure 5.15.) shows main pedestrian routes, as well as tertiary routes, which are allocated in the former mining site and next to the city's river Don.

Figure 5.15.Pedestrian movement (Strava 2019)

Figure 5.16. Cycle map (Open streetmap 2019)

SITE ANALYSIS

Green areas

The analysis of green areas shows that city is dominated by informal green areas, whilst design green are-as are not either commonly used or maintained, as it can be seen from photos presenting change or exist-ing state of green and play environments. Therefore, it is vital to inte-grate the development of new green recreation facilities in the proposed toolkit.

Figure 5.17. Green areas

SITE ANALYSIS

Points of attraction

Stainforth has seven listed buildings (see Appendix 3). However, the analysis of social media posts from Facebook (2019) and Instagram (2019) has shown that the dominant attention belongs to the Hatfield Colliery, which is also Grade II listed, as well as the riverfront, which makes them key points of attraction by residents and local visitors.

Also, within the last century, the city has lost lots of iconic places loved by residents, such as Stainforth Market and cinema. In Figure 5.2. you can find comments of people regarding the demolition of key attractions.

Hence, for the preservation of mining culture and addressing the demands and aspirations of local communities- it is vital to preserve the existing physical environment and create new points of attraction, that can be connected within the city grid.

Figure 5.22.Points of Attraction

Demolished Landmarks

Stainforth Market ?-early 1970's

Stainforth Savoy Cinema 1950th-1996

Stainforth Signal Box 1915-1980

The Peacock Pub 1959-2002

People's comments

- "...Oh wow what a building! Bet that was bulldozed anything of historic value ends up getting pulled down for modern housing..."
- "...the council would rather destroy buildings than preserve them for future generations...many children would now benefit from a local cinema run by local people..."
- "...a signal box, where my husband used to work.."
- "My first job..."
- "My favourite pub in Stainforth had loads of laughts back in the day..."
- "I loved it..."
- "...Had my wedding reception there..."

Figure 5.23. Demolished historic landmarks and people's comments about landmarks

Figure 5.24. Attraction Point 1: Hatfield Colliery (Social media analysis)

Figure 5.24. shows the analysis of social media and people's perception towards the colliery site, whereby the majority of people feel nostalgic and proud of being part of the mining history, which in turn indicates on the high priority of community involvement and mining history preservation.

The Hatfield colliery site consists of 90 ha of industrial land. The colliery itself was conserved in the "wet way" (Northern mine research society 2019), where the shaft is 786 meters deep, whilst the length of underground mining works (tunnels) is 82 km. For more details regarding employment and coal extraction please refer Appendix 5. Interestingly that in 70th colliery also used to extract methane, which makes it reasonable to propose methane extraction. Besides, the mining site has 2 basins for mining water, which is divided by railway. Therefore, to propose the use of those basins – there should be developed a new bridge and connections of the mining site and water basins.
The social and cultural value of the site was discussed previously in this chapter.

Figure 5.25. Hatfield Colliery: Physical environment (Doncaster Council 2019; Stainforth online 2019)

Figure 5.26. Summary: Opportunities and Constraints

Overall, the chapter of the analysis of the site has allowed forming key objectives for the toolkit application.

First of all, there is high demand and requirements to preserve mining history and culture. Secondly, there should be conducted land and water reclamation to improve environmental conditions and preserve species and biodiversity. Thirdly, the Hatfield colliery site presents a variety of opportunities for new industry development below and above ground, such as methane, watered mine shafts, water basis and other. Also, it is important to develop new opportunities from the existing physical environment, such as railway, motorway, and water (river Don) access, proximity to energy pylons (please refer appendix 6).

All of those interventions should bring the new meaning to the mining site, that will allow creating new employment opportunity and knowledge growth.

In addition to that, as most of the industrial site- the site of Hatfield colliery is separated from the city, as well as divided on its own by railway. That's why it is important to develop new routes and bridges to connect the site.

This summary and analysis were used to set the objectives for the toolkit application discussed on page 63. However, it is worth to mention several limitations of, such as the absence of the height data of the site, as well as the absence of data for land surface temperature, which is associated with geothermal energy. However, the toolkit in that will be discussed in the next chapter will still use geothermal energy site as a tool, because in non-volcanic regions like France and Germany- there used Enhanced geothermal Systems, which can generate heat from lower heat sources (Greenmatch 2019). As well as the UK aims to increase geothermal energy consumption, whereby such intervention in the selected site can be supported nationally and attract investment.

06 DESIGN DEVELOPMENT

6-1 INTRODUCTION....61
6-2 CONCEPT ALTERNATIVES....62
6-3 OBJECTIVES AND APPLICATION OF THE TOOLKIT....63
6-4 CONCEPT MASTERPLAN....64
6-5 DESIGN AND OBJECTIVES....65
6-6 PHASING AND EVALUATION....68

DESIGN DEVELOPMENT

Introduction to the chapter

Figure 6 illustrates the approach that will be used in this chapter.
The analysis conducted in the previous part has shown that the site has a variety of opportunities below and above grown. Therefore the proposed toolkit will try to maximise the outcomes of the intervention and fulfill objectives discussed in the summary of chapter 5 and on page 63.

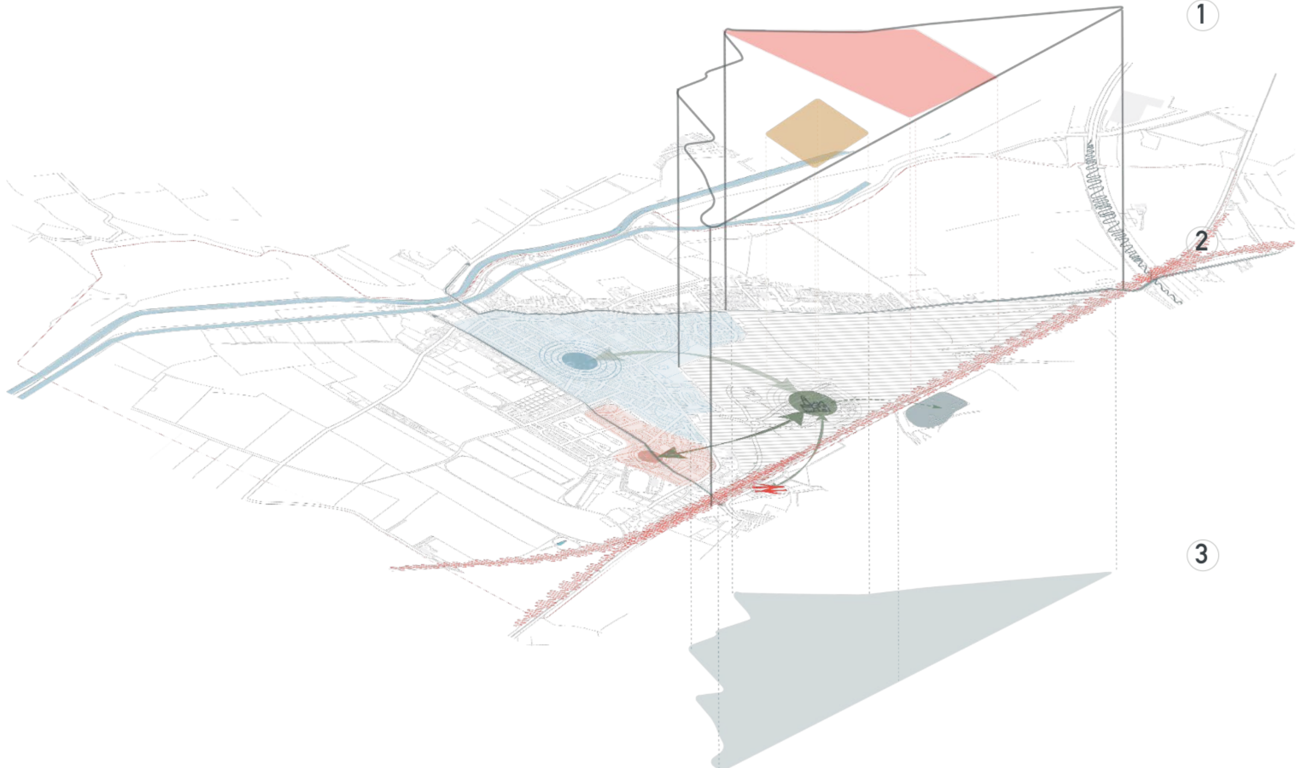


Figure 6. Introduction and aim of the chapter

DESIGN DEVELOPMENT

Objectives and application of the toolkit

OBJECTIVES

The series of objectives grew from the analysis of the site presented in chapter 5. Please refer to page 58. Whilst the analysis of case studies and literature has allowed identifying tools that can help to achieve those objectives (Page 43).

The proposed concept plan illustrates the potential implementation of those tools in place of former Hatfield colliery.

The limitation of this approach is its conceptuality and routes, as well as use, might be adjusted

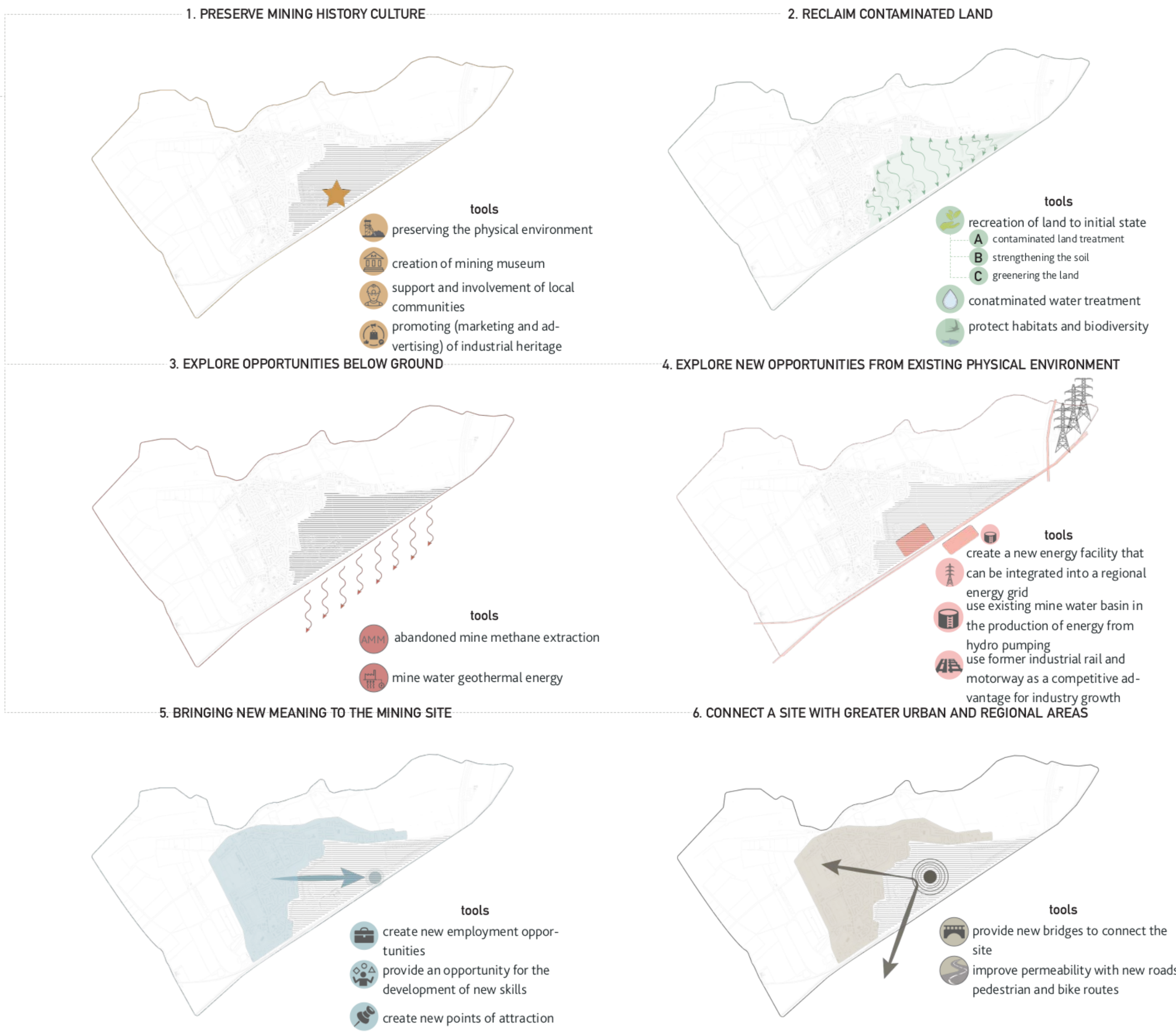


Figure 6.4 Objectives and Tools

Figure 6.5. Concept masterplan

DESIGN DEVELOPMENT

Design and objectives

Objective 1: Preserve Mining History and Culture

"Welcome to Stainforth! The new life with old traditions" is the slogan that can be used to meet residents and visitors of the city. The preservation of mining history and culture aimed to be achieved at three stages.
First, it is crucial to recreate contaminated land and water, preserve and maintain the physical environment of the colliery. Whilst later there can be created mining museum and additional points of attraction, such as new recreation areas that should be linked by bridges and new routes.
The industrial heritage should be promoted to attract new investments and support residents and community, who should be involved in the decision making at all of the stages.

Figure 6.6. Concept design for preservation of history

Stage 1

- recreation of land to initial state
- preserving physical environment
- support and involvement of local communities

Stage 2

- provide new bridges to connect the site
- creation of mining museum
- improve permiability with new roads, pedestrian and bike routes
- support and involvement of local communities
- promoting (marketing and advertising) of industrial heritage

Stage 3

- create new points of attraction
- promoting (marketing and advertising) of industrial heritage

Objective 2: Reclaim Contaminated Land

The collages below illustrate the potential change that land reclamations can bring and with the case of Eden project we can prove that it is feasible.
Local communities should be involved to monitor the impact of land reclamation and recreation initiative on their health and living. After the initial land treatment- soil should be strengthened to allow to develop new buildings and industries on former contaminated land.

Figure 6.7. Mining site: before

Figure 6.8. Mining site: after

Stage 1

- support and involvement of local communities and community consultation
- recreation of land to initial state
  - A contaminated land treatment

Stage 2

- recreation of land to initial state
  - B strengthening the soil
- conatminated water treatment

Stage 3

- recreation of land to initial state
  - C greenering the land
- protect habitats and biodiversity

Objective 3: Explore Opportunities Below Ground

The area has a methane release and previously Hatfield colliery used to extract methane (See Appendix 5). The more methane wells located at the site- the more gas can be extracted. In Figure 6.9. there proposed 20 methane bores with 25 meters safety zone around them. Such intervention will allow reducing the impact of methane releases on the environment and health.
Next to the methane station there proposed to install the system building with modular degassing equipment, which also contains cooling station (number 2 in Fig. 6.9. , approx. 1200 sq m). Also, within this area, there can be installed a geothermal plant (number 3) with lower capacity.
Potentially, the area of methane industry can be reduced and changed to mixed-use developments down the northern road, to prevent segregation with the residential area.
To minimise landscape impact- industrial areas can be designed with greener surroundings and even have recreation areas around them, whilst the save zone around those industries still should remain 25 meters (Pivnyak 2015).

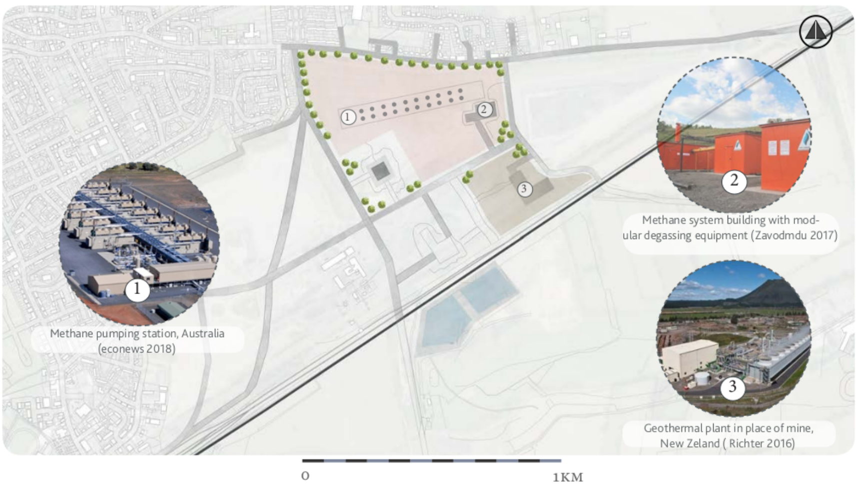


Figure 6.9. Concept design: methane extraction and a geothermal plant

Stage 1
- support and involvement of local communities and community consultation
- recreation of land to initial state
  - A contaminated land treatment
- conatminated water treatment
- recreation of land to initial state
  - B strengthening the soil

Stage 2
- abandoned mine methane extraction

Stage 3
- mine water geothermal energy

Objective 4: Explore New Opportunities From Existing Physical Environment

Figure 6.10. illustrates the potential location of hydro-pumping station next to water basins (number 1). In addition to that, former Hatfield colliery used to have small energy station, we is proposed to be relocated to point 3 in figure 6.10. It can be used to integrate and transform produced energy and integrate it to neighbouring energy pylons (see Appendix 6).
Point 2 in the figure 6.10 illustrates the area designated to growth for industries and can be used to allocated potential solar station or waste-to-power energy station to increase the energy mix produced within the site and allow to integrate produced energy to the national grid.

Figure 6.10. Concept design: Hydro-pumping and energy station

Stage 1
- support and involvement of local communities and community consultation
- recreation of land to initial state
  - A contaminated land treatment
- conatminated water treatment
- recreation of land to initial state
  - B strengthening the soil

Stage 2
- create a new energy facility that can be integrated to a regional energy grid
- use existing mine water basin in the production of energy from hydro pumping

Stage 3
- use former industrial rail and motorway as a competitive advantage for industry growth

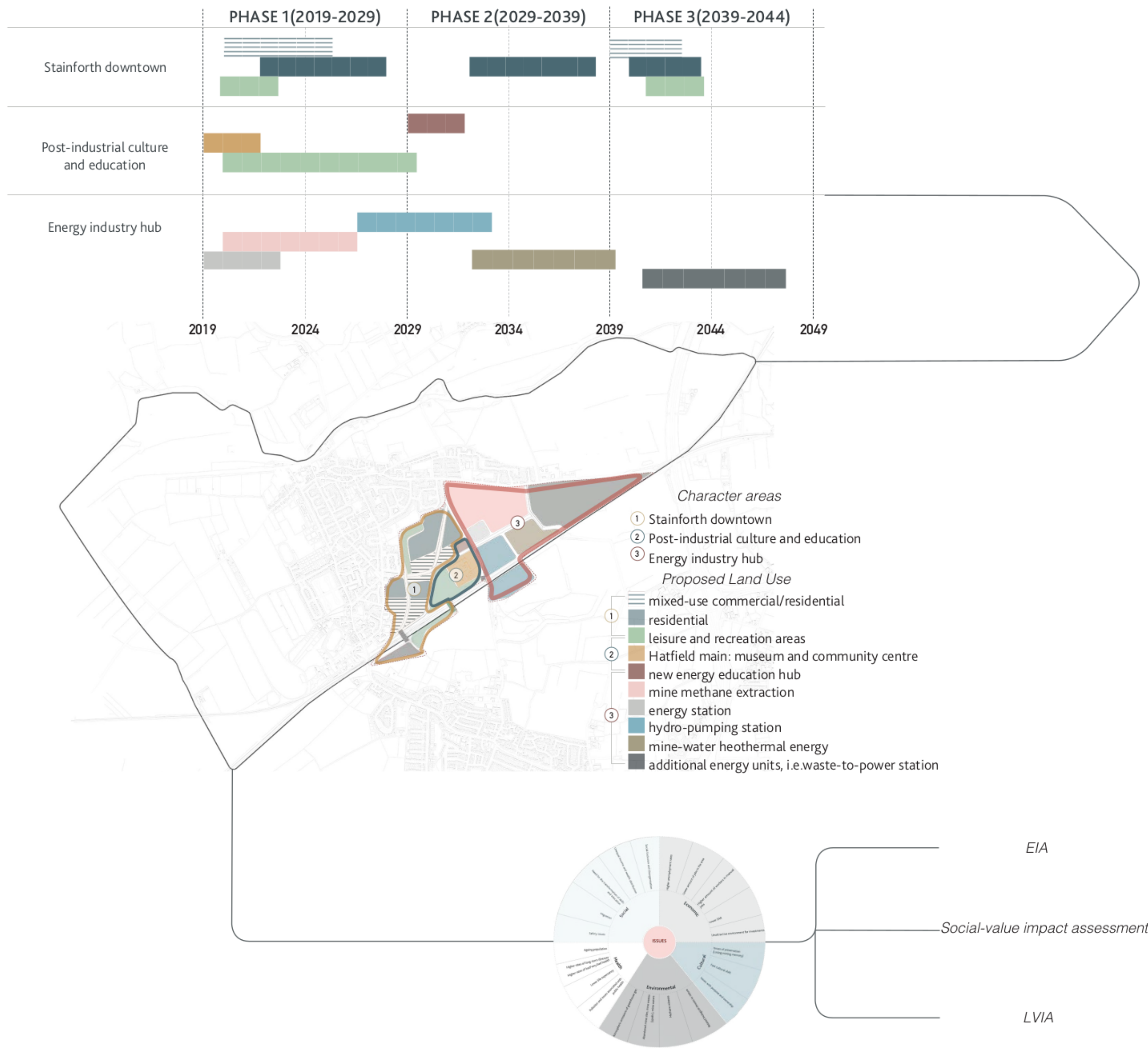


Figure 6.13. Phasing, character areas, and evaluation

Overall, the design can be divided into three-character areas of Stainforth downtown, proposed growth of the city center. Post-industrial culture and education with mining museum, community center, leisure and recreation areas, and energy education center. And the third area of energy industry-hub, which will bring employment and allow to achieve sustainable growth benefitting from facilities and environment left on site.

The phasing illustrates the strategy of prioritising the development, which will help to provide new residential, commercial activity simultaneously with the growth of proposed industries.

Whilst proposed an evaluation of the implementation of the toolkit can be done by analysing the wheel developed in this research, as well as conducting environmental impact assessment (EIA), social value impact assessment, and landscape value impact assessment (LVIA).

07 CONCLUSION

The research has shown that mining site can become central for life and economy as it was explored in case studies sections. Case of Ruhr, Pas-de-Calais has shown that complex intervention that aims to regenerate industry and promote mining culture can bring new meaning to the site.

At the beginning of this paper there was discussed social, economic, environmental, and health issues as a key indicator for sustainable growth. However, current attempts for regeneration do not solve these issues in complex, which leads to the displacement, uneven replacement of quality and quantity of jobs, as well as the demolition of culture.

This paper has proven, that the existing facilities of former mining sites can help to achieve regeneration and should not be neglected. There can be developed a new energy uses, which can provide a quality employment and knowledge growth, as well as the culture of mining should be preserved, rather than replaced by housing, because throughout the whole paper there was multiple proves that local community is proud of it and treat former collieries as their cultural heritage. Hence, the mining site is not simply a nostalgic moment, rather it has a great potential of becoming a central focus of attention.

The reasonable question to ask is “why do not everyone utilises this approach yet?”. It can be explained by the issues of funding. For example, in Ruhr mining companies that used to exploit coal were obliged to regenerate the site, whilst in the UK such a pattern is not common. However, funding issues can be seen as the limitation of this paper that needs to be explored more.

Besides, in the future there can be presented more quantitative study, that will help to measure costs and opportunities of such interventions, as well as numerically evaluate it.

Also, this paper has more concept approach and answers the question “How can the former mining area, which was a centre of the life and economy of mining town be exploited and developed to have a new role as a central focus in the future life and economy of town?”. Hence, the development of more detailed design can be provided.

This research has led to a greater amount of questions, but what became clear is that existing closed mining sites and those that will appear in future in different countries will need to look strategically at the opportunities provided and issues that are most commonly shared. As well as it worth to remember, that regeneration should benefit local residents, who aspire culture and need socio-economic growth.

08 REFERENCES

A

ADRIANO, D. ET.AL. (1980). UTILIZATION AND DISPOSAL OF FLY ASH AND OTHER COAL RESIDUES IN TERRESTRIAL ECOSYSTEMS: A REVIEW. JOURNAL OF ENVIRONMENTAL QUALITY ABSTRACT [ONLINE]. 9(3), PP. 333-344. AVAILABLE AT: HTTPS://DL.SCIENCESOCIETIES.ORG/PUBLICATIONS/JEQ/ABSTRACTS/9/3/JEQ0090030333 [ACCESSED 6 JULY 2019].

ALLGAIER, F. (1997). ENVIRONMENTAL EFFECTS OF MINING. MINING ENVIRONMENTAL HANDBOOK [ONLINE]. 140-157. AVAILABLE AT: HTTPS://WWW.WORLDSCIENTIFIC.COM/DOI/ABS/10.1142/9781860943768_0005 [ACCESSED 30 JUNE 2019].

AMIRTAHMASEBI, R. ET.AL. (2015). REGENERATING URBAN LAND. WORLD BANK GROUP: URBAN DEVEL-OPMENT SERIES [ONLINE]. AVAILABLE AT: HTTPS://OPENKNOWLEDGE.WORLDBANK.ORG/HAN-DLE/10986/24377 [ACCESSED 29 JULY 2019].

ANDREWS, R. (2017). A BRIEF REVIEW OF UNDERGROUND COAL MINE ENERGY STORAGE. ENERGY MATTERS [ONLINE]. AVAILABLE AT: HTTP://EUANMEARNS.COM/A-BRIEF-REVIEW-OF-UNDERGROUND-COAL-MINE-ENERGY-STORAGE/ [ACCESSED 29 JULY 2019].

ANGLO AMERICAN (2013). MINE CLOSURE TOOLBOX [ONLINE]. VERSION II. AVAILABLE AT: HTTPS://WWW.ANGLOAMERICAN.COM/~/MEDIA/FILES/A/ANGLO-AMERICAN-GROUP/PLC/SUSTAINABILITY/APPROACH-AND-POLICIES/ENVIRONMENT/MINE-CLOSURE-TOOL-BOX/TOOLBOX-MAIN-BROCHURE-LR.PDF [ACCESSED 30 JUNE 2019].

ARAGON, F. ET.AL. (2015). MINING CLOSURE AND EMPLOYMENT REALLOCATIONS: THE CASE OF UK COAL MINES. EDITORIAL EXPRESS [ONLINE]. AVAILABLE AT: HTTPS://EDITORIALEXPRESS.COM/CGI-BIN/CONFERENCE/DOWNLOAD.CGI?DB_NAME=CSAE2016&PAPER_ID=500 [ACCESSED 29 JUNE 2019].

B

BEATTY, C. ET.AL. (2007). TWENTY YEARS ON: HAS THE ECONOMY OF THE UK COALFIELDS RECOVERED. ENVIRONMENT AND PLANNING A: ECONOMY AND SPACE [ONLINE]. 39 (7), 1654-1675. AVAILA-BLE AT: HTTPS://JOURNALS.SAGEPUB.COM/DOI/10.1068/A38216 [ACCESSED 29 JUNE 2019].

BELL, D. AND JAYNE, M. (2003). 'DESIGN-LED' URBAN REGENERATION: A CRITICAL PERSPECTIVE. THE JOURNAL OF THE LOCAL ECONOMY POLICY UNIT [ONLINE]. 18(2), PP. 121-134. AVAILABLE AT: HTTPS://JOURNALS.SAGEPUB.COM/DOI/PDF/10.1080/0269094032000061396 [ACCESSED 29 JULY 2019].

BELL, F. ET.AL. (2001). ENVIRONMENTAL IMPACTS ASSOCIATES WITH AN ABANDONED MINE IN THE WITBANK COALFIELD, SOUTH AFRICA. INTERNATIONAL JOURNAL OF COAL GEOLOGY [ONLINE]. 45, PP. 195-216. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0166516200000331 [ACCESSED 30 JUNE 2019].

BIBLER, C. ET.AL. (1998). STATUS OF WORLDWIDE COAL MINE METHANE EMISSION AND USE. INTERNATIONAL JOURNAL OF COAL GEOLOGY [ONLINE]. 35(1-4), PP. 283-310. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0166516297000384 [ACCESSED 4 AUGUST 2019].

BIDDULPH, M. (2011). URBAN DESIGN, REGENERATION AND THE ENTREPRENEURIAL CITY. PROGRESS IN PLANNING [ONLINE]. 76(2), PP.63-203. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0305900611000377 [ACCESSED 29 JULY 2019].

BIFFA AWARD (2019). GRANTS SCHEME GUIDANCE NOTES [ONLINE]. AVAILABLE AT: HTTP://WWW.BIFFA-AWARD.ORG/WP-CONTENT/UPLOADS/2018/06/BOM156-GUIDANCE-NOTES-FOR-ONLINE-AP-PLICATION-FORM-V10-1017.PDF [ACCESSED 29 JUNE 2019].

BLOOLOOP (2018). EDEN PROJECT INTERNATIONAL'S AMBITIOUS OVERSEAS EXPANSION PLANS IN CHINA, DUBAI AND AUSTRALASIA. BLOOLOOP: NETWORKING THE ATTRACTION BUSINESS [ONLINE]. AVAILABLE AT: HTTPS://BLOOLOOP.COM/FEATURES/EDEN-PROJECT-INTERNATIONAL-DAVID-HARLAND/ [ACCESSED 30 JUNE 2019].

BOF (2019). TZW ENERGIEZENTRALE, HAMBURG. BOF ARCHITEKTEN [ONLINE]. AVAILABLE AT: HTTP://WWW.BOF-ARCHITEKTEN.DE/0719_TZW_ENERGIEZENTRALE.HTML [ACCESSED 29 JULY 2019].

BP (2018). STATISTICAL REVIEW OF WORLD ENERGY [ONLINE]. AVAILABLE AT: HTTPS://WWW.BP.COM/CONTENT/DAM/BP/BUSINESS-SITES/EN/GLOBAL/CORPORATE/PDFS/ENERGY-ECONOMICS/STATISTI-CAL-REVIEW/BP-STATS-REVIEW-2018-FULL-REPORT.PDF [ACCESSED 29 JUNE 2019].

BRIDGEWEB (2017). ISTANBUL PARKS TO BE LINKED BY ECO FOOTBRIDGE. BRIDGE: DESIGN AND ENGINEERING [ONLINE]. AVAILABLE AT: HTTPS://WWW.BRIDGEWEB.COM/ISTANBUL-PARKS-TO-BE-LINKED-BY-ECO-FOOTBRIDGE/4373 [ACCESSED 30 JULY 2019].

BURRELL, G. (2017). THE ROLE OF COAL MINING TOWNS IN SOCIAL THEORY: PAST, PRESENT AND FUTURE. TAYLOR & FRANCIS IN GLOBAL DISCOURSE [ONLINE]. AVAILABLE AT: HTTP://WP.LANCS.AC.UK/GOOD-CULTURE/FILES/2018/01/02-BURRELL.PDF [ACCESSED 29 JULY 2019]

C

CESTENFRANCE (N.D.). CENTRE HISTORIQUE MINIER DE LEWARDE [ONLINE]. AVAILABLE AT: HTTP://WWW.CESTENFRANCE.FR/CENTRE-HISTORIQUE-MINIER-DE-LEWARDE/ [ACCESSED 29 JULY 2019].

CHANWICK, M., HIGHTON, N. AND LINDMAN, N. (2013). ENVIRONMENTAL IMPACTS OF COAL MINING & UTILIZAION: COMPLETE REVISION OF ENVIRONMENTAL IMPLICATIONS OF EXPANDED COAL UTI-LIZATION. ELSEVIER [ONLINE]. AVAILABLE AT: HTTPS://BOOKS.GOOGLE.CO.UK/BOOKS?ID=KLPZAGAAQBAJ&DQ=ENVIRONMENTAL%20IMPACTS%20OF%20COAL%20MINING&LR&SOURCE=GBS_SIMI-LARBOOKS [ACCESSED 6 JULY 2019].

CLARKE ENERGY (2019). ABANDONED MINE METHANE (AMM) [ONLINE]. AVAILABLE AT: HTTPS://WWW.CLARKE-ENERGY.COM/COAL-GAS/ABANDONED-MINE-GAS/ [ACCESSED 29 JUNE 2019].

COAL AUTHORITY (2014). COAL AUTHORITY INTERACTIVE MAPVIEW [ONLINE]. AVAILABLE AT: HTTPS://WWW.GOV.UK/GUIDANCE/USING-COAL-MINING-INFORMATION#COAL-AUTHORITY-INTERAC-TIVE-MAP-VIEWER [ACCESSED 29 JUNE 2019].

COTE, M. AND COLLINGS, R. (2016). OPTIMIZING ABANDONED MINE METHANE PROJECTS. GLOBAL METHANE FORUM, WASHINGTON D.C. GLOBAL METHANE INITIATIVE [ONLINE]. AVAILABLE AT: HTTPS://WWW.GLOBALMETHANE.ORG/FORUM/PRESENTATIONS/COAL/TUESDAY-SESSION-1/COTE_RCE_OPTIMIZING_AMM.PDF [ACCESSED 29 JUNE 2019].

K

KALIN, M. (2004). PASSIVE MINE WATER TREATMENT: THE CORRECT APPROACH? ECOLOGICAL ENGINEERING [ONLINE]. 22(4-5), PP. 299-304. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0925857404000709 [ACCESSED 3 AUGUST 2019].

KARACAN, C. ET.AL. (2011). COAL MINE METHANE: A REVIEW OF CAPTURE AND UTILIZATION PRACTICES WITH BENEFITS TO MINING SAFETY AND TO GREENHOUSE GAS REDUCTION. INTERNATIONAL JOURNAL OF COAL GEOLOGY [ONLINE]. 86 (2-3), PP. 121-156. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0166516211000437 [ACCESSED 4 AUGUST 2019].

KINNAN, F. (1986). TECHNIQUES FOR ESTABLISHING INGROUND SUPPORT FOOTINGS AND STRENGTHENING AND STABILISING THE SOIL AT INGROUND LOCATIONS. US. PATENT DOCUMENT [ONLINE]. AVAILABLE AT: HTTPS://PATENTIMAGES.STORAGE.GOOGLEAPIS.COM/35/98/A1/1F241F70333E4C/US4618287.PDF [ACCESSED 3 AUGUST 2019].

KIRCHNER, J. (N.D.) THE TASKS OF RAG- STIFTUNG. THE RAG STIFTUNG FOUNDATION [ONLINE]. AVAILABLE AT: HTTPS://WWW.RAG-STIFTUNG.DE/EN/FOUNDATION [ACCESSED 29 JUNE 2019].

L

LAL, R. (2014). SOIL CONSERVATION AND ECOSYSTEM SERVICES. INTERNATIONAL SOIL AND WATER CONSERVATION RESEARCH [ONLINE]. 2 (3), PP. 36-47. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S2095633915300216 [ACCESSED 29 JULY 2019].

LEARY, M. AND MCCARTHY, J. (2013). THE ROUTLEDGE COMPANION TO URBAN REGENERATION. ROUTLEDGE COMPANIONS [ONLINE]. AVAILABLE AT: HTTPS://BOOKS.GOOGLE.CO.UK/BOOKS?HL=EN&LR=&ID=PULFAQAAQBAJ&OI=FND&PG=PP1&DQ=CULTURE+LED+URBAN+REGENERATION&OTS=RLH8A4YIVY&SIG=1Z53E4HJALUHYRUXFOSCVRDXZAK#V=ONEPAGE&Q=CULTURE%20LED%20URBAN%20REGENERATION&F=FALSE [ACCESSED 29 MARCH 2019].

LEE, J. (2018). CHINA'S SINKING COAL MINING TOWNS AND VILLAGES – IN PICTURES. THE GUARDIAN: GLOBAL FOCUS [ONLINE]. AVAILABLE AT: HTTPS://WWW.THEGUARDIAN.COM/GLOBAL-DEVELOPMENT-PROFESSIONALS-NETWORK/GALLERY/2016/SEP/09/CHINAS-SINKING-COAL-MINE-TOWNS-AND-VILLAGES-IN-PICTURES [ACCESSED 29 JULY 2019].

LINDEIJER, E. (2000). BIODIVERSITY AND LIFE SUPPORT IMPACTS OF LAND USE IN LCA. JOURNAL OF CLEANER PRODUCTION [ONLINE]. 8(4), PP. 313-319. AVAILABLE AT : HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0959652600000251 [ACCESSED 8 JULY 2019].

LOUGHRAM, J. (2018). GEOTHERMALLY HEATED WATER FROM OLD MINE TO HEAT HOMES IN WALES. ENGINEERING AND TECHNOLOGY [ONLINE]. AVAILABLE AT: HTTPS://EANDT.THEIET.ORG/CONTENT/ARTICLES/2018/01/GEOTHERMALLY-HEATED-WATER-TO-BE-PUMPED-FROM-OLD-MINE-TO-HEAT-WELSH-VILLAGE-HOMES/ [ACCESSED 29 JUNE 2019].

M

MACALISTER, T. ET.AL. (2015). THE DEMISE OF UK COAL MINING; DECADES OF DECLINE. THE GUARDIAN [ONLINE]. AVAILABLE AT : HTTPS://WWW.THEGUARDIAN.COM/BUSINESS/NG-INTERACTIVE/2015/DEC/18/THE-DEMISE-OF-UK-DEEP-COAL-MINING-DECADES-OF-DECLINE [ACCESSED 29 JUNE 2019].

MADANIPOUR, A. (2006). ROLES AND CHALLENGES OF URBAN DESIGN. JOURNAL OF URBAN DESIGN [ONLINE]. 11(2), PP. 173-193. AVAILABLE AT: HTTPS://WWW.TANDFONLINE.COM/DOI/ABS/10.1080/13574800600644035?CASA_TOKEN=4ACM8BICSDUAAAAA:IQZTSDK7CTVUNWFWCJHKCOW-AX8JWCXPYONTAJYSXYE7K5LUOLO5KMOXATLXAWGXBJHQZGZXSGGI_Q [ACCESSED 29 JULY 2019].

MANGENA, S. AND BRENT, A. (2006). APPLICATION OF A LIFE CYCLE IMPACT ASSESSMENT FRAMEWORK TO EVALUATE AND COMPARE ENVIRONMENTAL PERFORMANCES WITH ECONOMIC VALUES OF SUPPLIED COAL PRODUCTS. JOURNAL OF CLEANER PRODUCTION [ONLINE]. 14 (12-13), PP. 1071-1084. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0959652605000521 [ACCESSED 30 JUNE 2019].

MARTIN, D. (N.D.). PUBLIC HEALTH, SAFETY AND ENVIRONMENTAL IMPACTS OF COAL TRANSPORTATION AND STORAGE. SIERRA CLUB [ONLINE]. AVAILABLE AT: HTTPS://CONTENT.SIERRACLUB.ORG/CREATIVE-ARCHIVE/SITES/CONTENT.SIERRACLUB.ORG.CREATIVE-ARCHIVE/FILES/PDFS/100_306_LOUISIANAEXPORTS_FACTSHT-03_LOWRES.PDF [ACCESSED 30 JUNE 2019].

MARTINAT, S. ET.AL. (2014). THE EXPANSION OF COAL-MINING IN THE SEPRESSION AREAS- A WAY TO DEVELOPMENT? JOURNAL O STUDIES AND RESEARCH IN HUMAN GEOGRAPHY [ONLINE]. 8(1), PP. 5-15. AVAILABLE AT: HTTPS://S3.AMAZONAWS.COM/ACADEMIA.EDU.DOCUMENTS/42049916/THE_EXPANSION_OF_COAL_MINING_IN_THE_DEPR20160204-30232-1B3OMHI.PDF?RESPONSE-CONTENT-DISPOSITION=INLINE%3B%20FILENAME%3DTHE_EXPANSION_OF_COAL_MINING_IN_THE_DEPR.PDF&X-AMZ-ALGORITHM=AWS4-HMAC-SHA256&X-AMZ-CREDENTIAL=AKIAIWOWYYGZ2Y53UL3A%2F20190610%2FUS-EAST-1%2FS3%2FAWS4_REQUEST&X-AMZ-DATE=20190610T132757Z&X-AMZ-EXPIRES=3600&X-AMZ-SIGNEDHEADERS=HOST&X-AMZ-SIGNATURE=0D1DA9B984649368OE1CD70645DACA18A8DDD694D245C1CF930EF5E2FF504CB4 [ACCESSED 9 JUNE 2019].

MCKENZIE, W. (2018). RETIRED ALBERTA COAL MINE APPROVED FOR LARGE-SCALE HYDRO POWER STORAGE PROJECT. BIOCAP: ENERGY SAVING [ONLINE]. AVAILABLE AT: HTTPS://WWW.BIOCAP.CA/%E2%80%8BRETIRED-ALBERTA-COAL-MINE-APPROVED-FOR-LARGE-SCALE-HYDRO-POWER-STORAGE-PROJECT/ [ACCESSED 29 JULY 2019].

MCLVOR, A. AND JOHNSTON, R. (2007). MINERS' LUNG: A HISTORY OF DUST DISEASE IN BRITISH COAL MINING. ROUTLEDGE: LONDON [ONLINE]. PP. 237-273. AVAILABLE AT: HTTPS://WWW.TAYLORFRANCIS.COM/BOOKS/9781315595504 [ACCESSED 30 JUNE 2019].

MEYER, P. AND LYONS, T. (2007). LESSONS FROM PRIVATE SECTOR BROWNFIELD REDEVELOPERS. JOURNAL OF AMERICAN PLANNING ASSOCIATION [ONLINE]. 66(1), PP.46-57. AVAILABLE AT: HTTPS://WWW.TANDFONLINE.COM/DOI/ABS/10.1080/01944360008976083?CASA_TOKEN=RFBZHAICDUGAAAAA:QCDLQ-EACINGGJ_NQP_OPBETKUZAJDAPCDQE-OBTINXBVBERM3E1B4VGF213E-4LYHJFNDYZKU59AG [ACCESSED 29 JUNE 2019].

MILES, S. AND PADDISON, R. (2005). INTRODUCTION: THE RISE AND RISE OF CULTURE-LED URBAN REGENERATION. JOURNAL OF URBAN STUDIES [ONLINE]. 42(5/6), PP. 833-839. AVAILABLE AT: HTTPS://JOURNALS.SAGEPUB.COM/DOI/PDF/10.1080/00420980500107508 [ACCESSED 29 JULY 2019].

MINJNWATER (2014). MINE WATER: A BASIS FOR SUSTAINABLE ENERGY [ONLINE]. AVAILABLE AT: HTTPS://WWW.MIJNWATER.COM/MINEWATER-THEN/?LANG=EN [ACCESSED 29 JUNE 2019].

MUHAMMAD, I. ET.AL. (2014). ENVIRONMENTAL CONCERNS OF UNDERGROUND COAL GASIFICATION. RENEWABLE AND SUSTAINABLE ENERGY REVIEWS [ONLINE]. 31, PP. 600-610. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S1364032113008381 [ACCESSED 15 JUNE 2019].

N

NATIONAL GRID (2017). NETWORK ROUTE MAPS [ONLINE]. AVAILABLE AT: HTTPS://WWW.NATIONALGRIDET.COM/NETWORK-AND-ASSETS/NETWORK-ROUTE-MAPS [ACCESSED 20 JULY 2019].

NORTHERN MINE RESEARCH SOCIETY (N.D.). COAL MINING IN THE BRITISH ISLES [ONLINE]. AVAILABLE AT: HTTPS://WWW.NMRS.ORG.UK/MINES-MAP/COAL-MINING-IN-THE-BRITISH-ISLES/ [ACCESSED 29 JUNE 2019].

ODNR GEOLOGICAL SURVEY (N.D.). SHALLOW SOURCES AND APPLICATIONS OF GEOTHERMAL ENERGY [ONLINE]. AVAILABLE AT: HTTP://GEOSURVEY.OHIODNR.GOV/ENERGY-RESOURCES/GEOTHERMAL-ENERGY/SHALLOW-GEOTHERMAL [ACCESSED 29 JULY 2019].

O

ODNR GEOLOGICAL SURVEY (N.D.). SHALLOW SOURCES AND APPLICATIONS OF GEOTHERMAL ENERGY [ONLINE]. AVAILABLE AT: HTTP://GEOSURVEY.OHIODNR.GOV/ENERGY-RESOURCES/GEOTHERMAL-ENERGY/SHALLOW-GEOTHERMAL [ACCESSED 29 JULY 2019].

ONEGAI-KAERU (2016). HOW TO GET IKESHIMA ISLAND AND WHERE TO STAY: FORGOTTEN COAL MINE [ONLINE]. AVAILABLE AT: HTTPS://WWW.ONEGAI-KAERU.JP/2016/05/11/HOW-TO-GET-IKESHIMA-ISLAND-AND-WHERE-TO-STAY/ [ACCESSED 29 JULY 2019].

ONS (2012). LIFE EXPECTANCY AT BIRTH AND AT AGE 65 BY LOCAL AREAS IN THE UNITED KINGDOM: 2006-08 TO 2010-12. OFFICE FOR NATIONAL STATISTICS [ONLINE]. AVAILABLE AT: HTTPS://WWW.ONS.GOV.UK/PEOPLEPOPULATIONANDCOMMUNITY/BIRTHSDEATHSANDMARRIAGES/LIFEEXPECTANCIES/BULLETINS/LIFEEXPECTANCYATBIRTHANDATAGE65BYLOCALAREASINTHEUNITEDKINGDOM/2014-04-16 [ACCESSED 29 JUNE 2019].

ONS (2016). REGIONAL AND LABOUR MARKET STATISTICS IN THE UK. OFFICE OF NATIONAL STATISTICS [ONLINE]. AVAILABLE AT: HTTPS://WWW.ONS.GOV.UK/EMPLOYMENTANDLABOURMARKET/PEOPLEINWORK/EMPLOYMENTANDEMPLOYEETYPES/BULLETINS/REGIONALLABOURMARKET/JULY2016 [ACCESSED 29 JUNE 2019].

P

PARIS-POTTSVILLE EXPRESS (2013). COAL MAKING A COMEBACK IN MUCH OF EUROPE, BUT NOT IN FRANCE [ONLINE]. AVAILABLE AT: HTTPS://POTTSVILLE-PARIS-EXPRESS.BLOGSPOT.COM/2013/05/COAL-MAKING-COMEBACK-IN-MUCH-OF-EUROPE.HTML [ACCESSED 29 JUNE 2019].

PARRY, J. (2003). THE CHANGING MEANING OF WORK: RESTRUCTURING IN THE FORMER COALMINING COMMUNITIES OF THE SOUTH WALES VALLEYS. WORK, EMPLOYMENT AND SOCIETY [ONLINE]. 17(2), PP. 227-246. AVAILABLE AT: HTTPS://JOURNALS.SAGEPUB.COM/DOI/ABS/10.1177/0950017003017002001 [ACCESSED 29 JUNE 2019].

PIVNYAK, G. (2015). NEW DEVELOPMENTS IN MINING ENGINEERING 2015: THEORETICAL AND PRACTICAL SOLUTIONS OF MINERAL RESOURCES MINING. TECHNOLOGY AND ENGINEERING [ONLINE]. AVAILABLE AT: HTTPS://BOOKS.GOOGLE.CO.UK/BOOKS?ID=FQDCCWAAQBAJ&DQ=DEEP+COAL+MINE+LIQUIDATION+TECHNOLOGIES+WET+DRY&SOURCE=GBS_NAVLINKS_S [ACCESSED 15 JUNE 2019].

POWER, A. AND WILSON, W. (2000). SOCIAL EXCLUSION AND THE FUTURE OF CITIES. CASE: CENTRE FOR ANALYSIS OF SOCIAL EXCLUSION [ONLINE]. AVAILABLE AT: HTTP://SIMONPOULTER.CO.UK/IOD/IODPDF/CASEPAPER35.PDF [ACCESSED 29 JUNE 2019].

R

RAO, P. AND PATHAK, K. (2005). SOCIO-ECONOMIC IMPACTS OF MINE CLOSURE: A CASE STUDY USING SATELLITE IMAGERY. INTERNATIONAL JOURNAL OF ENVIRONMENTAL STUDIES [ONLINE]. 52(5), PP. 555-570. AVAILABLE AT: HTTPS://WWW.TANDFONLINE.COM/DOI/FULL/10.1080/00207230500196351 [ACCESSED 29 JUNE 2019].

RENEWABLES NETWORKING (N.D.). CASE STUDY: MINE WATER FOR RENEWABLE ENERGY [ONLINE]. AVAILABLE AT: HTTPS://WWW.RENEWABLES-NETWORKING.EU/DOCUMENTS/CASESTUDY-HEERLEN-THENETHERLANDS.PDF [ACCESSED 29 JUNE 2019].

ROYAL DUTCH SHELL (2018). SHELL ANNOUNCES METHANE EMISSIONS INTENSITY TARGET FOR OIL AND GAS ASSETS. SHELL [ONLINE]. AVAILABLE AT: HTTPS://WWW.SHELL.COM/MEDIA/NEWS-AND-MEDIA-RELEASES/2018/SHELL-ANNOUNCES-METHANE-EMISSIONS-INTENSITY-TARGET.HTML [ACCESSED 29 JUNE 2019].

RYAN, J. (2017). OLD COAL MINES HAVE A PLACE IN THE FUTURE OF CLEAN ENERGY. BLOOMBERG [ONLINE]. AVAILABLE AT: HTTPS://WWW.BLOOMBERG.COM/NEWS/FEATURES/2017-05-24/OLD-COAL-MINES-HAVE-A-PLACE-IN-THE-FUTURE-OF-CLEAN-ENERGY [ACCESSED 29 JUNE 2019].

RYAN, J. (2017). OLD COAL MINES HAVE A PLACE IN THE FUTURE OF CLEAN ENERGY. BLOOMSBERG [ONLINE]. AVAILABLE AT: HTTPS://WWW.BLOOMBERG.COM/NEWS/FEATURES/2017-05-24/OLD-COAL-MINES-HAVE-A-PLACE-IN-THE-FUTURE-OF-CLEAN-ENERGY [ACCESSED 29 JUNE 2019].

S

SANDLE, P. (2013). IN MINING RUINS LEFT BY THATCHER, NEW ECONOMY STRUGGLES. REUTERS [ONLINE]. AVAILABLE AT: HTTPS://UK.REUTERS.COM/ARTICLE/UK-BRITAIN-THATCHER-COAL/IN-MINING-RUINS-LEFT-BY-THATCHER-NEW-ECONOMY-STRUGGLES-IDUKBRE93B07C20130412 [ACCESSED 29 JULY 2019].

SAPSFORD, D. ET.AL. (2007). LOW FOOTPRINT PASSIVE MINE WATER TREATMENT: FIELD DEMONSTRATION AND APPLICATION. MINE WATER AND THE ENVIRONMENT [ONLINE]. 26(4), PP. 243-250. AVAILABLE AT: HTTPS://LINK.SPRINGER.COM/ARTICLE/10.1007/S10230-007-0012-6 [ACCESSED 4 AUGUST 2019].

SCHULZ,F. AND WIEGLEB, G. (2000). DEVELOPMENT OPTIONS OF NATURAL HABITATS IN POST-MINING LANDSCAPE. LAND DEGRADATION AND DEVELOPMENT [ONLINE]. 11(2), PP. 99-110. AVAILABLE AT: HTTPS://ONLINELIBRARY.WILEY.COM/DOI/ABS/10.1002/%28SICI%291099-145X%28200003/04%2911%3A2%3C99%3A%3AAID-LDR368%3E3.0.CO%3B2-I [ACCESSED 9 JUNE 2019].

SHANDRO, J. ET.AL. (2011). PERSPECTIVES ON COMMUNITY HEALTH ISSUES AND THE MINING BOOM–BUST CYCLE. RESOURCES POLICY [ONLINE]. 36(2), PP. 178-186. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0301420711000055 [ACCESSED 30 JUNE 2019].

SLOSS, L. (2017). ENVIRONMENTAL AND OTHER EFFECTS OF MINING AND TRANSPORTATION. IEA CLEAN COAL CENTRE [ONLINE]. AVAILABLE AT: HTTPS://WWW.USEA.ORG/SITES/DEFAULT/FILES/ENVIRONMENTAL%20AND%20OTHER%20EFFECTS%20OF%20MINING%20AND%20TRANSPORT%20CCC281.PDF [ACCESSED 30 JUNE 2019].

SONTER, L. ET.AL. (2014). OFFSETTING THE IMPACTS OF MINING TO ACHIEVE NO NET LOSS OF NATIVE VEGETATION. CONSERVATION BIOLOGY [ONLINE]. 28(4). AVAILABLE AT : HTTPS://ONLINELIBRARY.WILEY.COM/DOI/FULL/10.1111/COBI.12260 [ACCESSED 8 JULY 2019].

SPRINGER, N. (2015). FUEL SUSTAINABILITY BRIEF: NATURAL GAS. BSR [ONLINE]. AVAILABLE AT: HTTPS://WWW.BSR.ORG/EN/OUR-INSIGHTS/REPORT-VIEW/FUEL-SUSTAINABILITY-BRIEF-NATURAL-GAS [ACCESSED 29 JUNE 2019].

STAINFORTH OLD PHOTOS (N.D.). STAINFORTH OLD PHOTOS GROUP. FACEBOOK [ONLINE]. AVAILABLE AT: HTTPS://WWW.FACEBOOK.COM/STAINFORTHOLDPHOTOS/ [ACCESSED 29 JULY 2019].

STAINFORTH TOWN COUNCIL (2018). STAINFORTH NEIGHBOURHOOD DEVELOPMENT PLAN [ONLINE]. AVAILABLE AT: HTTPS://WWW.DONCASTER.GOV.UK/SERVICES/PLANNING/STAINFORTH-NEIGHBOURHOOD-DEVELOPMENT-PLAN [ACCESSED 29 JULY 2019].

STAINFORTHONLINE (N.D.) LOCAL HISTORIAN'S SCINTILLATING STAINFORTH SNIPPETS [ONLINE]. AVAILABLE AT: HTTP://WWW.STAINFORTHONLINE.CO.UK/2001/LOCALHISTORIANSNIPPETS.HTM [ACCESSED 15 JULY 2019].

STAMFORD, L. AND AZAPAGIC, A. (2014). LIFE CYCLE ENVIRONMENTAL IMPACTS OF UK SHALE GAS. APPLIED ENERGY [ONLINE]. 134(1), PP. 506-518. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S0306261914008745 [ACCESSED 30 JUNE 2019].

STRANG, K. (2017). INNOVATIVE CLOSED-LOOP UNDERGROUND PUMPED HYDROELECTRICITY GEOTHERMAL STORAGE SYSTEM. INTERNATIONAL JOURNAL OF ENVIRONMENTAL STUDIES [ONLINE]. 74(3). AVAILABLE AT: HTTPS://WWW.TANDFONLINE.COM/DOI/FULL/10.1080/00207233.2017.1288060 [ACCESSED 4 AUGUST 2019].

REFERENCES

T

THE COAL AUTHORITY (N.D.) UNDERSTANDING MINE WATER TREATMENT [ONLINE]. AVAILABLE AT: HTTPS://ASSETS.PUBLISHING.SERVICE.GOV.UK/GOVERNMENT/UPLOADS/SYSTEM/UPLOADS/ATTACHMENT_DATA/FILE/362236/UNDERSTANDING_MINE_WATER_TREATMENT.PDF [ACCESSED 11 JUNE 2019].

THE COALFIELD REGENERATION TRUST (2018). OUR IMPACT: EMPLOYMENT [ONLINE]. AVAILABLE AT: HTTPS://WWW.COALFIELDS-REGEN.ORG.UK/EMPLOYMENT [ACCESSED 29 JUNE 2019].

TOMS, M. (2014). KING COAL DETHRONED: THE DECLINE AND FALL OF THE BRITISH COAL INDUSTRY. OXERA: COMPELLING ECONOMICS [ONLINE]. AVAILABLE AT: HTTPS://WWW.OXERA.COM/WP-CONTENT/UPLOADS/2018/07/KING-COAL.PDF.PDF [ACCESSED 29 JUNE 2019].

TRADING ECONOMICS (2019). UNITED KINGDOM EMPLOYMENT RATE [ONLINE]. AVAILABLE AT: HTTPS://TRADINGECONOMICS.COM/UNITED-KINGDOM/EMPLOYMENT-RATE [ACCESSED 29 JUNE 2019].

TU DELFT (N.D.). MINE WATER PROJECT [ONLINE]. AVAILABLE AT: HTTPS://WWW.TUDELFT.NL/EN/CEG/ABOUT-FACULTY/DEPARTMENTS/GEOSCIENCE-ENGINEERING/SECTIONS/RESOURCE-ENGINEERING/LINKS/COAL-MINING-IN-THE-NETHERLANDS/FORMER-MINING-COMPANIES/MINE-WATER-PROJECT/ [ACCESSED 29 JUN 2019].

U

UN ENVIRONMENT (2019). OIL AND GAS SECTOR CAN BRING QUICK CLIMATE WIN BY TACKLING METHANE EMISSIONS. UNITED NATIONS ENVIRONMENT PROGRAMME [ONLINE]. AVAILABLE AT: HTTPS://WWW.UNENVIRONMENT.ORG/NEWS-AND-STORIES/STORY/OIL-AND-GAS-SECTOR-CAN-BRING-QUICK-CLIMATE-WIN-TACKLING-METHANE-EMISSIONS [ACCESSED 29 JUNE 2019].

UNECE (2018). 13TH SESSION GROUP OF EXPERTS ON COAL MINE METHANE [ONLINE]. AVAILABLE AT: HTTP://WWW.UNECE.ORG/INDEX.PHP?ID=48539 [ACCESSED 29 JUNE 2019].

UNESCO (2018). SITES OF JAPAN'S MEIJI INDUSTRIAL REVOLUTION: IRON AND STEEL, SHIPBUILDING AND COAL MINING, JAPAN. UNITED NATIONS EDUCATION, SCIENTIFIC AND CULTURAL ORGANISATION: WORLD HERITAGE CONVENTION [ONLINE]. AVAILABLE AT: HTTPS://WHC.UNESCO.ORG/EN/DECISIONS/6364/ [ACCESSED 30 JUNE 2019].

V

VEIGA, M. ET.AL. (2009). MINING WITH COMMUNITIES. NATURAL RESOURCES FORUM [ONLINE]. 25 (2001), PP. 191-202. AVAILABLE AT: HTTPS://ONLINELIBRARY.WILEY.COM/DOI/EPDF/10.1111/J.1477-8947.2001.TB00761.X [ACCESSED 30 JUNE 2019].

W

WARHUST, A. ET.AL. (2008). PLANNING FOR MINE CLOSURE: SOCIO-ECONOMIC IMPACTS. MINERALS & ENERGY- RAW MATERIALS REPORT 1999 [ONLINE]. 14(3), PP. 21-26. AVAILABLE AT: HTTPS://WWW.TANDFONLINE.COM/DOI/ABS/10.1080/14041049909362535?JOURNALCODE=SMIN20 [ACCESSED 29 JUNE 2019].

WAYMARKING (N.D.). ROYAL OAK UNDERGROUND STATION - LORD HILL'S BRIDGE, LONDON, UK IMAGE [ONLINE]. AVAILABLE AT: HTTP://WWW.WAYMARKING.COM/GALLERY/IMAGE.ASPX?F=1&GUID=87473782-0FA1-4C99-8F31-B5688D3AF4E3 [ACCESSED 29 JULY 2019].

WOLKERSDORFER, C. (2005). MINE WATER MANAGEMENT AND THE WATER FRAMEWORK DIRECTIVE. POST-MINING [ONLINE]. AVAILABLE AT: FILE://AD.UCL.AC.UK/HOME1/UCBQKM1/DOCUMENTS/GISOSWOLKERSDORFER.PDF [ACCESSED 9 JUNE 2019].

WORLD BANK (2018). MANAGING COAL MINE CLOSURE: ACHIEVING A JUST TRANSITION FOR ALL. WORLD BANK GROUP [ONLINE]. AVAILABLE AT: HTTP://DOCUMENTS.WORLDBANK.ORG/CURATED/EN/484541544643269894/PDF/130659-REVISED-PUBLIC-MANAGING-COAL-MINE-CLOSURE-ACHIEVING-A-JUST-TRANSITION-FOR-ALL-NOVEMBER-2018-FINAL.PDF [ACCESSED 29 JUNE 2019].

WORLD COAL ASSOCIATION (2014). HOW IS COAL CONVERTED TO ELECTRICITY? WORLDCOAL [ONLINE]. AVAILABLE AT: HTTPS://WWW.WORLDCOAL.ORG/COAL/USES-COAL/COAL-ELECTRICITY [ACCESSED 29 JUNE 2019].

Y

YOUNGER, P. (2004). ENVIRONMENTAL IMPACTS OF COAL MINING AND ASSOCIATED WASTES: A GEOCHEMICAL PERSPECTIVE. GEOLOGICAL SOCIETY, LONDON, SPECIAL PUBLICATIONS [ONLINE]. 13, PP. 169-209. AVAILABLE AT: HTTPS://SP.LYELLCOLLECTION.ORG/CONTENT/236/1/169.SHORT [ACCESSED 6 JULY 2019].

Z

ZAVODMDU (2017). FACTORY OF MODULAR DEGASSING UNITS [ONLINE]. AVAILABLE AT: HTTP://WWW.ZAVODMDU.RU/EN/ [ACCESSED 29 JULY 2019].

ZHENGFU, B. ET.AL. (2010). ENVIRONMENTAL ISSUES FROM COAL MINING AND THEIR SOLUTIONS. MINING SCIENCE AND TECHNOLOGY (CHINA) [ONLINE]. 20(2), PP. 215-223. AVAILABLE AT: HTTPS://WWW.SCIENCEDIRECT.COM/SCIENCE/ARTICLE/PII/S1674526409601873 [ACCESSED 6 JULY 2019].

APPENDICES

1

	Social Indicators						Economic Indicators		
Coalfield	Population, 2011	(%) of Total Population			Population growth, 2001-2011 (%)	LSOAS/datazones in deprived area GB (%)	Number of jobs in area per 100 residents of working age, 2012	Employment rate (%), 2011	% of residents in manual jobs, 2012
		0-15	16-64	65+					
Yorkshire	1,218,000	19	64	17	2.8	42	55	73	57
South Wales	757,000	19	64	18	3.2	54	41	69	57
Durham	599,000	18	64	18	-0.1	51	48	71	55
Lancashire	566,000	19	65	16	4.2	48	56	73	55
Nottinghamshire	526,000	19	64	18	4.7	38	51	74	58
North Derbyshire	332,000	18	64	18	4.3	38	61	74	58
North Staffordshire	279,000	19	64	17	2.1	51	45	72	62
Fife	267,000	18	65	17	5.4	45	48		57
N Warwickshire	190,000	20	65	16	3.6	23	56		57
S Derbys/NW Leics	165,000	19	64	17	10.6	11	57		52
Northumberland	145,000	18	64	19	3.6	43	40	71	55
Lothian	144,000	19	65	17	6.9	23	42		53
Ayrshire/Lanarkshire	125,000	18	65	17	3.6	50	37		59
South Staffordshire	122,000	19	65	17	5.5	24	52		56
West Cumbria	65,000	18	64	18	3	52	51		61
Kent	44,000	18	62	20	5.3	10	36		52
TOTAL // AVERAGE (for Coalfields)	5,544,000	19	64	17	4	43	50		59
GB Average		19	65	17	7.5	30		76	48

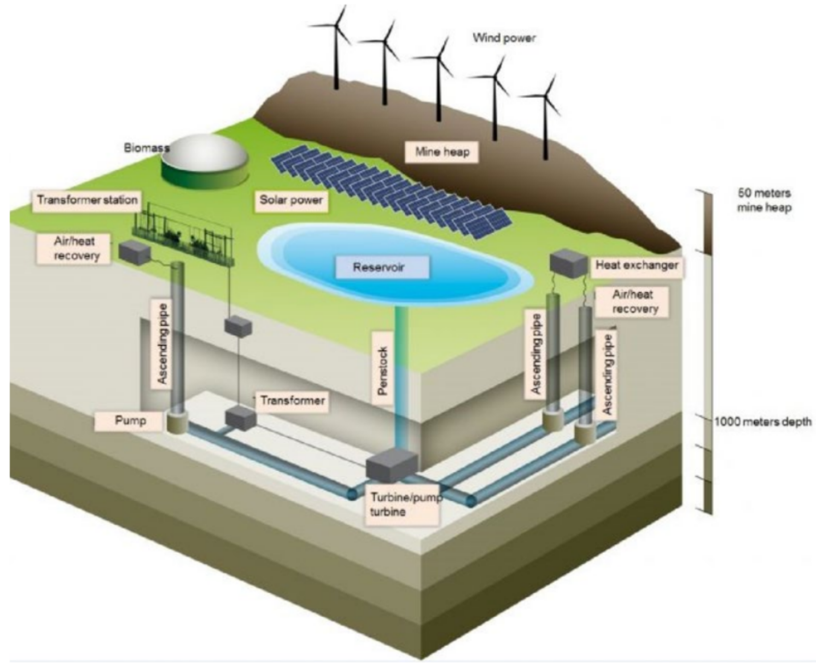
		Health Indicators					
Out-of-work benefit claimant rate (%), 2013	Unemployment 16-24 (%), 2011	Average life expectancy At Birth (yrs)		Average life expectancy At age 65 (yrs)		(%) of residents	
		Male	Female	Male	Female	General health bad or very bad	Long-term health problem
13.6	14.5	77	81	17	20	7.4	11.2
17.1	14.5	76	81	17	19	9.8	14.9
15.8	15.6	77	81	17	19	8.6	12.6
14.5	14.5	77	81	17	19	7.5	11.3
12.9	14.5	78	82	17	20	7.1	11.0
12.6	14	78	82	17	20	7.6	11.6
14.7	13.1	77	81	17	19	7.9	11.8
15.7	15.5	76	81	17	20	6.1	10.7
10.1	12.9	78	82	17	20	6.0	9.1
8.3	11.4	79	82	18	20	5.3	8.6
14.7	16.5	79	82	18	20	7.6	11.1
11.6	11.1	77	81	17	19	5.1	9.1
15.2	16.4	75	80	16	19	6.9	11.7
10.4	14	77	82	17	20	6.7	10.3
15.3	13.6	78	82	18	20	7.7	11.8
10.4	13.1	79	82	18	21	6.4	10.2
14.1	14	77	81	17	20	7.6	11.7
10.9	12.2	78	82	18	20	5.6	8.6

Appendix 1. Social, Economic, Health Statistics for Coalfields (Foden et.al 2014; ONS 2012; ONS 2014)

■ FINAL RESPONSIBILITY □ MONITOR □ SUPPORT/ COOPERATE

ACTORS	Framework	Exploration	Construction	Operation	Closure	Post-Closure
GOVERNMENT	SET ROLES & RESPONSIB.	MONITOR, ENFORCE, INFORM				MONITOR AND INFORM
MINING COMPANY	SUPPORT	CONSULT – DESIGN SITE W/ CLOSURE IN VIEW – PARTNERSHIPS				INITIAL MONITORING THEN SUPPORT
COMMUNITY	SUPPORT	INTEGRATE CLOSURE PLANNING IN BUSINESS PROCESSES FORM AND SUSTAIN PARTNERSHIPS WITH COMPANY AND OTHERS				
LOCAL GOVERNMENT	SUPPORT	BEGIN REGIONAL PLANNING PROCESSES WITH CLOSURE IN MIND EARLY ON SET-UP AND SUSTAIN PARTNERSHIPS – SUSTAINABLE ECONOMIC ACTIVITIES				
NGOS/ CIVIL SOCIETY ORG.	SUPPORT	LINKS TO INTERNATIONAL NGOS – CAPACITY BUILDING FOR LOCAL COMMUNITIES – MONITOR AND INFORM				
INTERNATIONAL AGENCIES	SUPPORT	DISSEMINATE BEST PRACTICE - DEVELOP AND PROPAGATE STANDARDS AND GUIDELINES – WORK WITH GOVERNMENT, COMPANIES AND COMMUNITIES				

Appendix 2. Mine Closure Planning (World Bank 2002)



Appendix 3. Transformation of former mine into a pumped-hydro facility (Andrews , 2017)

Appendix 4. Stainforth: Listed buidlings (Historic England 2019)

APPENDICES

5-6

YEAR	EMPLOYMENT (PERSONS)	COAL EXTRACTED PER YEAR (TONNS)	FACT
1927	2000	866,400	
1930	3600	1,444,000	
1961	2600	938,600	
1970	1730	624,530	100 CUBIC FEET OF METHANE PER MINUTE WAS EXTRACTED
1977	1770	638,000	
1983		471000	
1984	1709	616,949	
1986	1086	392,046	
1990	787	284107	
1991	620	384400	
1992	459	165699	
1993	300	108300	CLOSED (DRY CONSERVATION)
2001	223	80503	CLOSED (DRY CONSERVATION)
2004	175	63175	CLOSED (DRY CONSERVATION)
2007			
2008			
2011			
2013			
2015			CLOSED ((WET CONSERVATION)

Appendix 5. Hatfield Colliery: Facts (Northern mine research society 2019)

Appendix 6. Energy Pylons and Stainforth (National Grid , 2017)

RISK ASSESSMENT FORM
FIELD / LOCATION WORK

UCL

The Approved Code of Practice - Management of Fieldwork should be referred to when completing this form
http://www.ucl.ac.uk/estates/safetynet/guidance/fieldwork/acop.pdf

DEPARTMENT/SECTION BARLETT SCHOOL OF PLANNING
LOCATION(S) SOUTH YORKSHIRE COALFIELD
PERSONS COVERED BY THE RISK ASSESSMENT Kateryna Martovytska

BRIEF DESCRIPTION OF FIELDWORK Observation and analysis of coalfields

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.
If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.
Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / **low** ?

The highest potential risk associated with the fieldwork might be pollution of the area, while other risks were not identified

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
☐	work abroad incorporates Foreign Office advice
☐	participants have been trained and given all necessary information
☐	only accredited centres are used for rural field work
V	participants will wear appropriate clothing and footwear for the specified environment
☐	trained leaders accompany the trip
☐	refuge is available
☐	work in outside organisations is subject to their having satisfactory H&S procedures in place
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EMERGENCIES	**Where emergencies may arise use space below to identify and assess any risks**
e.g. fire, accidents	Examples of risk: loss of property, loss of life

The risk of such emergencies is low

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
☐	participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
☐	fire fighting equipment is carried on the trip and participants know how to use it
V	contact numbers for emergency services are known to all participants
V	participants have means of contacting emergency services
☐	participants have been trained and given all necessary information
☐	a plan for rescue has been formulated, all parties understand the procedure
☐	the plan for rescue /emergency has a reciprocal element
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

FIELDWORK 1 May 2010

EQUIPMENT	**Is equipment used?**	NO	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
☐	the departmental written Arrangement for equipment is followed
☐	participants have been provided with any necessary equipment appropriate for the work
☐	all equipment has been inspected, before issue, by a competent person
☐	all users have been advised of correct use
☐	special equipment is only issued to persons trained in its use by a competent person
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	**Is lone working a possibility?**	YES	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. alone or in isolation lone interviews.	Examples of risk: difficult to summon help. Is the risk high / medium / **low**?		

There is a potential of observations and gathering on-site information alone. However, because the area is inhabited the risk of hazard is low

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
☐	the departmental written Arrangement for lone/out of hours working for field work is followed
☐	lone or isolated working is not allowed
V	location, route and expected time of return of lone workers is logged daily before work commences
V	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
☐	all workers are fully familiar with emergency procedures
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

WORKING ON OR NEAR WATER	Will people work on or near water?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess ar risks
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / lc		

CONTROL MEASURES Indicate which procedures are in place to control the identified risk

- ☐ lone working on or near water will not be allowed
- ☐ coastguard information is understood; all work takes place outside those times when tides could prove a threa
- ☐ all participants are competent swimmers
- ☐ participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
- ☐ boat is operated by a competent person
- ☐ all boats are equipped with an alternative means of propulsion e.g. oars
- ☐ participants have received any appropriate inoculations
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	Do MH activities take place?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES Indicate which procedures are in place to control the identified risk

- ☐ the departmental written Arrangement for MH is followed
- ☐ the supervisor has attended a MH risk assessment course
- ☐ all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
- ☐ all persons performing MH tasks are adequately trained
- ☐ equipment components will be assembled on site
- ☐ any MH task outside the competence of staff will be done by contractors
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	Will participants work with substances	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		

CONTROL MEASURES Indicate which procedures are in place to control the identified risk

- ☐ the departmental written Arrangements for dealing with hazardous substances and waste are followed
- ☐ all participants are given information, training and protective equipment for hazardous substances they may encounter
- ☐ participants who have allergies have advised the leader of this and carry sufficient medication for their needs
- ☐ waste is disposed of in a responsible manner
- ☐ suitable containers are provided for hazardous waste
- ☐ OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	Have you identified any other hazards?	NO	If 'No' move to next section If 'Yes' use space below to identify and assess any risks
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		

CONTROL MEASURES Give details of control measures in place to control the identified risks

Have you identified any risks that are not adequately controlled?			
	NO	V	Move to Declaration
	YES	☐	Use space below to identify the risk and what action was taken

Is this project subject to the UCL requirements on the ethics of Non-NHS Human Research?

If yes, please state your Project ID Number

For more information, please refer to: http://ethics.grad.ucl.ac.uk/

DECLARATION The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

- ☑ I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk
- ☑ I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR **Colin Haylock**

**** SUPERVISOR APPROVAL TO BE CONFIRMED VIA E-MAIL ****

FIELDWORK 5 May 2010

Major Research Project

BPLN0052

Urban design and City Planning

Kateryna Martovytska

2018/2019