

Ekonomická
fakulta
Faculty
of Economics

Jihočeská univerzita
v Českých Budějovicích
University of South Bohemia
in České Budějovice

University of South Bohemia
Faculty of Economics
Department of Regional Management

Master thesis

FINANCING OF BROWNFIELDS IN SELECTED COUNTRIES

Author: Bc. Matěj Řehoř

Supervisor of diploma thesis: RNDr. Zuzana Dvořáková Líšková, Ph.D.

České Budějovice 2020

Original copy of the assignment

UNIVERSITY OF SOUTH BOHEMIA IN ČESKÉ BUDĚJOVICE

Faculty of Economics

Academic year: 2019/2020

ASSIGNMENT OF DIPLOMA THESIS

(project, art work, art performance)

Name and surname: **Matěj ŘEHŮŘ**
Personal number: **E18446**
Study programme: **M6237 Regional and European Project Management**
Field of study:
Work topic: **Financing of Brownfields in Selected Countries**
Assigning department: **Department of Regional Management**

Theses guidelines

Objective:

The most important aim of the thesis is to define the concept of brownfield as such, to understand the reasons for its origin and to understand the reasons for the revitalization. The emphasis is placed on the occurrence of industrial brownfields mainly in the Czech Republic, however the examples of brownfields located in Germany and France, and in other European countries are also discussed.

Methodological approach:

- 1) The concept of brownfield as such. Different definitions of the term. How to distinguish brownfield from other objects;
- 2) Brownfield financing. Different sources of brownfield financing and securing;
- 3) Reasons for the formation of brownfield land;
- 4) The approach to brownfield redevelopment;
- 5) The impact of brownfields on the environment and the surrounding infrastructure;
- 6) Definitions of CABERNET, CLARNET;
- 7) Brownfield project and initiatives, such as HOMBRE.TIMBRE, RESCUE;
- 8) Comparison of brownfields in the Czech Republic, France and Germany using examples.

Framework structure:

1. Introduction. Objectives.
2. Theoretical background.
3. Research.
4. Conclusion.
5. English summary.
6. References, Appendices.

Extent of work report: **50 – 60 pages**
Extent of graphics content: **as necessary**
Form processing of diploma thesis: **printed**
Language of elaboration: **English**

Recommended resources:

Cabernet: Concerted Action on Brownfield and Economic Regeneration Network: Brownfield [online]. [cit. 2018-12-28]. Dostupné z: <http://www.cabernet.org.uk>

Dennison, Mark S. (1998). Brownfields Redevelopment: Programs and Strategies for Rehabilitating Contaminated Real Estate. Government Institutes, Rockville, Maryland.

The European Regional Development Fund: Financial instruments [online]. 2015 [cit. 2019-04-22]. Dostupné z: https://www.fi-compass.eu/sites/default/files/publications/ERDF_The_european_regional_development_fund_EN.pdf


Meliene, V., Wignall, L., MALYS, N. (2010). Journal of Environmental Engineering and Landscape Management: Brownfield regeneration [online]. 2010 [cit. 2019-02-04]. Dostupné z: https://www.researchgate.net/publication/225071284_Brownfield_Regeneration_Waterfront_Site_Developments_in_Liverpool_and_Cologne

Osman, R., Frantál, B., Klusáček, P., Kunc, J., Martínát, S. (2015). Factors affecting brownfield regeneration in post-socialist space: The case of the Czech Republic. Land Use Policy [online]. 2015, 48, 309-316 [cit. 2017-01-19]. Dostupné z: <http://www.sciencedirect.com/science/article/pii/S0264837715001702>

Supervisors of diploma thesis: **RNDr. Zuzana Dvořáková Lišková, Ph.D.**
Department of Regional Management

Date of assignment of diploma thesis: **January 30, 2020**

Submission deadline of diploma thesis: **August 15, 2020**


doc. Dr. Ing. Dagmar Škodová Parmová
Dean

JIHOČESKÁ UNIVERZITA
V ČESKÝCH BUĎĚJOVICÍCH
EKONOMICKÁ FAKULTA
Studentská 13
270 05, Česká Budějovice


doc. Ing. Eva Čudlinová, CSc.
Head of Department

In České Budějovice January 30, 2020

Statement

I hereby declare that, in accordance with Article 47b of Act No. 111/1998 Coll. in the valid wording, I agree with the publication of my master thesis, in full form to be kept in the Faculty of Economics archive, in electronic form in publicly accessible part of the IS STAG database operated by the University of South Bohemia in České Budějovice accessible through its web pages. Further, I agree to the electronic publication of the comments of my supervisor and thesis opponents and the record of the proceedings and results of the thesis defence in accordance with aforementioned Act No. 111/1998 Coll. I also agree to the comparison of the text of my thesis with the Theses.cz thesis database operated by the National Registry of University Theses and a plagiarism detection system.

České Budějovice, August 31st, 2020

Bc. Matěj Řehoř

Acknowledgement

I would like to thank madam RNDr. Zuzana Dvořáková Líšková, Ph.D. for her supervision and for providing me documents that helped me with this master thesis.

CONTENT

Introduction.....	10
1. Introduction to the topic of brownfields	12
2. Brownfield definitions.....	15
2.1. Brownfields within the global understanding	19
2.2. Brownfield classification	21
2.2.1. Viable or self-developing brownfield sites (category A).....	21
2.2.2. Marginally non-viable or passive-developing sites (Category B)	22
2.2.3. Non-viable or non-developing sites (category C).....	22
2.2.4. Another categorization of brownfields	23
2.3. Greenfield sites.....	23
2.3.1. Greenfield Sites.....	23
3. Brownfield financing	25
3.1. Brownfield financing	25
3.2. Four models of financing brownfield redevelopment.....	27
3.2.1. Public-Private Partnerships (PPPs).....	27
3.2.2. Land Value Finance (LVF)	27
3.2.3. Urban Development Funds.....	28
3.2.4. Impact Investment Funds	28
3.3. Types of funds helping finance brownfield sites	28
3.3.1. The European Regional Development Fund.....	28

3.3.2.	Cohesion Fund	28
3.3.3.	European Agricultural Fund for Rural Development	29
3.3.4.	European Social Fund	29
3.3.5.	JESSICA	29
3.4.	Other instruments of brownfield financing	30
4.	Reasons for brownfield occurrence	36
4.1.	Options for brownfield elimination.....	40
5.	Brownfield regeneration	41
5.1.	Sustainable brownfield redevelopment	45
5.2.	Regeneration process of brownfield.....	50
5.2.1.	Site selection	52
5.2.2.	Site preliminary assessment.....	52
5.2.3.	Main site investigation	56
5.2.4.	Funding methods.....	57
5.2.5.	Remediation strategies and options	57
5.2.6.	Site clean-up	58
5.2.7.	Site management.....	58
5.2.8.	End of the regeneration process	58
5.2.9.	Other important aspects	59
6.	Impacts of brownfields and their perception	61
6.1.	Positive impacts of brownfields	62

6.1.1.	Reuse of brownfields	62
6.1.2.	Brownfield location within the city	63
6.1.3.	Benefits of brownfields.....	64
6.2.	Negative impact of brownfields	66
6.2.1.	Brownfield disadvantages.....	67
6.3.	Brownfield perception.....	69
7.	Notions of CABERNET, CLARINET	71
8.	Notions of RESCUE, TIMBRE, HOMBRE and such	73
9.	Comparison of contaminated sites in three particular countries	76
9.1.	Czech Republic	76
9.1.1.	Examples of brownfield financing from the EU in the Czech Republic ..	84
9.2.	Germany	87
9.3.	France	91
9.3.1.	Examples of brownfield financing from EU funds.....	92
10.	Own research	94
10.1.	Brownfield financing.....	94
10.2.	Number of brownfields.....	103
10.2.1.	Situation in Germany	103
10.2.2.	Situation in France	104
10.2.3.	Situation in the Czech Republic.....	106
11.	Conclusion	110

References.....	113
List of Abbreviations	124
List of pictures	124
List of graphs	125
List of tables.....	126

INTRODUCTION

The name of my master thesis is financing of brownfields in selected countries therefore the main purpose of this master thesis is to give a general overview on brownfields in European Union, to get familiarised with the problem of contaminated sites across Europe, to get to know the process of brownfield remediation, to show how brownfield sites are financed from the EU, to indicate a possible solution how to diminish the number of brownfields, to analyse the situation in different countries and to compare the number of contaminated sites from available data. I want to focus particularly on brownfields in the Czech Republic, France and Germany because I studied the master degree programme in these three countries so I thought it would be nice to compare brownfields from each of that country.

This master thesis is divided into several sections.

The theoretical part is dedicated to the short introduction to the topic of brownfields where I mention some general information about these sites, the first section is devoted to some of brownfield definitions in the European Union and in the world where it tries to explain to us what brownfields are so that we can understand better next sections of this master thesis and can get better perspective of what this master thesis is all about. Also, in the first section, we get to know the brownfield sites classification and other categories and what the main differences between brownfield and greenfield sites are.

The second part provides an overview on brownfield financing, what the main sources of financing are and what funds we can use to help finance brownfield sites.

Thirdly, I talk about the nature of brownfields site, where they come from and how they appear.

Fourth section focuses on the brownfield redevelopment. It gives us some definitions on what the brownfield redevelopment is. It has lots of content because in this part, it is described the whole process of a site remediation.

The fifth part explains what the positive and negative impacts of brownfields on the environment and on the infrastructure might be, what the pros and cons of brownfield sites are and what the perception of brownfields is.

The next two sections will give us a short overview of CABERNET and CLARINET networks and other projects and initiatives that exist and are somehow linked to brownfield sites. It gives us a short introduction how they work and what they do.

Practical part is devoted to the actual situation regarding contaminated sites in the Czech Republic, France and Germany, their history and their comparison which can give us an idea of how each country has coped with the problem of brownfields since their appearance.

For my own research I will be focusing on money funding from the EU and I will make a comparison concerning the number of contaminated sites in the Czech Republic, Germany and France. For that purpose, I will be using the latest data found that are available online for public. The analysed data were used for the comparison method between each country.

Methodology

I used the method of gathering all possible literature sources and information concerning brownfields to get more knowledge about the topic of brownfields. For that, I needed qualitative data. The qualitative data were gathered from technical articles available online or from technical books. I used Czech and foreign sources. Also, plenty of information about brownfields could be found on the Ministry's websites that contribute to the brownfield redevelopment. After collecting the information, reading and getting familiarised with the topic, I started the analysis of all gathered sources by going through and selecting important data for my thesis. From all that received information, I was able to come up with some research questions and I will answer them in the conclusion section at the end of the thesis.

For my own research and the comparison of selected countries, I needed quantitative data. The data to show examples of brownfield financing were gathered from websites focusing on European funds. Other data were used to compare the number of brownfields and financial data were used to compare the financial situation concerning brownfield funding from the EU.

In my master thesis, I would like to concentrate on these research questions:

What are the financial sources of brownfield redevelopment?

What are the steps that help remediate brownfields?

What is the impact of brownfields on the environment and possibly on citizens?

1. INTRODUCTION TO THE TOPIC OF BROWNFIELDS

Europe's landscape is changing dramatically. Cities and their infrastructures are expanding into productive agricultural land, cutting the landscape, affecting wildlife and ecosystems. In addition to landscape fragmentation, soil and land face a number of other threats such as contamination, erosion, degradation and even abandonment among the most important (EEA, 2019). The European landscape has changed significantly over the last fifty years. The ongoing restructuring of European business and the increasingly pervasive influence of globalisation has led to considerable changes in European industrial activities. In particular, significant impacts are seen in the downsizing of enterprises and the loss of a number of historical industries. Growth in other service industries and transformations in the urban lifestyle have also led to significant changes in land use (CABERNET network Report, 2006). Land is a limited asset. To protect unspoiled and pristine habitats and guarantee sustainability, we need to make sure it is used in the most efficient way possible. However, every year in the EU, more than 1000 km² of undeveloped land is appropriated for housing and lodging, roads, industry, and recreation without full consideration of diverse tangible and intangible services and values that those soils provide to us (European Commission, 2013).

Brownfield sites in particular present challenges to national and regional policy makers in terms of bringing the land back into beneficial use and in terms of cleaning up contaminated land and groundwater (Ferber & Grimski, 2002). Brownfield remediation and regeneration represents a valuable opportunity and a chance not only to prevent the loss of pristine countryside, but also to enhance urban spaces and remediate contaminated soils (European Commission, 2013). According to the European Environment Agency (EEA, 2019), there are about three million brownfield sites across Europe often located and well connected within urban boundaries. Soil contamination affects almost 250 000 sites throughout Europe (Doerle, 2012). According to Ahmad et al. (2018), Almost 800,000 sites have been perceived as a brownfield in Europe with an estimated remedial cost of about 115 billion euros. Hundreds of contaminated sites that are often located in central places due to historical urban development processes have to be cleaned up to avoid pollution of groundwater (Doerle, 2012), therefore many of these sites need to be investigated whether their remediation is required (EEA,2019).

Land is a finite, valuable and scarce resource and Europe doesn't deal with the managing of its urban land in a very sustainable way. Brownfields are present in many European

countries. Brownfields are a land use problem caused by the failure of historical land management strategies (Doerle, 2012; Nathanail et al., 2007). To solve problems of brownfields, the process of regeneration must take place. The regeneration of brownfields is a complex of processes that takes time but to be successful, brownfield regeneration must be an important point for local, national and European land use policies (Nathanail et al., 2007). The necessity for reusing the land and especially buildings in the currently unexploited former European industrial, commercial, transport, military sites has gained a new level of urgency among governments and developers due to the fast-growing world population environment. The demand for developed land continues to rise. This is driven by new lifestyles that require more space as well as by competition between municipalities to attract new developments because of the assumed economic revenues (European Commission, 2016; Maliene et al., 2012). Land revitalization or brownfield redevelopment is a beneficial process to undertake. But it also costs a lot of money. Lands are often contaminated with harmful substances that require expensive procedures to treat. For instance, toxic waste sites pose a direct threat to human health. In other cases, sites pose a low risk to nearby residents but are left unused or under-used. Eventually, the benefits of remediation of any brownfield site should exceed the costs (Haninger & Timmins, 2017).

Brownfields are located on land once used and now probably disposed of (Grimski et al., 2007). Also, transforming brownfield sites as part of a sustainable environmental policy captures global attention which increases the trend of redeveloping brownfield while keeping the environment preserved (Ahmad et al., 2018).

Brownfields are present in every country of the world where the industrialization process took place in some way. Particularly across Europe, the presence of derelict land has been a subject of concern. Brownfields and their revitalization have been an issue in European countries since the end of the 1960s (Dehoorne et al., 2016; Planeta, 2007). In developed countries, brownfields happen to be from contaminated industrial sites or former factory sites usually located in declining areas of the city (Ahmad et al., 2018). The scale of brownfields has become a problem since the European economic crisis in the 1970s. There are individual brownfields that are extremely small in mixed urban areas up to large military sites such as former industrial sites or military airfields (Doerle, 2012). It is an important topic related to changes in the socio-economic structure of individual regions, strategic, territorial and landscape planning (Planeta, 2007). Brownfield sites present

particular challenges to national and regional policy makers in terms of bringing the land back into beneficial use and of cleaning up contaminated soil and groundwater. In this respect, successful brownfield redevelopment policies and strategies need a combination of environmental, spatial and urban planning approaches (Grimski & Ferber, 2001).

The issue of brownfields is currently one of the frequently discussed topics both in the sphere of spatial planning and in related areas such as building construction, data models of buildings, environment or nature conservation. This issue is tied to human civilization on a global scale (Kramarova, 2019). They represent a fundamental problem and an obstacle to the sustainable development of municipalities, cities and regions. Addressing this issue is expressed as a priority in many policies and strategies of public authorities at national, regional and local levels (Planeta, 2007). Recent orientation toward new buildable areas has also contributed to the increase of brownfield projects in many cities all over the world (Kurtović Folić & Perovic, 2012).

The location of brownfields is one of significant factors influencing potential investor decisions and brownfields remediation. The issues of regeneration and redevelopment of underused, abandoned, derelict and often contaminated lands and buildings remain one of the greatest challenges for urban planners and developers today. As the global economic situation is rather uncertain, investments fall, many industries disappear or are moved to countries with lower labour costs, therefore new brownfields emerge more easily and their sustainable redevelopment is still limited by many barriers and associated problems (Frantál et al., 2015). Brownfield land might be a lost opportunity and a problem at the same time. Brownfields can have a negative impact on the surrounding area and community and block effective neighbourhood regeneration. Regenerating brownfields can stimulate opportunities at numerous levels to improve urban quality of life, enhancing urban competitiveness, and reduce urban sprawl. Finding solutions for brownfield sites is an important part of the search for effective policies that are aimed at ensuring a sustainable future for land and cities. The brownfield agenda is therefore an essential component of the Sustainable Urban Development in the European Union (Nathanail et al., 2007).

2. BROWNFIELD DEFINITIONS

Thanks to the CABERNET network, we can find an overall definition for brownfield sites. CABERNET defines brownfields as sites that have been affected by the former uses of the site and surrounding land. These sites are derelict and underused and may have real or perceived contamination problems or are mainly in developed urban areas and require intervention to bring them back to beneficial use (Oliver et al., 2005). This brownfield definition is now largely accepted in the European Union.

Another definition of the term brownfield identified by the CABERNET refers to sites as previously developed land or contaminated or derelict land, encompassing a range of sites in terms of size and location (Oliver et al., 2005: Workshop on Re-using Brownfield Sites and Buildings, 2010). Because of the CABERNET definition, brownfield is now a term well established in the common language of urban land management stakeholders (Oliver et al., 2005)

According to Nathanail et al. (2003), brownfields are equivalent to land affected or potentially affected by contamination (Nathanail et al. 2003).

According to Osman et al. (2015), brownfields are underused, abandoned, derelict and often contaminated lands and premises that are results of mutual relations within the concrete locality, its history, social, legislative, and ecological processes that represent particular information about the state of the surrounding society.

We can also call brownfields as abandoned, former, unusable, obsolete industrial areas or buildings, devastated, ravaged areas, industrial buildings, land polluted by industry, old sites, lands on which the original production activity ended. These areas also include ecologically damaged localities (Líšková et al., 2016).

Brownfield land is described as a land which is not economically worth developing, it has no interest for the market, it is not developable without financial support and it is unable to attract investors and financial investments at the same time (Rizzo et al., 2015).

The issue of brownfields is emphasized with the intention of reusing abandoned areas that have lost their original use and regenerate them in a way from which profits individual stakeholders but also the whole society (Turečková et al., 2019).

Brownfields originate as relics of industrial, agricultural, residential, and military activities (KUNC et al., n.d.).

It is not possible to use such site suitably and effectively without regeneration process therefore the regeneration is one of significant drivers of the brownfield redevelopment (Osman et al., 2015).

Brownfields are abandoned, under-utilized or contaminated properties. Redeveloping these properties or buildings into productive projects and areas may mitigate environmental impacts, provides tax revenue and improves the social status of these places¹. However, brownfields may take more time to redevelop and under some conditions may be risky to use.

According to Nathanail (2010), brownfield sites are:

- closed petrol stations
- former military bases
- disused warehouses
- derelict office blocks
- dilapidated housing
- abandoned offices
- disregarded monuments
- discarded railway lands
- infilled landfills

Planeta, 2007 says that brownfields are abandoned, former, unused, doubtfully used, obsolete industrial premises that also include areas, zones, territories, localities, devastated industrial areas, industrially polluted areas, industrial buildings, industrial heritage, industrially polluted land, dilapidated industrial premises, areas used in the past, land on which the original production or other activity was terminated, ecologically damaged localities, heavily polluted land, land with old ecological burden, land affected by ecological burden, economically underused areas, neglected land.

Due to the short history of industrialization, plenty of brownfield sites can be found in the form of former factories, buildings, railway areas, military areas, coalfields, semi-urban or agricultural areas (Ahmad et al., 2018). We can have brownfields for industrial, mining, military, transport, agricultural and brownfields for former amenities like

¹ Greenfield vs. Brownfield: What's Better for Your Manufacturing Facility? (n.d.).

shopping centers, hospitals, restaurants, apartment buildings. Brownfields can also be ecologically polluted, be contaminated and dangerous from a technical construction point of view. Because these sites decay much time, they disrupt the urban structure of the site, abandoned buildings on brownfield areas decay gradually therefore they become more dangerous and the repairs they require afterwards are more and more demanding, they are ugly and are the usual place of concentration of especially homeless and drug addicts (Líšková et al., 2015; Turečková & Nevima, 2018).

There is also a new generation of brownfields to consider because of the worldwide financial crisis from commerce, housing, infrastructure to tourism. In these cases, contamination of soils should not pose serious problems (European Commission, 2016). Among identification points of how we recognise brownfields sites belong total area of the affected area, number of buildings, condition of infrastructure or the extent of ecological burden. These are the criteria that we try to follow when assessing any brownfields sites. But the most important indicator of brownfield identification is the area of the territory which expresses the ratio of brownfield to the area of the territory (Líšková et al., 2016).

In this thesis, I would like to focus more on brownfield comparison among the Czech Republic, Germany and France. Therefore, I present three definitions of brownfields from these three countries.

The CzechInvest definition of brownfield is considered as the main definition in the Czech Republic. Sites that have been affected by the former uses of the site and surrounding land are derelict and underused, may have real or perceived contamination problems and are mainly in developed urban areas and require intervention to bring them back to beneficial use (Oliver et al., 2005: Workshop on Re-using Brownfield Sites and Buildings, 2010).

In France, the brownfield sites are viewed as areas previously been developed that are temporarily or definitively abandoned followed by the cessation of activity (agricultural, industrial, service, processing, military defense, storage or transport) and need to be reclaimed for a future use. They can be partially occupied, derelict, or contaminated (Ahmad et al., 2018; Ferber & Grimski, 2002). The land pollution is extensive and derives mainly from agricultural activities, in other words via the application of fertilisers or

pesticides. The most frequent consequence is groundwater pollution due to nitrogen and pesticides (EEA, 2000).

Aucame (2016) takes the definition of industrial brownfield from ADEUS² which defines it as a built or non-built site, it is not rehabilitated nor fully reused, it is abandoned for at least two years and it had participated in an industrial activity which degraded the actual state of site in such a way that any new use is possible only with the revitalization process. Concerning Germany, brownfield site is considered as inner city building that is not used (Oliver et al., 2005). Also, according to the Federal Ministry for the Environment, the brownfield redevelopment is rehabilitation of industrial sites and elimination of hazards to human beings and the environment and reintegration of rehabilitated sites into the economic cycle (Ferber & Grimski, 2002). Brownfield in the German legal context means “*harmful change to soil*”, in other words “*potential contamination*”. The definition also includes former landfills as well as abandoned sites such as any types of facilities or plants where hazardous substances were used from industrial sites to gas stations. The term brownfield indicates sites which had previously served for commercial, industrial or military purposes and for which no new use has been found yet. It should also include abandoned housing areas, railway yards, abandoned shopping malls and offices. The fact that the contaminated land is vacant and without any use might also be considered as a decisive factor for classification of brownfield (Grimski & Dosch & Klapperich, n.d.: Interreg Central Europe, n.d.).

According to EEA (2000), contaminated sites are defined in Germany as abandoned waste disposal sites, abandoned industrial sites and sites where there are reasons for suspecting harmful changes in the soil or other hazards for individuals or the general public.

It is also important to mention the difference between “*contaminated*” and “*potentially contaminated*” sites. EEA, 2011 says that contaminated sites are areas where the presence of soil contamination has been confirmed and it presents a potential risk to humans, water or ecosystems. On the other hand potentially contaminated sites are sites where soil contamination is suspected but not verified and detailed investigations need to be carried out to verify whether there is a risk of any impacts on humans or ecosystems (EEA, 2011).

² Agence de Développement et d’Urbanisme de l’agglomération strasbourgeoise (ADEUS)

Potentially contaminated sites might pose a risk to human health and environment therefore they should be considered as contaminated due to a possible contamination whether it has been confirmed or not yet. When comparing brownfields in the Czech Republic, Germany and France in the last section of this master thesis, I will consider contaminated sites as well as potentially contaminated sites as brownfield sites.

2.1. Brownfields within the global understanding

There is no common definition of brownfield across the 27 member states of the European Union. This may mean the lack of information regarding the issue of the concept of brownfields across Europe (Grimski & Ferber, 2001). The reasons why no common legislation at European level for brownfield sites has been adopted are that in every state there is a different legislative base and the approach to deal with brownfields is individual. It is because of differences coming especially from different environments, population density and historical development (Kramarova, 2019).

The European Union perceives brownfield land as derelict, under-utilised or vacant land that may or may not have environmental damage, on which previous use has ceased or subsided and which the market was not able effectively reuse without some sort of an intervention. What is and what is not a brownfield also depends on local circumstances. What appears to be brownfield by one standard may be regarded as a budding enterprise by another. Also, it is important to realise that some brownfield sites may still be partially in use. Although many brownfields are no longer in full use (Brownfields handbook, 2010).

In the United Kingdom, the brownfield definition stands for a derelict land which was previously developed, land was so damaged by previous industrial or other development that it is incapable of beneficial use without treatment (Adams et al., 2009; Oliver et al., 2005).

In both Poland and Romania, brownfield lands are defined by the presence of contamination. The vast coalfields of Silesia that are located in Poland are classified as brownfield lands and while many of Polish regions suffer from widespread contamination as many coalfields and factories remain in operation, these regions would not be classified as brownfields if adopting a definition of brownfields as previously developed land as in western Europe (Oliver et al., 2005).

When we talk more about European brownfield definitions, there is an apparent contrast in the perception of the term brownfield between the nations of Western Europe and those of Scandinavia for example. One factor for that might be the population density. We also must mention that in many European countries, northern countries included, there is no official brownfield definition or there is no real information regarding the topic of brownfields. In Denmark, Finland and Sweden, the term brownfield seems to be associated with contamination by land management (Oliver et al., 2005).

Throughout the rest of Europe, the contamination issues are priority in countries such as Bulgaria, Italy, Poland, Romania or Spain. The presence of potential or confirmed contamination seems to be the decisive indicator when talking about brownfield sites (Oliver et al., 2005).

The most common definition of brownfield in both the US and Canada is the one put forward by the United States Environmental Protection Agency (US EPA) when it formally launched its brownfields action agenda in 1995. The agency defines brownfields as abandoned, idled, underused industrial and commercial facilities or real properties where expansion, reuse or redevelopment is complicated by real or perceived environmental contamination or the presence of hazardous substances or pollutants (US EPA: Adams et al., 2009).

The consequence of these different definitions in the European Union and in overseas is that those sites that are considered to be brownfields under one definition would not be considered brownfield under another. One of the fundamental problems in seeking a global solution to brownfields is the fact that there is no uniform global definition (Kramarova, 2019).

An important role is setting the rules at the transnational level in the form of European regulations to specify contaminated sites and the seriousness of possible environmental and health risks. It is also important to develop unified European methodology to define European norms for the remediation of certain locations for their next use (Líšková et al., 2018).

The significance of the brownfield issue is well understood at the global level. Some countries, for example the United States, Great Britain, France and Germany have long-term experience with the problems of brownfields which had emerged during the 1970s as a result of massively declining mining, heavy industries and textiles. In comparison, in the post-socialist countries, brownfields appeared in large numbers after the collapse of

socialism and the return to a market economy with the restructuring of traditional industries and following globalization trends during the last decade of the 20th century. The occurrence of agriculture or military brownfields in post-socialist countries has been increasing but industrial brownfields are considered to be the biggest problem for the affected parties (Frantál et al., 2015). Their negative socio-economic impacts mean that brownfields are more in focus for European Union regional development, environmental protection and urban initiatives. While many European directives come from a technical environmental protection addressing relevant brownfield aspects separately like Waste Framework Directive, Landfill Directive, Soil Directive or European Environmental Impact Assessment Directive, a shift can be seen in European brownfield policies to address environmental protection and spatial planning issues. Brownfield sites are not only discussed in technical terms anymore but as an opportunity for saving resources and delivering sustainable urban development which reflects the complexity of brownfield regeneration and its social, environmental and economic consequences (Franz et al., 2006).

2.2. Brownfield classification

According to Brownfield Handbook (2010), brownfields can be divided:

- By their use (industrial, military, railway and transport, agricultural, commercial, cultural, leisure, institutional)
- By their likelihood of reuse
- By their size
- By their risks
- By their nuisance

CABERNET network together with CLARINET came up with a classification of brownfield sites.

2.2.1. *Viable or self-developing brownfield sites (category A)*

These sites are economically viable. The development of this site is profitable and therefore, the regeneration is possible. The redevelopment projects are driven by private funding (Brownfield Handbook, 2010: Nathanail, 2010). The regeneration of this kind of brownfields has greater advantages than risks from investment perspective. Sites like these can usually be found in economically dynamic locations (Franz et al., 2006). These

are sites of local and regional importance with high property value and low reclamation costs that have their own dynamic development potential, the redevelopment implies an increase of the value of the site and there is no need for specific public sector intervention (Ferber & Grimski, 2002).

2.2.2. Marginally non-viable or passive-developing sites (Category B)

The second group of brownfields are called potentially developed brownfield sites or passive-developing sites.

Their regeneration is at the margin of profitability, project comes with risks or insufficient profitability, support comes through public and private cooperation (NSRB 2024, 2019), but in many situations, private developers are not able or willing to act on their own to ensure that the full economic potential of site reuse will be achieved. These sites tend to be funded through public-private co-operation or partnerships (Brownfield Handbook, 2010: Nathanail, 2010), but there are also many brownfields whose redevelopment relies mostly on public-sector funding. Reasons can be significant contamination leading to high remediation costs, inadequate infrastructure or low real estate prices. With the help of public funding, it is possible to find private investors (Franz et al., 2006). These are the sites of local and regional importance with a specific development potential but with accompanying risks of development which require a piece of advice and assistance with planning and funding (Ferber & Grimski, 2002).

2.2.3. Non-viable or non-developing sites (category C)

Those are the sites with either overwhelming contamination or extremely limited economic possibilities due to an adverse location. The regeneration is not profitable. Regeneration requires and relies on public support in the form of subsidies or other measures from municipalities' driven projects, public funding or specific legislative instruments such as tax incentives that are required to help regenerate these sites (Brownfield Handbook, 2010: NSRB 2024, 2019). These are sites without development potential at least during the foreseeable future. These are the most problematic sites in industrial regions. A high density of brownfield sites in a certain area and low site values coupled with high site preparation costs do not allow self-sustaining redevelopment (Ferber & Grimski, 2002). These are sites where reclamation costs are much higher than site value therefore it cannot be reasonably brought back into economically beneficial use. These sites are considered as a loss (Nathanail, 2010). Investment in these sites can

pay off in the longer term in terms of boosting the local economy by making the location a more attractive place to live (European Commission, 2016).

Usually, the removal is the best solution for this kind of site. They are a problem especially in small municipalities. Removing brownfields and converting them into open space can be a permanent solution (NSRB 2024, 2019).

To conclude, where the reclamation costs are usually equal to the site value, then public-private partnerships or the creation of infrastructure by the public sector can attract private investment to a site (Nathanail, 2010).

Categorization of sites may help authorities to guide money to those places where it is most needed. It is important to consider that categorization itself might have an effect on the market value. Therefore, planners must be wary classifying sites (Doerle, 2012).

2.2.4. Another categorization of brownfields

A different categorization of brownfields comes from (Grimski et Ferber, 2001).

- Brownfields in traditional industrial areas
- Brownfields in metropolitan areas
- Brownfields in rural areas

2.3. Greenfield sites

To understand better the issue of brownfields, we also need to take a look on what greenfield sites are.

2.3.1. Greenfield Sites

Greenfield sites are undeveloped areas usually within or outside a city that are situated typically on agricultural land. It is an area that has not yet been built up and is used as agricultural land or is a purely natural area.³ The incremental trend of urbanization rate and urban areas growth lead to high demand of greenfield development. Greenfields are mostly used for the construction of manufacturing plants and other commercial projects

³ BROWNFIELDS A GREENFIELDS v Libereckém kraji, 2019, retrieved from https://investujpodjestedem.cz/wp-content/uploads/2019/11/02_LK_BF_GF.pdf

because they are uncomplicated and straightforward for construction ⁴ (Doerle, 2012). The failure to reuse brownfields is also connected with new constructions on greenfields because if the brownfields that were used in the past are located inside cities, they remain unused, the infrastructure decays and a new building is constructed on greenfields (Líšková et al., 2015).

The advantages of greenfields are design flexibility for meeting project requirements, room to expand for future growth, greenfield can be leased or owned, construction timelines are typically faster⁵. The cost of creating a greenfield in an industrial zone might be up to four times lower than a brownfield redevelopment in the Czech Republic (Kunc et al., n.d.).

On the other hand, the disadvantages concerning greenfields might be: infrastructure installation is often required, sites might be located further away from the city and its services⁶, which means there is a longer commute for workers, sites might be viewed as urban sprawl and might have a negative environmental impact.

Even though the regeneration of brownfield sites can have great development effects including economic, social and environmental benefits, brownfield sites are not perceived as an economically attractive solution nor as a competitive option for regeneration for investors when compared with greenfield sites (Rizzo et al., 2015).

⁴ Greenfield vs. Brownfield: What's Better for Your Manufacturing Facility? (n.d.).

⁵ Greenfield vs. Brownfield: What's Better for Your Manufacturing Facility? (n.d.).

⁶ Greenfield vs. Brownfield: What's Better for Your Manufacturing Facility? (n.d.).

3. BROWNFIELD FINANCING

After the first part of the master thesis I tried to explain what brownfields are according to its definitions, let's move to another section where I will be talking about the brownfields financing.

According to Thornton et al. (2006), the European Union and its member states provide and guarantee different public incentives to make brownfield regeneration more attractive to investors, but they don't think very much about their sustainability. Deciding on how to regenerate brownfields site and make them viable again should involve more than just redeveloping the site to meet its regulations. Member states, policy makers, landowners, developers or investors themselves should understand all the aspects of brownfield regeneration, sustainability issues and what policies are needed to be implemented (Thornton et al., 2006). The economic demands of the brownfield regeneration process require the participation of several financial entities at various levels. Given the big amount of necessary funds for brownfield redevelopment, financial loans for the long-term solution of brownfield redevelopment must be used. When making financial decisions, the financial institution always evaluates the risk of investments and always checks both the person who asks for the loan as well as the specific redevelopment projects. The main role of a financial institution is the correct provision of the necessary funds on time (Líšková et al, 2016).

3.1. Brownfield financing

According to Brownfield Handbook (2010), we can identify three main sources of brownfield financing:

- 1) Private sources
- 2) Public sources
- 3) Their possible combinations

The public funding is more common, and it usually comes from:

- A) Budgets of municipalities, regions or state budget
- B) EU funds (the European Regional Development Fund is the main source of financial support)
- C) Donations and grants from other funds and organizations (Brownfield Handbook, 2010).

Public initiatives are necessary to enable revitalization and development. Funding is an important instrument to promote and support inner-urban development (Doerle, 2012).

Private sources come from the previous owner who somehow must undergo a process of regeneration. Another way is the input of money of a new private investor as a new owner of a property usually for business purposes (Brownfield Handbook, 2010).

The governments and the European Union provide funds for certain purposes directly or indirectly supporting the revitalization of brownfields. According to FEA (2005), activities that are supported are:

- a) redevelopment concepts
- b) urban planning
- c) detection of contamination and clean-up
- d) demolition of buildings and facilities
- e) redevelopment
- f) building renovation

The progress and implementation of effective financing mechanisms is an essential part of any successful brownfield redevelopment, especially in the current economic climate where investors are wary about the current economic situation (Medda et al., 2012). When taking into account the low willingness of local investors to invest in real estate especially in the current difficult economic situation and the low attractiveness of many locations for foreign developers, a successful redevelopment of the brownfield is a long-term process which depends on public sector support (Kunc et al., n.d.). Particularly in former industrial regions, much brownfield regeneration relies on public intervention to be economically viable but the possibilities for public funding are usually limited (Franz et al., 2006).

As far as the financial sources for brownfield regeneration projects, a mix of private and public money contribute the most to the quicker brownfield regeneration. The possibilities for the public money investments in regeneration process are quite limited and possibilities to interventions in case of private properties are much reduced due to legislation policies (Martinat et al., 2016). The main reason why the private sector invests in some regeneration areas is the assumption of getting something back, getting something in return. On the other hand, the principal reasons why not to invest in brownfield site are the negative image of neighbourhood or lack of capital (Frantál et al., 2015).

Direct aid includes those types of aid where public resources are used. The most common form of direct support is via subsidies. Another type of financial aid is financial instruments such as revolving funds, guarantees, discount loans, pre-seed funds but I don't want to get into that very much because that is more complicated matter. Investment realization of regeneration projects by public entities like investment preparation of brownfields for remediation, equipment of technical infrastructure areas or projects of reconstruction of existing buildings or participation in regeneration projects within joint ventures also belong to the direct support financing. Long-term leases of brownfield sites to investors to make the process of regeneration may be considered as direct support as well. Indirect support represents support in the form of promotion of brownfields via conferences, seminars, education and consultancy. The indirect support also includes the management of the brownfield database and the offer of brownfields to investors (NSRB 2024, 2019).

There are different funding mechanisms that may attract private investments to the redevelopment of brownfields. Investors may encounter difficulties in estimating financial returns and costs of this type of project. To achieve the effectiveness of funding mechanisms, it is required continuous incentives and a balance of public and private intervention (Medda et al., 2012).

3.2. Four models of financing brownfield redevelopment

We can distinguish among four models of financing brownfield redevelopment according to Medda et al. (2012). There is a small introduction.

3.2.1. *Public-Private Partnerships (PPPs)*

When talking about this model, it depends on which projects regarding the redevelopment of brownfield are supported by the public and private partners. These projects need formal arrangements between partners and a clear identification of roles and responsibilities. Close co-operation among different partners on a project such as authorities, private actors, local residents can play a key role in the success of a project (Medda et al., 2012).

3.2.2. *Land Value Finance (LVF)*

This model is designed to recover the capital cost of the urban investment by capturing some or all the increments in land value resulting from the investment. The tools are very flexible mechanisms that can be used to finance a broad range of urban development and

regeneration projects. For instance, tax increment financing can encourage urban investment through either tax relief or through property tax specifically reserved for the development (Medda et al., 2012).

3.2.3. Urban Development Funds

This particular model has a broader scope that can integrate brownfield redevelopment within the funds themselves. A nice example is the revolving fund where investors obtain low-interest funds and the interest they pay flows back into the fund pool (Medda et al., 2012).

3.2.4. Impact Investment Funds

These are socially responsible investments that are not specifically driven by profit, but they can also provide social and environmental benefits. There are several financial paths to support brownfield redevelopment. To choose the best option, all stakeholders need to understand the relationship between investment and the real estate market, establish and start formal and transparent partnerships. But it is very important to explore and understand the context and connection of the redevelopment brownfield project and encourage the financing of brownfield redevelopment (Medda et al., 2012).

3.3. Types of funds helping finance brownfield sites

The most important EU funds and instruments that partly finance brownfield site regeneration

3.3.1. The European Regional Development Fund

It was established in 1974. The Fund's primary objective is to strengthen economic and social cohesion in the European Union and to decrease regional disparities. In the 2014-2020 period, money is distributed into several key activities such as innovation and research, the digital agenda, support for small and medium-sized enterprises, the low-carbon economy. Brownfield revitalization funding is partly carried out via support for SMEs and innovation and research (European Commission).

3.3.2. Cohesion Fund

Another option how to finance brownfield sites is via Cohesion Fund. It is aimed at member states whose gross national income per capita is less than 90% of the European average. It aims to reduce respectively eliminate economic and social disparities and to

promote sustainable development. This fund was set up in 1993 to support four less developed countries (Greece, Portugal, Spain and Ireland). For the period 2014-2020, the Fund concerns Bulgaria, the Czech Republic, Estonia, Croatia, Cyprus, Lithuania, Latvia, Hungary, Malta, Poland, Portugal, Romania, Greece, Slovakia and Slovenia (European Commission). The Fund supports two areas, the trans-European transport network and the environment. It is through environmental support that brownfields are supported (Líšková et al., 2018).

3.3.3. European Agricultural Fund for Rural Development

We can partially finance brownfields via the European Agricultural Fund for Rural Development that lie within the European common agricultural policy. It is a financial instrument that supports rural development. The aim is to increase the competitiveness of agriculture, food, forestry and the development of rural areas. In the V4 countries, it is used to fund programs that support the revitalization of rural brownfields (Líšková et al., 2018).

3.3.4. European Social Fund

ESF might support brownfield sites via social inclusion by promoting social enterprises, locally disadvantaged areas or sites to be regenerated and used again so that it may come back to life, especially in regions where the level of unemployment is higher. It is not the main source of brownfield financing, but it is one of many possibilities.

3.3.5. JESSICA

Another financial instrument option is the so-called JESSICA (Joint European Support for Sustainable Investment in City Areas). It was introduced by the European Commission in 2006. JESSICA aims at innovative financing of urban development, it invests in sustainable urban transformation which includes brownfield regeneration and it wants to achieve more effective and sustainable cohesion policy (Brownfield Handbook, 2010; Groenendijk, 2007; Medda et al., 2012; Líšková et al., 2016). JESSICA is designed to help achieve the development of urban infrastructure, cultural heritage and monuments, the re-use of former industrial premises, university buildings and the creation of new commercial premises for small and medium-sized enterprises (Líšková et al., 2016). It is managed by European Investment Bank and the Council of Europe

Development Bank. These two institutions finance urban renewal and development projects through loan financing (Groenendijk, 2007).

3.4. Other instruments of brownfield financing

There is a list of other instruments that help finance brownfield sites in the Czech Republic:

- subsidies from the state or regional budget
- brownfield regeneration is funded through various departments of the Ministry of the Environment, the Ministry of Industry and Trade, the Ministry of Regional Development, via their many EU Operational Programmes and national programmes that exist such as Integrated Regional Operational programme (IROP), Environment programme, OPEIC programme via REAL ESTATE support or Rural Development Programme, Regeneration and Commercial Use of Brownfields, Business Properties and Infrastructure Programme (CzechInvest)

How much money will go to each project depends on aspects such as the area of a brownfield, the location, for what purpose the new site will serve, if the site is contaminated which will demand more money for decontamination. National programmes usually distribute money directly to municipalities or regions where it depends on how many inhabitants that particular municipality has or if that region is considered to be more affected by any industry activity such as mining in the case of Moravian-Silesian or Ústecký region.

Table 1 – Examples of programmes financing brownfields in the Czech Republic

EU Operational Programmes	National programmes
Enterprise and Innovation for Competitiveness	Regeneration and Commercial Use of Brownfields
Environment	Business Properties and Infrastructure Programme
Integrated Regional Operational Programme	Regeneration and non-commercial Use of Brownfields
Rural development Programme	Support for the modernization and development of country
	Demolition of buildings in socially excluded areas

Source: Měsíčník EU aktualit (2017), CzechInvest

In the Czech Republic, the support from the EU for the revitalization of brownfields is conducted mostly through the Operational Program called Enterprise and Innovation for Competitiveness (Líšková et al., 2018). The Ministry of Industry and Trade oversees this programme called OPEIC (OPPIK). This programme is the most important one for supporting brownfields in the Czech Republic for the programming period 2014-2020. Within the OPEIC programme, there is a support programme called REAL ESTATE. The primary goal of this programme is to facilitate the reconstruction of obsolete, spatially and technically unsuitable buildings for small and medium-sized enterprises that should turn brownfield sites into modern business premises (CzechInvest, Czech ministry of Industry and Trade, API).

Another way to receive funds comes from the Integrated Regional Operational Program (IROP). The Ministry for Regional Development of the Czech Republic seeks to find solutions to a large part of social problems and to provide a tool for compensating for regional economic differences through this programme. Some grant calls allow for reconstruction or modernization of buildings if their future use needs meet the objective of the specific call (CzechInvest, 2018). In the IROP database, there are 8 brownfield projects that were funded through this programme. These projects were terminated or are being revitalized.

The objective of the Operational Programme Environment is protection and improvement of the quality of the environment in the Czech Republic. In the period 2014-2020, the programme offers funds from the Cohesion Fund and the European Regional Development Fund. The Axis 3: Waste and Material Flows, Ecological Burdens and Risks can be used in the case of brownfield regeneration (CzechInvest).

EU funds may also come from the European Investment Bank (EIB). It focuses on six areas: Climate and environment, development, innovation and skills, small businesses, infrastructure, cohesion. It is an infrastructure fund investing in the remediation and regeneration of industrially polluted land in the EU (EIB).

The Ministry of Regional Development has been involved in the development of the territory and it seeks to support its restoration and removal of burdens of long-neglected buildings and areas that cannot be used properly. For these purposes, there is a programme *“Support for the territory revitalization”* (Podpora revitalizace území) to help municipalities and regions with brownfield regeneration (CzechInvest, 2018). There are

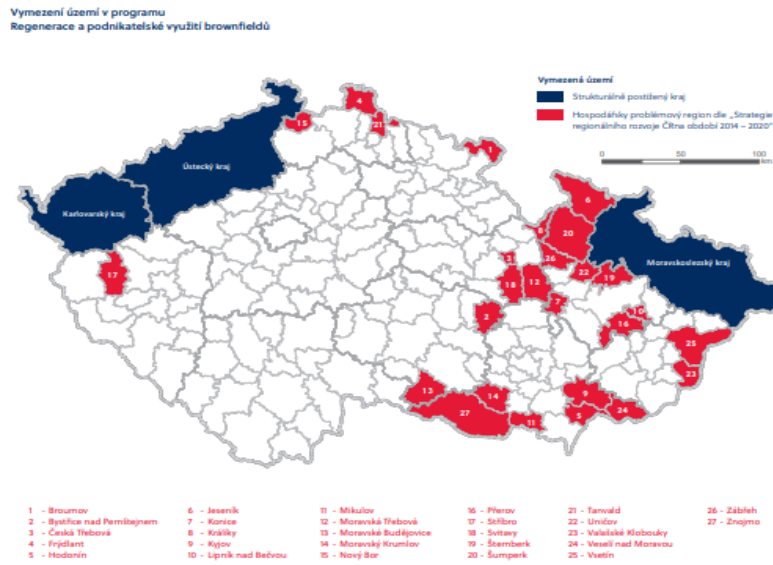
two sub-programmes worth mentioning. It is the “Regeneration and non-commercial use of brownfields” programme and the “Demolition of buildings in socially-excluded areas” programme. The first programme is aimed at brownfields site whose future use will be for non-commercial purposes and it will serve the general public, there will be no money gains. The second programme seeks to prevent the emergence of areas with social segregation therefore the regeneration will follow the demolition (Czech Ministry of Regional Development).

The Czech Ministry of the Environment is also involved in the issue of brownfields. It covers issues such as environmental protection, prevention and elimination of environmental burdens, water purity, protection of the rock environment and soil, landscape care. The Ministry of the Environment is interested in using revitalization processes of underused areas to strengthen ecological functions of landscape and improve the environment in municipalities (Planeta, 2007).

Important national programmes for brownfield revitalization in the Czech Republic are “*Regeneration and Commercial Use of Brownfields*” programme and the “*Business Properties and Infrastructure Support*” programme. These programmes are financed from the state budget. In both programmes, the recipients of subsidies are municipalities and regions of the Czech Republic (Měsíčník EU, 2017). Both programmes are managed by the Ministry of Industry and Trade.

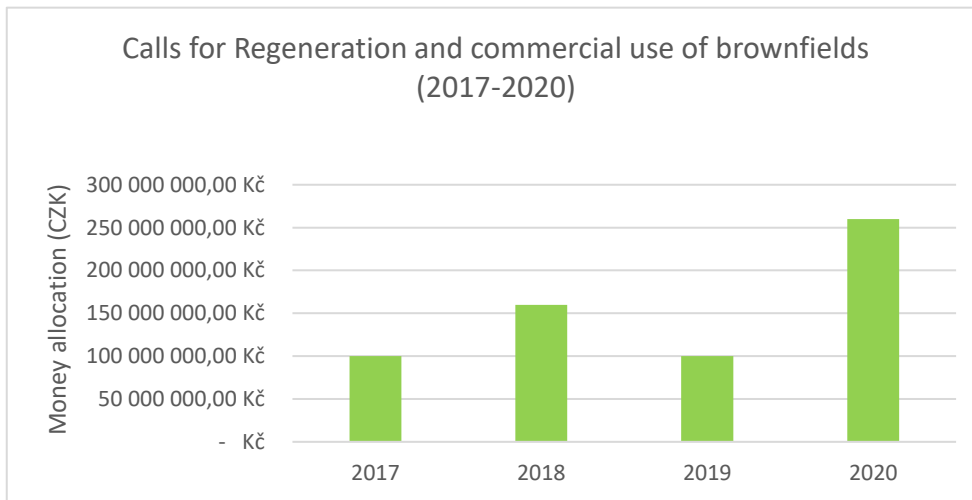
The main goal of the “*Regeneration and Commercial Use of Brownfields*” programme is to help neglected areas in structurally affected regions (Moravian-Silesian, Ústí nad Labem and Karlovy Vary), economically problematic regions in the revitalization process of obsolete and unused areas and their transformation into industrial and commercial areas up to 10 ha. This programme has been opened since 2017 and is scheduled to be opened until 2023. The total money allocation for this programme is 2 billion Czech crowns (CZK). It is managed via calls. The total money allocation for each call varies. In 2017 and 2019, it was 100 million CZK. In 2018, it was 180 million CZK. In the last call, the estimated money allocation for the call is 260 million CZK. The minimum money for one project was decided to be 1 million CZK, the maximum is 50 000 000 CZK (CzechInvest, 2019; Měsíčník EU, 2017).

Picture 1 - Regeneration and Commercial Use of Brownfields



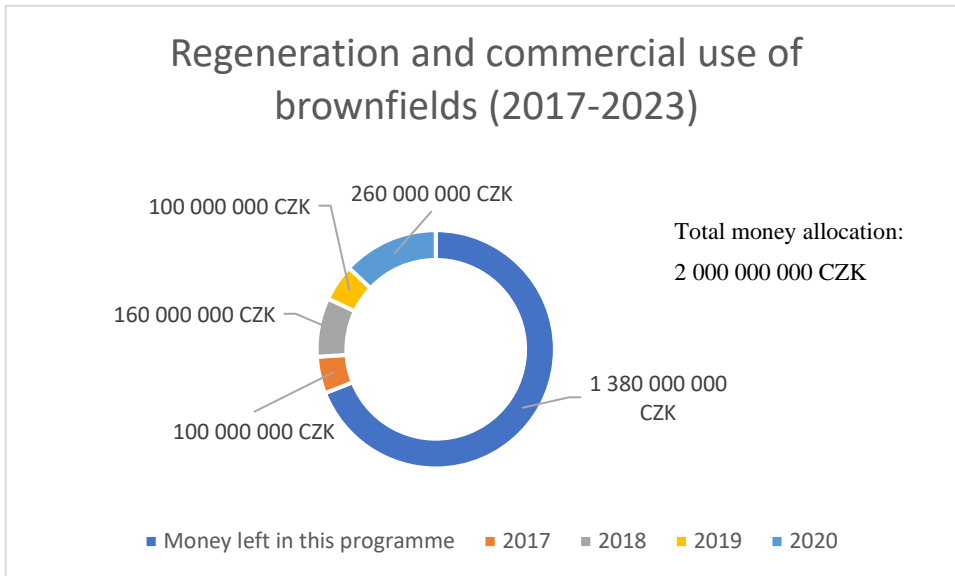
Source: CzechInvest, 2019

Graph 1



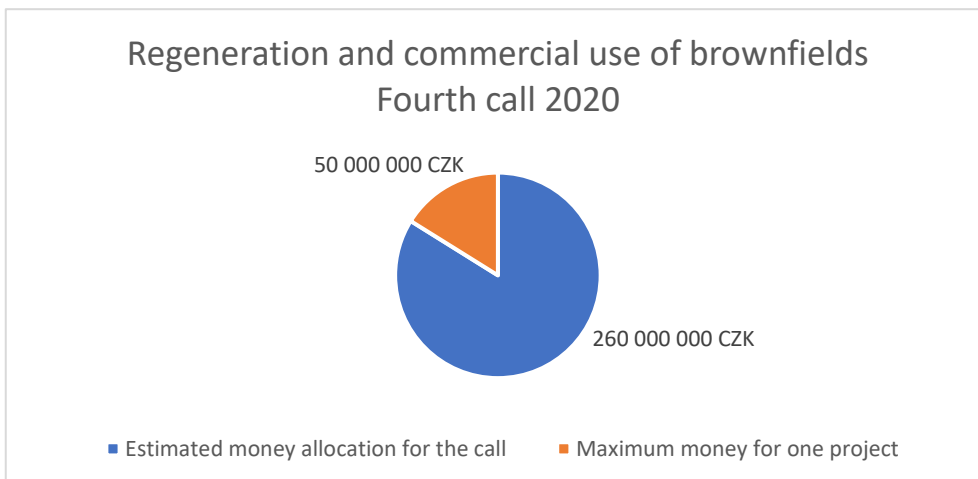
Source: Czech Ministry of Industry and Trade

Graph 2



Source: Czech Ministry of Industry and Trade

Graph 3



Source: Czech Ministry of Industry and Trade

Many industrial brownfields do not reach subsidies. For instance, municipalities in the Czech Republic have few chances to receive subsidies for projects related to brownfield regeneration. Czech municipalities would rather see the creation of a brownfield programme for the removal of brownfields without the development potential. Among these types of brownfields are mostly the agricultural ones in rural municipalities (NSRB 2024, 2019). Ministry for Regional Development focuses mostly on development of

municipalities in the Czech Republic and gives them money. But in general, regional, national and European funding provides money to initiate the process of revitalization. These initiatives started by increased awareness of the negative economic and ecological effects on derelict sites but on the other hand it also shows the positive development potential of such sites (Grimski & Ferber, 2001).

For the next 2021-27 period, the Ministry of Trade wants to implement a new support programme for the revitalization of brownfield sites for commercial use. It is a new Operational Program “*Technology and Applications for Competitiveness*” (OP TAK) (CzechInvest, 2019).

I didn't find any specific Operational Programmes for brownfield financing in France nor Germany. Money funding for revitalization of brownfield sites will probably go through thematic objectives Research & Innovation, Competitiveness of SMEs, Environmental protection & Resource Efficiency, Social Inclusion.

4. REASONS FOR BROWNFIELD OCCURRENCE

We do not have much information about the nature of Europe's brownfields. We can start to search for the origins of industrial brownfields during the economic cycle which began at the beginning of the Industrial Revolution in the first half of the 19th century when industrial activities started to be gradually concentrated into vast premises that required more production and also labor productivity (Kunc et al., n.d.). Since the second half of the 19th century, de-industrialisation and abandonment of productive and mining sites already led to many brownfield sites all over Europe (Pizzol et al., 2016). Industrial brownfields came along with the first industrial estates in the 19th century but brownfields as an independent object of study came into focus among political representatives and scientists in the second half of the 1990s (Kunc et al., n.d.). The key processes driving the occurrence of brownfields originate from economic transition, from central planning towards a market economy at the beginning of the 1990s. Alongside this process, it is also the shift towards a globalised post-industrial economy based on a service sector leaving traditional industrial sites unused (Martinat et al., 2016). Most of the current brownfield land is the result of Europe's 20th century industrial history such as mining which is usually the biggest source of brownfields and heavy industry (Oliver et al., 2005; Kunc et al., n.d.). Many countries with industrial traditions face the problem of abandoned industrial premises. The oldest brownfield locations can be found in regions of primary energy raw material extraction which were very important for the development of industrial fields in the period of the Industrial Revolution (Kunc et al., n.d.).

For instance, timber processing, paper and pulp production seem to be an important source of brownfields in Scandinavia. In Mallorca, Spain, derelict hotel buildings are considered as brownfield sites. With the continued growth of the tourism industry and the effects of rapid and often poor regulation of buildings in the beginning of tourist boom in the 1960s and 1970s, dealing with derelict or underused tourist infrastructure may become a major issue to be addressed which shows the importance of considering any types of brownfields that we might find (Oliver et al., 2005). The establishment of strong industrial regions happened during the period of total development under a market economy in 1920s and during the implementation of a centrally planned economy after the second-world war. This reason also resulted in the industrial brownfield background in the Czech Republic. Many small industrial plants had to close in traditional industrial regions,

especially in the textile industry. Declining tendencies in industrial production started to be clearly visible in the 1980s (Kunc et al., n.d.).

Deindustrialization is one of the reasons why there are brownfield sites throughout all the traditional industrial regions of Europe (Franz et al., 2006). During the process of deindustrialization, cities suffered from economic decline reflecting in a lack of demand for vacant properties and at the same time in an oversupply of them (Bosák et al., 2019). The process of industrial change has created brownfields across Europe, particularly in urban and industrialised areas. Brownfield sites represent the heritage of the prosperous phase of industrial activities, they are very often an integral part of a city's structure affecting the quality of urban life (Pahlen & Glöckner, n.d.). Brownfields might present significant social, environmental or economic problems in the world. Brownfields have diverse origins, they are spread throughout the land but are particularly important topic in densely urbanized areas especially in cities (Navratil et al., 2018). Brownfields do not exist by themselves. They are products of the interrelationships between places and social and ecological processes. Brownfields are placed in a certain geographical space and originate from time (Frantál et al., 2015).

Brownfields are not something new within the city. It usually happens that some abandoned sites and buildings appear during a particular economic cycle, the use of these abandoned sites is no longer needed, and they are continuously replaced by other activities. Industrial activities usually gather around historical city cores resulting in the appearance of abandoned or underused sites depending on the fluctuations of the industrial business cycle. It is very similar to the industrial activities relocating to countries with lower costs (Frantál et al., 2015; Navratil et al., 2018). Therefore, the economic perspective on contaminated brownfields can help understand factors for successful and sustainable reintegration of these sites into the market cycle (Doerle, 2012). Brownfield regeneration factors can also be linked to the existence of short-term and long-term business cycles. In times of economic expansion there is a significant recovery of abandoned and neglected areas, while in times of recession, economic restructuring and disruptions, the number of brownfields increases (Turečková et al., 2019). The emergence of derelict land is economic structural change, derelict land is usually linked with a loss of jobs and it may also cause the decline of living in the neighbourhoods around derelict sites but it doesn't happen too much (Grimski & Ferber, 2001). Larger number of brownfields are located within the structurally affected regions

where the population often faces high unemployment. After the decline of one dominant industry, the region is exposed to structural unemployment (Líšková, 2016).

In the Czech Republic since the 1990s, there has been a strong will of city residents especially in large cities to move to the suburbs. The result of these trends is the existence of more than 10 thousand unused sites that take up more than 30 thousand hectares of land (Navratil et al., 2018). Therefore, the occurrence of brownfields within the districts and regions of the Czech Republic is not the same because of many reasons such as the different historical and economic developments of individual areas (Martinat et al., 2016). The Czech Republic is one of the European countries with a rich industrial tradition. The first half of the 20th century was marked by the further concentration of industry in the traditional regions. The final establishment of industrial regions in Bohemia and Moravia in the 1930s and the stagnation or decline of the textile industry were the first milestones for the future origination of industrial brownfields. The center of industrial production moved later into the large cities, such as Prague, Brno and Pilsen and to the north and northwest of the Bohemian region (Kunc et al., n.d.). On the other hand, many abandoned sites also appeared because of societal and economic transitions in both urban and rural areas. These sites were used before for other reasons. We may ask ourselves whether such building development supports the sustainable development strategies of cities and villages and whether this form of development threatens the future use of land-based resources (Martinat et al., 2016).

There are other reasons for the occurrence of brownfields, especially in industrial regions where the industry plays a main role:

- the long-term development of mining and heavy industry which is supported massively from the state which can change the demographic, educational and social structure of the city (Martinat et al., 2016)
- Excessive focus on the eastern markets of countries of the former Eastern Bloc, the lack of competitiveness of many industrial fields, low labour productivity, limited absorption of new technological developments. These are the macroeconomic factors that might lead to the increase of brownfield sites (Kunc et al., n.d.)
- Due to political, economic and industrial changes such as the transition to a market economy in some countries, brownfields started to appear from other activities that are characteristic for rural sites such as agriculture, closed-down facilities

providing rural services like consumer cooperatives, provincial houses of culture (Skála et al., 2013)

Some industrial brownfields that were created due to industrial decline in cities might be perceived differently. On one hand, they are an incompatible barrier of the past and at the same time, they might be an opportunity for the development of new activities (Bosák et al., 2019). Also, the presence of derelict land might have adverse effects on the economic and social health of a city (Grimski & Ferber, 2001).

Any industrial premises that are located very close to the historical city centre were quickly incorporated into the city structures and became barriers for urban planning (Kunc et al., n.d.). The location of inner-city brownfields influences indeed the type of regeneration. It is assumed that a more successful and faster brownfield regeneration process takes place within more populated municipalities. Brownfields are often placed on strategic locations near the coast, central city zones, railways and transport routes (Kurtović Folić & Perovic, 2012). The regeneration of brownfields that are located for instance near airports, near the city centres or rail stations usually develops faster (Turečková et al., 2019). The main geographical barrier for regeneration at the city level is in the case that the location of brownfield is further away from the city centre. This place is less populated and with greater green spaces (Frantál et al., 2015). However, people responsible for brownfield revitalization should ask local residents about their opinion when planning the brownfield regeneration in the city centre especially where regeneration is co-funded from public funds (Navratil et al., 2018).

Former industrial regions are typical by large extents of brownfields, a shrinking population and a weakening economy. The 2004 expansion of the European Union from 15 to 25 member states added many more mining, heavy industrial, railway and military sites to the European brownfield list (Franz et al., 2006). About one-half of the existing brownfields is still represented by previous industrial sites and vacant factory complexes. Another frequent type is represented by derelict buildings of previous used amenities such as educational, sport, cultural and other community facilities. A significant proportion of existing brownfields in the city might also be represented by post-military structures like training grounds, barracks or hangars (Frantál et al, 2015).

Contaminated sites are particularly numerous in cities with a strong industrial tradition and in most cases in closed industrial plants, sites with water disposal, manufacturing, chemical or industrial activities, petroleum using services are found to be contaminated

sites. Because these contaminated areas are often found in derelict urban areas with previous industrial development, environmental remediation must be combined with redevelopment policies to meet sustainability goals (Tendero & Bazart, 2018; Turvani & Tonin, n.d.). Also, the technological modernization of production has led to less intensive utilization of many traditional industrial premises and it was another reason for the appearance of many brownfields (Kunc et al., n.d.). Large buildings in poor condition that are the remains of industrial activity are unattractive for investors. Costs associated with the regeneration of these objects are so high that private investors prefer construction on greenfields therefore the only solution is full investment from public sources (Líšková et al., 2015). The problems of the evolution and regeneration of brownfields in large cities result mostly from transitional economies of post-1989 Eastern Europe countries. Examples are: residential and commercial suburbanization and re-urbanization that result in significant migration flows, the expansion of the city into the surrounding countryside, changing built-up and social structures within the inner parts of cities and the housing estates (Frantál et al., 2015).

4.1. Options for brownfield elimination

Three major options for the elimination/reduction of contamination might be:

- 1) Decontamination measures: the source of contamination or the contaminated material is eliminated or reduced
- 2) Containment measures: prevention or reduction of spreading of the contaminants
- 3) Protection and restriction measures: other measures to prevent or reduce hazards (Gentile et al., 2009)

5. BROWNFIELD REGENERATION

Brownfield regeneration is a large complex of diverse activities that need to be conducted to achieve the reuse of the site. This section is devoted to the process of brownfield regeneration.

We may call the restoration and further use of brownfields using following terms. All these terms are similar and may be used when talking about brownfields: revitalization, reuse, regeneration, reclamation, remediation, conversion, transformation, rehabilitation, reconstruction, reintegration, return for productive use, integration into urban organism, new functional use, alternative use (Planeta, 2007). The following activities may be part of regeneration and revitalization projects according to the NSRB 2024 (2019).

Recultivation = restoration of natural functions to the territory or area

Remediation = removal of technical, soil or water defects such as contamination

Reconstruction = restoration of the original state of building, from the technical point of view the objects will be new

Modernization = achievement of a new technical standard which includes the achievement of a higher standard of technical and transport infrastructure

Revitalization = Elaborating land use concept as part of an overall urban planning concept with the idea to integrate the site from the planning perspective into the urban fabric (Doerle, 2012)

Reintegration = Successful commercialization and utilization on the market (Doerle, 2012)

It is impossible to use brownfields suitably and effectively without going through a process of regeneration, brownfields are not available for immediate reuse without intervention (Kunc et al., n.d.: Tendero & Bazart, 2018). Brownfield redevelopment is widely acknowledged as one of the major tools to achieve sustainable development (Grimski & Ferber, 2001), because strategic brownfield redevelopment can be a win-win scenario for both the economy and the environment (Thornton et al., 2006). The regeneration of the growing number of brownfields in Europe is an essential part of improving European global competitiveness in a sustainable way (CABERNET brownfield network, 2006). The use of places that have already been used once before is extremely important for sustainable development (Líšková, 2016). The regeneration of brownfield land to green space can deliver multiple benefits to society and the environment through improvements in the quality of a site and its surrounding landscape

(Atkinson & Doick, 2014). Regeneration should deal with the environmental, economic, material and social problems related to brownfields, making efforts to find permanent solutions for them (Líšková et al., 2015). Within the definition of brownfield regeneration, we may include planning processes and methods for citizen participations, sustainable land use, management and reuse of existing buildings and infrastructure, the reuse of soil and debris and management of any risks from contamination, the management of brownfield regeneration projects (Franz et al., 2006; Pahlen & Glöckner, n.d.).

Regeneration is a complex process due to very uncertain environmental conditions, the real estate or the whole location gets the possibility of recovery involving the reintegration of derelict and abandoned sites into their economic environments (Doerle, 2012; Franz et al., 2006). These abandoned buildings and expansive sites usually located in cities represent a fundamental problem for the sustainable development of cities and towns (CzechInvest, 2018). The primary objective of brownfield redevelopment is the reuse of land and the reintegration of the properties into the economic cycle (Ferber & Grimski, 2002). Other objectives of brownfield regeneration are beneficial land use, ecological safety, economic viability, promotion of cultural identity, improvement of sociological dimensions, reduction of urban sprawl, development of spaces for productive activities and improvement of social image and the provision of public facilities without compromising quality of life (Ahmad et al., 2018; Kurtović Folić & Perovic, 2012). Brownfield redevelopment is one of the major sources of environmental sustainability as it reduces environmental pollution, makes renewable resources available at the site and protects biodiversity and the natural environment (Ahmad et al., 2018). Regenerating brownfields is a more complex process than for example the greenfield development or urban regeneration. The process of regeneration is affected by local, national and European barriers. Regenerating brownfields is a significant challenge due to the complexity of the problem (Nathanail et al., 2007) therefore it can be delayed or limited in some ways. The factors might be lack of interaction between stakeholders, decision makers, users and designers, financial constraints, inadequate criteria and development policies, insufficient cooperation between public and private partners, differences between development goals and actual needs (Kurtović Folić & Perovic, 2012). Remediation of contaminated soils is also normally an expensive operation. It is often of high priority and is undertaken despite of high costs (Brownfield Handbook, 2010). The

extent of remediation and construction work depends on the extent of damage to the areas, buildings and equipment and on the need for modifications for new use. Brownfield regeneration projects may include the removal or reconstruction of original buildings (NSRB 2024, 2019).

Cleaning up contaminated sites is viewed as one of the environmental policy priorities in many countries because brownfields are usually linked with ecological risks and they are known for environmental burden. Agricultural brownfields that are often small areas or idle parts of larger areas can pose serious environmental hazards. The risks can follow from former area utilization such as storage of potentially hazardous material which might include preparations for plant protection, pesticides, fertilizers, petroleum and oil products storage, any spillage of liquids from agricultural machine, unsuitable agricultural waste treatment or from activities such as illegal dumps or hazardous waste storage (Skála et al., 2013). Current trends suggest a common approach where landowners, local authorities, central and regional governments have increasing commitments towards the avoidance and clean-up of contaminated land (Ferber & Grimski, 2002). Environmental hazards are widely discussed in the topic of industrial brownfields because the nature of the environmental load is significantly determined by the mode of former industrial production and economic impacts of the ecological burdens of urban brownfields are well documented (Skála et al., 2013).

Remediation of contaminated sites is attractive because it reduces risks to human health and ecological systems and brings lots of social and economic benefits (Turvani & Tonin, n.d.). Brownfield redevelopment means the process of rehabilitating a particular piece of land for a new use. Brownfield redevelopment involves the usage of properties in the economic and natural cycle whose original usage has been lost such as abandoned factory or company sites or property owned by the military that doesn't use the site anymore (Brownfield redevelopment and inner urban development, 2015).

The process of brownfield redevelopment is a complex process involving various players which means dealing with the different interests of a variety of stakeholders, including regulators, investors, citizens, urban and spatial planners, land owners, developers, consultants, academics, community groups, technology providers, politicians and the financial sector (Brownfield redevelopment and inner urban development, 2015: Pahlen & Glöckner, n.d.) and if they want to be engaged in the process of brownfield

redevelopment, they have to embrace the responsibility for their actions that comes with it. Sometimes it is difficult to examine and define the interests of different stakeholders. For example, brownfield developers must negotiate site remediation, permits, liability, funding and economic viability (BenDor et al., 2011; Peric & Furundžić, 2013). The process of regeneration also involves numerous stakeholders at various stages of the process which requires a good communication and co-ordination with all project members, it also requires the quality of the project organisation and the cooperation between the project participants (including local communities, local, state and federal governments, private parties and non-profit organizations) as important factors for a successful brownfield regeneration. Communication, understanding and trust among stakeholders are the key goals in brownfield regeneration process (EPA, 2006; FEA, 2005; Pahlen & Glöckner, n.d., Peric & Furundžić, 2013). The importance of stakeholder involvement and the importance of availability and provision of useful information is considered to be beneficial for successful brownfield regeneration since it allows to identify all stakeholders involved in the process and to be sure that everyone has access to the information to clearly communicate with each other (Rizzo et al., 2015). Especially urban brownfields are a challenging issue for local stakeholders in terms of remediation of the environment, revitalization of former industrial sites in the urban and regional context, reintegration of rehabilitated sites into the economic cycle (Doerle, 2012). Different stakeholder objectives can affect the generation process in many ways. A lack of shared understanding amongst stakeholders can affect the regeneration process in a negative way. The stakeholder engagement and participation have a role in all aspects of the regeneration process. A lack of coordination between local, national and European strategies can impede sustainable regeneration (Nathanail, 2007), therefore the sustainable brownfield regeneration requires individuals who understand the problem and has the ability to identify the opportunities that brownfield sites can represent (Nathanail, 2010). Successful development of brownfields can be achieved when these stakeholders work together to assess and clean up the property and pursue a common redevelopment goal (EPA, 2006). Decisions on brownfield remediation projects are long-term commitments and careful ex ante planning is required to ensure they are economic and effective (European Commission, 2013). Changing policies, the development of economic instruments and management tools that support the regeneration process as well as the increasing number of various projects supported by the European Commission or

national grants emphasize the increasing interest in brownfield regeneration (Pizzol et al., 2016).

5.1. Sustainable brownfield redevelopment

When I talk about the sustainability, brownfield regeneration combines all three pillars of sustainable development and therefore, it is a key element of sustainable urban development (Pahlen & Glöckner, n.d.). According to Franz et al. (2006), the sustainable brownfield regeneration is the management, rehabilitation and return to beneficial use of brownfields in such a way to ensure the implementation and continuity of satisfying human needs for present and future generations in environmentally friendly, sensitive, economically viable and socially acceptable ways (Kurtović Folić & Perovic, 2012). Economically, by generating development and employment in usually deprived urban areas. Environmentally, by remediating environmental risks of industrial premises. It is an important objective to improve the environmental situation on the site and in the neighbourhood. Socially, by bringing new life to urban areas and offering new opportunities for the communities and municipalities, neighbourhoods, cities and regions (Pahlen & Glöckner, n.d.). So not only municipalities are somehow requested to be involved in brownfield development. It highly depends on their actions and policies how and to what extent brownfields are brought back into use or stay derelict (Doerle, 2012). The process of brownfield development consists of four components of sustainability: Remediation (environmental issue), revitalization (social issue), reintegration (economic issue) and regulatory and administrative processes.

Derelict, vacant and underused land has to be redeveloped for urban growth, for the improvement of environmental quality or to attract investments (Doerle, 2012). Sustainable brownfield regeneration makes abandoned, underused, derelict or contaminated land useful for a new use in order to bring life back to the land and the community it lies within such as the possibility to clean contaminated land (Maliene et al., 2012; Nathanail, 2010). But contaminated land presents a major challenge to brownfield developers and the risks associated with the presence of potentially toxic chemicals in soil and water need to be managed or reduced (Ferber & Grimski, 2002). But to be sustainable doesn't always mean to be green. The regeneration of a brownfield site can also cause some negative environmental impacts (Franz et al., 2006). We should also mention within the sustainability the possible contamination, existing buildings and

infrastructures, the site's topography, ground-water conditions, existing green therefore a thorough assessment of the site's potentials and restrictions is essential (Pahlen & Glöckner, n.d.).

Brownfield regeneration is essential part and the basis for circular land use cycle management and may also be described as a management process in European countries. Brownfield regeneration is a key policy objective to help cope with rising population in urban areas in some parts of the Europe (Doerle, 2012; Maliene et al., 2012). The revitalization of contaminated sites is often hampered by real or perceived environmental contamination, high costs for cleaning up so the profitable and safe redevelopment is in the interest of every part included (Bartke et al., 2012; FEA, 2005). When a property contains environmental contamination, potential buyers discount the value of the property by the cost of the direct damages that result from the contamination. Because the cost of remediation determines the price of the property, direct damages directly decrease the value of the property (Carroll & Eger, 2006). So, while the contamination reduces property value what is not in the interest of owners and possible developers, sites with existing poisonous waste risk contaminating groundwater is not in the interest of the public. Remediation is therefore in the interest of private and public stakeholder as well (Doerle, 2012).

What do we have to comply with if we want to have a sustainable brownfield regeneration?

These are criteria that are met by sustainable brownfield regeneration projects according to Franz et al. (2006)

- 1) The management and reuse of existing buildings follows sustainability objectives while retaining or reusing buildings and infrastructures on brownfield sites
- 2) The management of risk from contamination and the reuse of soil and debris include the reduction of negative environmental impacts on the site and in the neighbourhood including human health risks
- 3) A minimized energy and water demand and the production of renewable energy on the site contribute to sustainability
- 4) Another criterion for sustainability objective is to generate and safeguard employment and economic development
- 5) Land use and urban design on brownfield sites are regarded as sustainable when land use functions match regional socio-economic demands and needs.

Also, the aim should be that only the most sustainable brownfield regeneration projects will be funded and regenerated from the European Union (Franz et al., 2006). Brownfield regeneration is carried out in accordance with usually accepted best practices in the European countries. But of course, there are other obstacles such as a lack of financial resources. The regeneration usually requires significant sums of money and involve lengthy time periods. It concerns mainly national programs that are very poorly funded. Although national registers provide some data on the status of brownfield sites, these registers are incomplete in all countries and therefore, they are not very useful as a basis for public intervention (Líšková et al., 2018; Atkinson et al., 2013). Also, it is very complicated to ensure that particular brownfield regeneration will be successful (Turečková et al., 2019), because any brownfield sites with even small amounts of contaminants may still be extremely challenging to remediate (BenDor et al., 2011). Contamination and environmental burden of brownfields is a major problem for brownfield regeneration (Turečková et al., 2019). Harmful substances or noise from the site may be a serious threat for human health and can lead to a deterioration of the natural environment (Pahlen & Glöckner, n.d.). The environmental and health risks like a contamination of soils and pollution might indeed affect the health of the population that lives in the neighbourhoods of any brownfields (Turečková & Nevima, 2018). Usually, contaminants such as petroleum hydrocarbons, metals, inorganic solvents, and hazardous and non-hazardous solid wastes may be present in both urban and rural brownfields, but rural brownfields are more likely to contain agricultural and mining related contaminants. Due to the nature of these contaminants, they may impact large areas of land and groundwater (GOV of BC, n.d.).

Waste is a real problem. Brownfields often contain larger amounts of waste. So, the objective of sustainable brownfield regeneration is to apply waste re-use strategies (Pahlen & Glöckner, n.d.; Vojvodíková, Mihola, n.d.). Buildings that are not maintained might lead to a state of disrepair where part of the building may collapse or injure someone eventually (Vojvodíková, Mihola, n.d.). The minimisation of waste generation is one of the key points within the sustainability. Increasing land prices and reduced availability of suitable disposal option on the site make waste generated from buildings expensive and difficult to handle so new recycling techniques should be applied which should lead to the reduction of costs of the redevelopment process. In general, the

sustainable waste management on the site must include the overall reduction of waste, an improved recycling of waste and the avoidance of the hazards to the environment and human health (Pahlen & Glöckner, n.d.).

Another challenge associated with the brownfield revitalization is how to deal and what to do with old buildings and infrastructure that is located on the site. Demolition of buildings and other infrastructure generates lots of waste and its environmental-friendly disposal or re-use is vital. Concrete, brick and cement are usually the main components along with smaller amounts of metals, glass and sulphates (Del Rio et al., 2010).

Brownfields are usually polluted, or they may be burdened in some way. All that increases the expenses required for the preparation of a land with respect to its new utilization. This makes these sites unattractive for new investors and they remain unused. Because a brownfield land is not attractive, the consequence might be the value of land decreases but also the value of buildings in its surroundings (Líšková et al., 2015). Less attractive brownfields especially in peripheral locations with low property market values are often insufficiently used (Ferber & Grimski, 2002). A significant proportion of brownfield land especially in areas with low market values is not often viable to bring them back into beneficial use. Without some form of public intervention these sites will remain unused and derelict for the foreseeable future (CABERNET network Report, 2006).

Even after regeneration, it may take time for the public to start using the site as previous uses of the land may cause real public concerns around issues of health and safety (Atkinson et al., 2013). Usually, regeneration tends to focus on economic factors such as job opportunities and commercial uses and not the ecological, historical and visual properties of these sites. Attitudes towards brownfield regeneration projects don't have to be automatically good especially for sites that have remained unused for a long period of time (Ruelle et al., 2012). As brownfield sites are known for a loss of jobs in the affected regions, their regeneration should provide as many long-term jobs as possible. The promotion of brownfield regeneration means to offer a huge development potential. For instance, it includes activities such as cleaning up environmental hazards, removing neighbourhood bad locations while at the same time, it means creating jobs, providing housing and promoting general economic health in local communities (Thornton, 2006). Regeneration of brownfields should improve any business conditions for life and appearance of towns, villages and landscape but the actual process of regeneration

depends on the level of development of a single urban unit (Kurtović Folić & Perovic, 2012). The legal persons such as businesses, households and public administration usually profit from the brownfield regeneration (NSRB 2024, 2019). Brownfield revitalization is closely related to the issues of territorial development and sustainable development of the area (Líšková, 2016). Regeneration of brownfields comes under the competence of public administration and self-government in the areas of spatial development and urban planning. Urban planning and its tools can create suitable conditions for brownfields regeneration by effective use of tools contained in urban planning legislation and building regulation (NSRB 2024, 2019).

The consumption of energy is an important aspect regarding sustainable development. As existing buildings on brownfield sites often do not comply with modern energy standards, energy related aspects are often obstacles for reusing these buildings in a sustainable way therefore sustainable brownfield projects have to pay special attention to the consumption of energy (Pahlen & Glöckner, n.d.).

The regeneration of brownfield sites is a process which required a full control of water demands and its consumption. The principles of sustainable water management are related to water conservation. In this context, a sustainable reuse of existing buildings must take into consideration opportunities to minimise the water demand of the buildings and to reduce the production of water-waste (Pahlen & Glöckner, n.d.).

Brownfield regeneration relies on public funding to be economically viable therefore public investment is needed. Those brownfield sites that require high remediation or rehabilitation costs and have limited possible revenue will not be redeveloped properly due to a lack of public funding or co-funding respectively (Franz et al., 2006). This is because the clean-up interventions are very expensive and financial capital is hard to find. Plus, there is a considerable delay between the initial investment and the time in which the site can be productively used again (Turvani & Tonin, n.d.).

One of the key drivers of brownfield regeneration is the economic revitalisation of an urban area (CABERNET network Report, 2006). It is assumed that the successful regeneration is linked with the prosperous region. Those regions that are successfully developed should have a positive impact on brownfield regeneration. In regions where a

higher potential of local development is made possible, a higher probability there is that a local brownfield will be more successfully regenerated. (Turečková et al., 2019). The regeneration of brownfields should contribute to the improvement of the quality of life in the cities and partially contribute to a more environmentally friendlier way of thinking of the society (Turečková & Nevima, 2018). Other successful factors for redeveloping brownfields are clear property relations, decontamination and regeneration costs and acceptable return rates for investors. In addition to political and economic factors, geographical factors might play an important role as well (Frantál et al., 2015). Regenerating a brownfield site to a greenspace for instance should bring the land back into use and it may be used such as play areas or community gardens. Situating new greenspace on brownfield can help make sure that urban residents have access to natural greenspace close to their residence. However, there are limitations concerning the regeneration of brownfield to greenspace. Most projects are designed to serve the public, not to generate private revenue and therefore it is necessary to justify expenditure of public money (Atkinson et al., 2013). One of the conditions behind the successful progress of the regeneration process is a transparent registration of brownfield sites. Such registration must be carried out using an integrated method of registering brownfield sites in the database in order that they may be compared with other brownfields in other cities and regions (Böhm, n.d.).

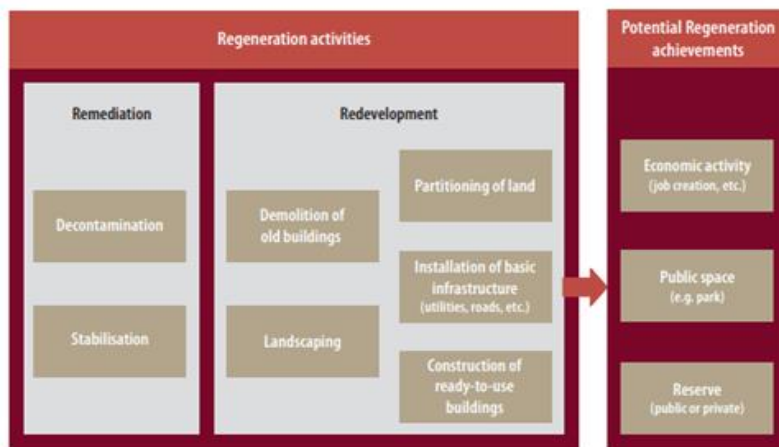
5.2. Regeneration process of brownfield

If any community, city or a region is interested in redeveloping a brownfield area, they will need to take a number of steps to ensure that the potential environmental contamination is handled properly and that they meet the requirements to receive financial and technical assistance (Pins, n.d.). According to Atkinson & Doick, 2014:Pins, n.d.: Rizzo et al., 2015: Vaníček & Jirásko, n.d., the whole remediation process has a few steps that should be followed to achieve the anticipated result which is the reuse of a brownfield site. It is only a general list of steps that needs to be done to conduct a remediation process. Some parts of this process happen all together, some steps are not needed for example due to the ease complexity of a site.

- 1) Site selection
- 2) Site identification/site assessment/environmental site assessment
- 3) First phase of investigation

- 4) Preliminary economic analysis
- 5) Second phase of investigation/second phase of environmental site assessment which includes detailed site analysis
- 6) Planning regarding site development and methods of finances and funding
- 7) Identification and selection of appropriate site remediation, strategies and options
- 8) Environmental site clean-up
- 9) Redevelopment of site
- 10) Site implementation, site establishment, control

Picture 2 – Simple scheme of brownfield redevelopment



Source: European Court of Auditors

In the beginning, we must decide what we will do with brownfields. The first of the possible solutions is their demolition and avoid regeneration which might be costly (Bosák et al., 2019). It is most effective to demolish the current premises and prepare the sites as open areas for marketing or further use. Brownfields are often seen as barriers in the contemporary city's structure limiting an area's development. Barriers may include lack of capital, lack of a brownfield database, lack of clean-up materials, the complexity of rules and regulations and uncertain conditions on a brownfield site might be seen as reasons for demolition (Ahmad et al., 2018; Navratil et al., 2018). But the demolition of historically valuable premises should be minimised, and the focus should be put on their refurbishment to preserve the place (Navratil et al., 2018).

The second approach is a regeneration process where we think of a vision of the new use of the brownfield and continue with other steps that follow (Bosák et al., 2019). Determination of the after-use on former brownfield site is one of the key elements for the success of a project. We must consider strategic land-use planning and detailed, site

specific, planning decisions. Land-use planning provides the overview that determines the general viability of proposed after-uses (Ferber & Grimski, 2002). Also, the regeneration process focuses on different aspects and phases including environmental and health risk assessment, remediation cost assessment, uncertainty assessment, evaluation of the sustainability of projects, management of the negotiations and partnership among involved stakeholders (Pizzol et al., 2016).

What usually triggers the redevelopment process? It is the availability of money or the purchase of land by development companies that focuses on buying contaminated land for redevelopment (Grimski & Dosch & Klapperich, n.d.) and its intention is to reuse the site again. I continue with steps that need to be followed during the regeneration process.

5.2.1. Site selection

A regeneration project begins with site selection that we want to remediate and ends with renewed site establishment. The first step includes a preliminary identification of site, a historical investigation of a suspected contaminated site where available data are collected on the former industrial activity which leads to the identification of potential contamination with the objective to include such sites in a list of contaminated sites (EEA, 2000: Gentile et al., 2009). In the beginning of the revitalization process, it has to be determined the site redevelopment prioritization which means to identify areas in need of revitalization or properties that pose any environmental concerns such as those situated in close proximity to schools or hospitals for example (FCM, 2016).

5.2.2. Site preliminary assessment

After the first phase of investigation into the site, we can move forward to the preliminary assessment of the potential chemical or biological nature of the subsoil based on appropriated data and what impact on the surrounding environment it has. The purpose of the site assessment is to determine the likelihood that some form of environmental contamination is present at the site, at what level and to what extent by collecting all the relevant and available information (Brownfield Handbook, 2010: EEA, 2010: Vaniček & Jirásko, n.d.). It is undertaken within defined time in order to deliver the project objectives (Atkinson & Doick, 2014). These preliminary investigations are carried out to confirm the existence of contamination. The site assessment includes a visual site assessment, interview with past and present owners and occupants, a search of databases regarding contamination near the site. The historical use of the site and the materials that were used

and produced on site will guide the assessment strategy and type of sampling and chemical analysis that will need to be done (Brownfield Handbook, 2010: EEA, 2010: Vaníček & Jirásko, n.d.). Basic identification data and information about the property are gathered and collected in an inventory and we get to know some information about the site such as the size of the site, the way the site is used, orientation analysis of ownership relations, a rough estimate of the investment costs for the revitalization of the site, potential investment plans, identification of past, present and possible future uses of the site, existence of environmental burdens and traffic availability (FCM, 2016: Planeta, 2007). But information available on the cost and benefits of brownfield redevelopment projects is very limited. Public and private project developers often cannot provide transparent information about property prices, treatment cost or benefits (Ferber & Grimski, 2002). Useful information about the price concerning the size may be also obtained from the database and we can find out about any possible problems we might have to deal with on the site. We may get preliminary information regarding the site area, ownership and other data. Typical problem with ownership is that the land ownership has often changed over many years in 20th century. In this case, other historical documents can be used (Vaníček & Jirásko, n.d.).

It is important to know that the site planning and site assessment are vital parts of the regeneration process to start with. The planning processes are similar for different regeneration sites and the familiarity with a good planning procedure improves project delivery at regeneration sites. Within planning, it is considered developing land use plans, economic development plans, brownfield strategies and programs that target priority sites, neighbourhoods or specific types of brownfields. Successful delivery of regeneration projects is dependent on the planning of project delivery and on good project management. Planning and site assessment are processes to make sure that constraints and aims are effectively addressed, and proposals are appropriate to use for the site (Atkinson & Doick, 2014: Ferber & Grimski, 2002). Also, the access to the property must be secured from the property owner before beginning assessment activities (EPA, 2006).

Brownfield environmental assessment consists of three phases: site assessment, site investigation and development of remedial actions. Identifying the presence and extent of contamination is essential to evaluate risks and to determine an appropriate reuse. The environmental assessment process starts with the collection of the basic information

regarding the current status of the site, a history of past environmental studies and information regarding possible redevelopment plans. It is a basic review of known environmental records, information and development history of a site. An environmental assessment phase I is performed to identify the presence, type and extent of contamination that might be on site. A preliminary assessment evaluates current and historical land uses or activities, potential areas of contamination and surrounding land uses or activities. If required, a phase II assessment may be conducted to sample or test for specific hazards that may have been identified in phase I and to help develop a remedial action plan. The environmental assessment for each property is carried out to determine if the site is contaminated or not. If the contamination has been confirmed at a site suspected of being contaminated, it is necessary to assess the contamination, what is recommended to do and determine whether it poses a risk to the environment and human health. There are several approaches to assess the potential hazardous effects of contamination on soils and groundwater but the most widely used in Europe is risk assessment. The risk assessment follows two phases to confirm contaminant types or concentrations and describe contaminated areas, it specifies the extent of contamination. These phases go one after another sequentially. The results from the first stage serve as a basis for the next stage. The first phase of environmental assessment takes weeks but the second one and risk assessment might take months. The elimination of ecological burden can take even years (Brownfield Handbook, 2010: CzechInvest, 2018: EPA, 2006: FCM, 2016: Pérez et al., 2018: Pins, n.d.).

The complexity of brownfield sites requires a step by step approach to site assessment according to the specific national regulations of each country (Ferber & Grimski, 2002).

First tasks of the initial stages of a site assessment includes:

- a site walkover/visual inspection
- a desk study with preliminary investigations
- detailed investigations and surveys, data collection
- analysis of the information collected (Ferber & Grimski, 2002).

5.2.2.1. *Site walkover*

The main aim of this phase is to evaluate the site regarding wider area, surface water, groundwater from old monitoring wells, discussion with owners or former employees, information about vegetation, inspection of existing buildings with assessment of their

condition referencing to any unusual symptoms such as colour or smell. All visual inspections should be accompanied with photographs or videos. Also, it can include a more thorough review of conditions at the site and some samples of the soil might be collected for instance (Brownfield Handbook, 2010: Vaníček & Jirásko, n.d.).

5.2.2.2. *The desk study and preliminary investigations*

It enables identification of likely constraints and opportunities for the reclamation and reuse of the site and it also includes the preparation of broad budget costing (Ferber & Grimski, 2002). The preliminary investigation also determines the site characteristics and the extent and magnitude of contamination at a particular site. Preliminary investigation concerns the identification of potential contamination via the actual soil and groundwater sampling to confirm or deny whether the contamination is present according to information of site history. The brownfield redevelopment may take longer than a typical real estate development due to environmental assessment and cleanup activities. It is crucial and very important to conduct a detailed study of the site in order to identify the cause, nature and extent of contamination and the possible threats to the environment or to any people living or working nearby (EPA, 2006: Pins, n.d.: Rizzo et al., 2015).

5.2.2.3. *Archive and contemporary data collection*

The availability and efficient management of data is crucial for comprehensive planning and brownfield management. Decisions need to be based on detailed information. Acquisition of data is not easy due to its amount (Doerle, 2012). The information on the history of the site should include data on past and present land use of the site, soil stratification and hydrogeology. The information might be obtained by visiting the site via observations, the use of detailed maps, detailed examination of public and private archives, interviewing current or former workers, neighbours, environmental activist groups, water companies and water authorities, and by evaluating old and recent aerial photographs (EEA, 2000). Other data are gathered about former industrial processes and associated materials and the sort of waste material that were produced on the site. These data may be shared later to facilitate information with other municipal departments, governments or the public (FCM, 2016). Information can be obtained regarding potential problems or past incidents during any previous remediation process from historical documents and from these data a judgement can be made on the probability of soil and

water contamination. All the data we have are very important so that we are able to divide the sites on:

- A) sites with high attractiveness
- B) Interesting sites
- C) Less interesting sites
- D) Very problematic sites (Vaníček & Jirásko, n.d.)

5.2.2.4. Data evaluation from the preliminary phase

After evaluating the data, we can get to the point when we find out some information regarding the site. There are two aspects:

A) Evaluation of the potential of the site - information that includes the size of the site, disposition, quality of buildings, halls, technical equipment, transport links, population density, land value, peripherality, entrepreneurial activity, education index, what can be used in the future, what is recommended for demolition (Pizzol et al., 2016: Vaníček & Jirásko, n.d.). Whether the site has a potential to be sustainable and used again for some other reason.

B) Site attractiveness- this factor is similar to the first one and it evaluates in which part of the city the site is situated, what is the traffic accessibility, it is compared with similar localities or similar projects, what is the impact of the remediation process with respect to humans and what benefits society and the local authority can get from the site (Vaníček & Jirásko, n.d.). Landscape quality, estimated regeneration costs, ownership, previous use, specific localization, infrastructure, in terms of the site's attractiveness are factors that are considered important in appreciation of any site and they deserve more attention when planning brownfield regeneration projects (Pizzol et al., 2016: Ruelle et al., 2012). Important factors in the remediation process might also be general information about buildings, history of building utilization, information from archive and other historical documents, materials from hydro/meteorological institutes, material from aerial observation with the help of photos (Vaníček & Jirásko, n.d.). All these data might help evaluate the brownfield site.

5.2.3. Main site investigation

During this phase, detailed analysis on other issues has to be also carried out to work on the revitalization plans of areas which includes detailed analysis of ownership relations, structure assessment of ownership relations, state and design of construction, state and

design of technical, urban and architectural solution of the project, time schedule in the form of a project implementation schedule, the owner's intentions with the given locality, willingness of the owners to revitalize the site, assessment of geological conditions, determination of soil conditions at the site, assessment of possible conflicts of the plan for the regeneration of brownfields (Planeta, 2007).

Also, the thorough analysis must be conducted in order to achieve the regeneration process. In the analysis, it can be discussed the link to spatial planning documentation, more detailed determination of the structure of ownership relations, mapping of the expected or confirmed extent of ecological damage, classification of the site by category, analysis of the state of technical infrastructure, analysis of the state of existing objects, schedule of costs for site revitalization, finding out whether the site had or has the right for money support from public sources, extended transport accessibility or distance from major agglomeration centers (Planeta, 2007).

It also must be decided:

- how to manage or treat any contamination problems
- whether to dismantle or reuse existing buildings and infrastructure
- the influence of any naturally developing ecology
- development of techniques, and procedures to address all aspects particularly within the traditional industrial regions of Europe (Ferber & Grimski, 2002).

5.2.4. Funding methods

One of the developer's roles is to provide financing to develop the property. To ensure that clean-up and redevelopment are not slowed down by a lack of funding, all public and private funding sources such as grants, or loans identified in the predevelopment step should be secured. A combination of private and public sector funding may be used to finance assessment, remediation, purchase and redevelopment activities. These funding sources may include local, state, and federal government programs that offer tax credits, grants, subsidies, bonds or loans. Public financing may be used for many components of the redevelopment, including building demolition, infrastructure development and clean-up activities (EPA, 2006).

5.2.5. Remediation strategies and options

The analysis and selection of clean-up alternatives relies on the data collected during the site assessment, the investigation phases and the cost-benefit analysis. It aims to collect

all available information on possible strategies and options including the capability to meet specific clean-up and redevelopment objectives in compliance with legal requirements and regional or local planning and development goals (Rizzo et al., 2015).

5.2.6. Site clean-up

It is time for the environmental site clean-up when someone already owns the property. That owner has already completed the assessment of full extent of contamination (Pins, n.d.) Clean-up and development occurs once the planning processes have been completed. This step encompasses receiving construction approvals, conducting clean-up and construction, integrating clean-up and construction activities. Depending on the type, quantity and toxicity of contamination on-site, cleanup activities may include soil, surface water or ground water remediation (EPA, 2006).

5.2.7. Site management

Property management of a brownfield may continue after the redevelopment is considered done. Management involves several tasks to ensure the long-term sustainable reuse of the property. This includes managing the financial aspects, community relations and any long-term environmental issues associated with the property (EPA, 2006).

5.2.8. End of the regeneration process

The regeneration process ends with renewed site establishment. Any renewed site should be made accessible for all means of transport in order to open the planned land use for all population groups and abilities (Pahlen & Glöckner, n.d.). Any brownfield project is considered successfully redeveloped when the construction is complete, ownership and leasing transactions are finalized, the property is occupied and being used as planned before the revitalization (EPA, 2006). From a social point of view, according to Pahlen & Glöckner (n.d.), accessibility means to encourage every part of the population to make use of the site. From an economical perspective, opening the site for all population groups improves the chances to market the site by attracting as many potential consumers as possible and the redevelopment should create jobs and taxable property improvements. It should be guaranteed that the selected interventions and the remediation were properly implemented therefore it should be ensured the long-term durability, reliability and effectiveness of the site (Pins, n.d.: Rizzo et al., 2015).

5.2.9. *Other important aspects*

A good communication is also very important to keep the public informed during the different steps of the redevelopment of the site and to get their feedback and reaction to be successful in the regeneration process. The good communication is essential for the sustainability of the project (Pahlen & Glöckner, n.d.). Is it necessary to include the local population in the planning, preparation for remediation, implementation of the project and subsequent operation of a regeneration process? Their opinion is crucial for the success of any regeneration project in order to make new sites viable and useful again (Martinat et al., 2016).

There are other tasks during the regeneration process such as administration, project management, safety, communication and engagement, sustainability analysis, monitoring and evaluation (Atkinson & Doick, 2014). The site monitoring in particular is possible via the location tracking if there are any ownership changes, extent of clean-up activities undertaken on site or any other issues (FCM, 2016).

The regeneration of brownfield sites and their return to beneficial use has meant a lot in the European Union over the past 10 years and in almost all European countries, brownfield problems are identified as serious problems that need a solution. In consideration of this situation, many research projects and networks have been launched to facilitate brownfield regeneration (Grimski & Ferber, 2001; Franz et al., 2006).

Brownfield regeneration should be an important step towards efficient use of land resources such as soil or water therefore brownfield sites should be regarded as a valuable opportunity and not a costly problem (European Commission, 2013). The revitalisation of brownfields contributes to sustainable urban development. It can make cities more valuable for citizens and workers and more attractive for companies to settle down. It may reduce traffic volumes, it may help reduce additional expenditures for the construction of any premises such as nurseries, schools, parks or traffic areas (FEA, 2005).

The main goal is to create a coordinated approach to brownfield regeneration via state policies, financial programs and appropriate conditions that will enable brownfields to find new economic or public benefits. The reuse of brownfields is supposed to contribute to the economical use of the built-up area and the development of towns and villages (NSRB 2024, 2019).

The further objectives and measures for brownfield site redevelopment might be to:

- A) embed the issue of brownfields in the policies and strategies of public authorities at the state, regional and local levels
- B) more efficient use of public funds
- C) to increase the interest of private investors in brownfield regeneration
- D) to support the development of the real estate market
- E) more consistent use of spatial planning tools
- F) to reduce the pressure on the occupation of agricultural land for industrial use
- G) greater awareness of professionals and the public concerning the issue of brownfield regeneration (NSRB 2024, 2019)

To conclude, the long-term objectives of any regeneration strategy are reduction of the number of brownfields in accordance with the principles of sustainable development as well as improvement of the quality of the urban environment and increase of the competitiveness of cities and towns which also involves the effective use of public resources for the support of brownfield regeneration which may be viewed not only as a long-term goal but also a means of achieving a complete regeneration of the site (CzechInvest, 2018).

6. IMPACTS OF BROWNFIELDS AND THEIR PERCEPTION

Why are brownfield sites being revitalized and why are engaged parties willing to build on them again? Because in most cases, investments in the reuse of brownfields have usually their advantages (Česko v datech, 2017).

Brownfield revitalization can often have many forms after the removal of environmental burdens. The most traditional forms are industrial or residential construction especially in the wider centers of larger cities where space is freed by factories that no longer are in service. Brownfields are perceived negatively in the context of their existence and the impact of their presence on the surrounding residential property values of the inhabitants of municipalities or cities (Turečková et al., 2017). Most local governments are somehow negatively impacted by the existence of brownfields. Even one or two brownfield sites can significantly impact municipalities (GOV of BC, n.d.). The essential environmental problem is possible pollution of soil and underground caused by previous bad utilization of land. Such pollution has a negative impact on the environment and may also have a direct negative influence on human health (Líšková et al, 2015). All these links may somehow affect both local inhabitants and tourists (Martinat et al., 2016). Brownfields affect property values within urban cities both directly because of actual contamination and indirectly through negative perceptions of areas associated with contamination. Brownfields may also affect the value of the contaminated property itself and the value of surrounding properties because of actual contamination that spreads beyond property borders (Carroll & Eger, 2006). It is estimated that groundwater contamination with toxic chemicals negatively affects property values of sites. The presence of a hazardous waste can significantly reduce the market values of residential and commercial properties on and around the site (Carroll & Eger, 2006). These sites are not nice, and they do not meet requirements of the local population how the city should look like which significantly affects the perception of these sites. The problem of brownfields is different in cities that are heavily affected by the recent decay of buildings or the heavy industry and mining (Turečková & Nevima, 2018).

We can not forget that these are mostly areas or sites where buildings have already stood in the past so we don't have to worry about any problems with unsuitable geological subsoil for construction for instance or it is land on which industrial activity has taken place (Česko v datech, 2017).

6.1. Positive impacts of brownfields

6.1.1. *Reuse of brownfields*

There are many possible types of possible reuse of brownfields. Demolition, environmental damage removal, restoration, reconstruction, new construction, beneficial use, change of use (Browntrans, 2012).

The demolition of site and creation of green spaces or demolition followed by new development seems to be an economically good option (Navratil et al., 2018). Preference for the demolition of derelict buildings and development of new buildings on current brownfield locations is affected by the city, city zone or location of brownfield. Higher preferences of refurbishment solution for brownfield regeneration are in city centres and in inner city structure meanwhile on the outskirts, the interest in refurbishment is significantly lower (Navratil et al., 2018). There are great opportunities for brownfields to be revitalized in inner city redevelopment that encompasses areas like empty lots, unplanned interior areas, vacant buildings or other underused properties (Grimski & Dosch & Klapperich, n.d.). Many contaminated sites and many previously developed sites in cities with little or no risk of contamination which have been abandoned or are no longer maintained can be restored to improve the environment and to attract new investment for jobs, housing or public facilities (Grimski & Ferber, 2001). Any form of refurbishment, demolition with new development, demolition and keeping green spaces is supposed to have a positive effect on surroundings. Reuse of such abandoned sites improves the quality of life of local population by means of reduction of criminality, it improves local environment, increases prices of the land, increases perceived value of properties in neighbourhoods and attracts entrepreneurs (Turečková et al., 2019).

Brownfields are perceived as significant but specific elements of territorial development and spatial arrangement of the cultural and natural environment. The new use of temporarily abandoned areas helps reduce the pressure on construction on greenfields in the urbanized area and it helps maintain the compactness of the current built-up area (Turečková et al., 2017). Once cleared and treated, redeveloped brownfields can be used again in various beneficial ways such as logistics or storage facilities, the creation of

innovation clusters hosting business incubators. These sites might also be used to produce renewable energies by installing photovoltaic panels for example.⁷

6.1.2. Brownfield location within the city

The central parts of a city are often the most attractive and these are areas where the regeneration will most likely involve redeveloping brownfields for housing. During the late 19th and early 20th centuries, industrial sites were established surrounding the city-centre. However, the dynamic growth of cities during the 20th century saw them become integrated into the densely urbanised suburbs. Brownfields emerged there from various former uses including brick pits, quarries, transit depots, waste fields or agriculture (Navratil et al., 2018).

Brownfields located in attractive areas with favourable economic development potential and good transport links are more likely to be regenerated than brownfields located in less-favoured peripheral areas. The proximity to the city centre and transport links are important factors viewed for the development of brownfield projects. The most evident and visible examples are the inner-city areas where most post-industrial brownfields are usually redeveloped into supermarkets, shopping malls and other facilities of civic amenities (Frantál et al., 2015).

In modern cities of today, brownfields could be used for new open green spaces within the cityscape which would contribute to the health and better quality of life for local residents. Green infrastructure can mitigate the tendency of concrete and tarmac surfaces. Green space which is rebuilt after the demolition of brownfield in city should also help avoid urban heat by cooling the city down (Navratil et al., 2018). Urban greenery is believed to have a positive effect on a city's biodiversity, residents' quality of life, and housing. Transformation of brownfields within residential areas into parks and other types of recreational facilities is desired and valued by residents because it promotes human and environmental health. Some redevelopment projects aim to transform brownfields into controlled green areas with public sector funding. Even though the perception of revitalisation of brownfields into parks is good, it is not always positively accepted by the

⁷ Reconversion des friches industrielles, une approche globale pour créer de la valeur dans les zones urbaines, online on <https://www.usinenouvelle.com/article/tribune-reconversion-des-friches-industrielles-une-approche-globale-pour-creer-de-la-valeur-dans-les-zones-urbaines.N801410>

public, particularly if the regeneration plan includes privatisation of council property (Navratil et al., 2018).

However, in the outskirts, there is a high interest in converting brownfields into open spaces for recreation. This could be related to the perception of outskirts as recreational grounds with extensive use which shows the habit of brownfield regeneration in suburban areas where there is usually lower population density and a greater supply of green spaces. Brownfields on the outskirts are often transformed into public recreational grounds for environmental and social reasons (Navratil et al., 2018). Demolition and redevelopment into new buildings is most preferred in the inner city. On the other hand, demolition and creating green spaces or brownfields non-regeneration are most acceptable in the outskirts (Navratil et al., 2018).

In general, larger post-industrial and post-agricultural brownfields sites are less likely to be regenerated and usually take longer to redevelop than smaller sites because of the area. Due to this fact, these larger sites located further away from the city seem to be the most critical brownfields whose regeneration was, is and will be realized with more difficulty without some form of political intervention or public money (Frantál et al., 2015).

Other key reasons are that brownfield regeneration contributes to sustainable urban development that prevents land degradation, reduces negative effects of suburbanization and urban sprawl (Turečková et al., 2019).

6.1.3. Benefits of brownfields

Some advantages of brownfields if regenerated may be according to FEA (2005)

- 1) Better location quality to the city centre, public transport, urban environment, closer location to business partners if it is the case
- 2) Brownfield might have a stable increasing value of the property if regenerated to the good reuse
- 3) It tends to have lower construction costs thanks to available infrastructure
- 4) They reduce sprawl and they contribute to the redevelopment of a section of a city, they improve image of a city
- 5) they may have positive environmental effects, if well-repaired, they have investment potential ⁸

⁸ Greenfield vs. Brownfield: What's Better for Your Manufacturing Facility? (n.d.).

Local governments realize that responsible brownfield redevelopment can transform environmentally damaged properties into productive lands resulting in the environmental, economic and social community benefits. According to GOV of BC (n.d.), these benefits are:

- 1) improvements in environmental quality (soil, air and ground water)
- 2) improvements to human health
- 3) protection of groundwater resources
- 4) reduction of urban sprawl
- 5) economic growth including the retention and creation of local jobs
- 6) increased property tax revenues
- 7) revitalization of neighbourhoods and employment areas
- 8) increased affordable housing opportunities

The benefits of revitalizing these sites include the economic development by increasing the public tax base through new job creation that should result in making them more productive and attractive, it also helps address urban sprawl. Other economic benefits might be that domestic and foreign investment can be attracted to the restoration of the tax base of government, especially at the local level which should mean the increase of employment boosting the local economy, increasing the usage of existing municipal services. All this could be the initiator for additional economic development (Turvani & Tonin, n.d.: Haninger & Timmins, 2017.: BenDor et al., 2011).

The remediation of contaminated sites can contribute to numerous benefits, among them the improvement of environmental quality and the reduction of risks posed to human health and ecological systems, the reduction of development pressure on greenfields sites, protection of public health and safety, protection of groundwater resources, protection and recycling of soil resources, restoration of former landscapes and establishment of new areas that have some ecological value, there is also an option to conserve a natural resource to use it in the future to preserve it for future generation therefore many contaminated sites have the potential to become a profitable site that generate new activities and new employment opportunities. The social benefits may be the renewal of urban cores, the improvement of the quality of life, the elimination or reduction of the negative social stigmas associated with the affected communities by revitalizing them, loss of property values in these communities, enjoyment of people and quiet recreation. Because of that, cleaning up contaminated sites is currently considered as one of the

environmental policy priorities in many countries (Atkinson et al., 2013; Turvani & Tonin, n.d.).

The successful brownfield revitalization can benefit from the typically prominent location of the sites and of already existing infrastructure and it can drastically enhance sustainable regional development by contributing to a reduction of land consumption and urban sprawl (Schädler et al., 2011).

But in many cases, even good conditions for brownfields regeneration may not be enough if there are some barriers such as weak local political involvement, a lack of information, poor communication and cooperation among stakeholders (Frantál et al., 2015). The knowledge about the environmental benefits of brownfield regeneration is relatively low. What is lacking is awareness of the social and environmental problems associated with brownfield sites (Martinat et al., 2016).

6.2. Negative impact of brownfields

With uncertain levels of contamination, as a result of former industrial, commercial or military use, brownfield sites consume scarce soil resources and may cause environmental and health risks, as well as economic and social costs. So, the need to considerably reduce land consumption is well recognised at national and EU levels (European Commission, 2013). It also identifies environmental threats in sustainable development in regions such as a loss of agricultural soil (Vojvodikova et al., 2019). Non-regenerated brownfields affect house prices in an area. Some typical reasons for high rehabilitation costs and reduced real estate value of brownfields might be wrong location, legacy infrastructure or contamination. Property values diminish when there is a perception of decrease in benefits associated with the property or an increase in the cost of maintaining and owning the property that results from environmental contamination (Carroll & Eger, 2006; Franz et al., 2006). Other warnings are about higher concentrations of socio-pathological events such as crime near brownfields (Navratil et al., 2018). Brownfields show greater occurrences of social impacts such as unemployment and even psychological impacts like fear of crime, economic impacts like decreased market values of land and properties, environmental impacts such as real or perceived contamination (Martinat et al., 2016). Brownfields may cause minor or major problems, they may be a limitation for further development of built-up areas and they might reduce economic development, they might have a negative impact on the environment, they are linked with social and economic

impacts on population that lives nearby and they have an unfavourable impact on the wider region where they are located (Turečková et al., 2019). For instance, the reuse of postmining brownfields is highly specific and problematic regarding both environmental risks such as undermining and contamination (Martinat et al., 2016). These are some of the reasons why brownfields should be regenerated. It is necessary to suppress the negative side of brownfields and transform it into the potential for further development of the area and regions (Turečková et al., 2017). The economic, environmental and social barriers that are present at the site might impede brownfields to have any beneficial use (Thornton et al., 2006).

Brownfields are seemed as barriers to local development, they have become contributors to urban sprawl, burdens degrading the value of surrounding properties, potential hazards to human health and the environment, grounds for neighbourhood crime and other illegal activities (Frantál et al., 2015). Brownfields are considered to be undesirable sites, their occurrence is associated with several negative effects which the society tries to minimize. (Turečková et al., 2019). Leaving premises and sites as brownfields are not preferred, particularly in the city centre (Navratil et al., 2018). Significant economic losses may come afterwards because of the existence of brownfield sites located without any use in the centre of cities, not providing a source of tax income (Böhm, n.d.).

The land where the brownfield site was located used to provide a number of job opportunities. The closure of businesses located there can lead to an increase in unemployment. Unfortunately, the unemployment usually comes with population migration, a change in demographic structure or an increase in crime. The place can become dangerous and people might leave it therefore the area becomes very unattractive. Abandoned buildings slowly fall into disrepair, they become dangerous and increasingly difficult to repair. The value of land decreases. The properties around these brownfields are also devalued (Líšková, 2016).

6.2.1. Brownfield disadvantages

Some disadvantages and risks are:

- 1) Higher costs and delays due to a bad cooperation between involved parties
- 2) How the contamination will be handled, the redevelopment of site may be complicated by any forms of contamination
- 3) A negative marketing image (FEA, 2005)

- 4) If restoring an older brownfield building, it may not meet structural or environmental requirements, it can meet with higher risks of cost overruns due to any unexpected developments on the brownfield side⁹
- 5) The centrality/proximity with existing infrastructure
- 6) Existing contamination due to former industrial uses, high development complexity due to problematic ownership and the great number of stakeholders as well as the question of financing of loaded sites (Doerle, 2012).

One of the main obstacles in brownfield development is its unattractiveness to developers, de-contamination that is required, providing a long-term strategy for its use and cost-effectiveness (Maliene et al. 2012). The presence of brownfields hampers the economic development in the affected regions as its negative appearance and the risks associated with the environmental hazards are major obstacles for investment (Ferber & Grimski, 2002). The decontamination of contaminated sites may take up to a few years and even decades because of their mixed and plenty of unknown contaminants in the soil (Interreg Central Europe, n.d.).

Brownfields can have significant negative environmental, economic and social impacts on a community. For instance, if the site is left in their deteriorated state, brownfield sites can:

- 1) harm human health and the environment
- 2) attract vandals, open dumping and other illegal activity that can lead to urban blight
- 3) lower surrounding property values contribute to neighbourhood deterioration and may negatively impact the quality of life in a community
- 4) reduce local employment opportunities and tax revenues
- 5) limit economic opportunity and growth (GOV of BC, n.d.).

Brownfields can have significant negative impacts on the environmental, economic and social quality of life, even in communities with only a few brownfield sites such as abandoned gas stations or manufacturing facilities. Furthermore, the negative impacts of brownfields can be lasting and increase over time if a stigma has developed around these

⁹ Greenfield vs. Brownfield: What's Better for Your Manufacturing Facility? (n.d.).

brownfield sites for some time (GOV of BC, n.d.). Brownfields affected by the environmental burden mean a greater financial and time pressure on investors. These reasons may discourage private parties from investing in brownfield restoration. (Líšková, 2016).

Brownfields are dangerous as for the bad quality of their technical infrastructure and not usually secured against the intrusion of people who should not be there. Those risks relate to bad statics and neglected maintenance of individual buildings or failures of concrete structures due to corrosion of materials are very high (Turečková & Nevima, 2018).

6.3. Brownfield perception

Brownfield regeneration can greatly affect those who live or work nearby. These people are key stakeholders and have much to contribute to developing regeneration strategies (CABERNET network Report, 2006). The attitudes of city residents towards alternative types of brownfield regeneration might depend on

- the extent of brownfields in a city
- brownfield location
- place of residence
- type of regeneration

There are ways how perception of brownfields is constructed by local population and which characteristics of brownfields influence values of residential properties the most. In the Czech Republic, it is considered that the brownfields are an urban problem therefore the interest is also concentrated on smaller municipalities because it was identified a significant proportion of abandoned areas in municipalities with up to 2000 inhabitants (Vojvodíková, Mihola, n.d.). The occurrence of brownfields that were heavily affected by the heavy industry and mining, significantly affects values of these properties that are in neighbourhoods of these sites (Turečková et al., 2017). It is assumed that proximity of neglected, abandoned and decaying grounds impacts values of residential properties. The occurrence of brownfields causes a decrease of property residential values in almost every urban zone. It can be city centre, inner city, suburban zone (Turečková & Nevima, 2018). Their impact on the value of the residential property is transformed into the reduced price. Through this lower property price, there is a social loss from the economic point of view and the social surplus decreases (Turečková et al., 2017).

But all brownfields are not the same, some of them are partly utilized, only part of them is located where people do not live. Values of residential properties in the neighbourhood of brownfields are also considerably influenced by the way how population perceives these sites. Willingness to purchase any real estate in the proximity of brownfield is affected by the mix of factors such as geographical location, accessibility of the site, availability of infrastructure. Once the brownfield regeneration process is finished, values of residential properties in neighbourhoods usually increase (Turečková & Nevima, 2018). Public perception about brownfield also varies. Some people perceive it as an opportunity for recreational activities and the others consider it dangerous to human life (Ahmad et al., 2018). By its nature, brownfield remediation and redevelopment mitigate adverse environmental impacts, minimize or eliminate pollution and make efficient use of natural resources (GOV of BC, n.d.).

The aim is to make from brownfield sites competitive areas again (NSRB 2024, 2019), because they might provide a considerable potential for urban renewal in city centers and suburbs and substantial conditions for internal development in many places all around the globe (Grimski & Dosch & Klapperich, n.d.).

7. NOTIONS OF CABERNET, CLARINET

Some notions of CABERNET and CLARINET were already mentioned in the first section in relation to some brownfield definitions. CABERNET tries to identify any data describing the scale and nature of the brownfields problem across Europe. This information is essential in order to establish indicators of brownfield such as changes over time, its extent, location and type and to determine realistic and effective targets for the future regeneration of brownfield land (Oliver et al., 2005). CABERNET is Europe's sustainable brownfield regeneration network that focuses on issues that come up regarding the brownfield regeneration. It is one of the few forums available for the interaction of diverse stakeholder groups at a European level. This network enhances brownfield site remediation across Europe. It also provides new management strategies, innovative tools and a framework for other research activities (Nathanail, Millar et al., 2007). The network is a forum that consists of stakeholders from groups such as landowners, municipalities, researchers, developers, national regulators, representatives of community groups, consultants and professional advisors. These groups meet to discuss and exchange practices, experiences and aspirations relating to brownfields and the wider issues of urban regeneration. It also allows a diverse group of stakeholders to share experiences from across Europe. It provides new management strategies, innovative tools and a framework for coordinated research activities (CABERNET network Report, 2006).

CLARINET means Contaminated Land Rehabilitation Network for Environmental Technologies in Europe (Nathanail, 2010). It is a project funded under the Environment and Climate Programme of the European Commission (Ferber & Grimski, 2002). It copes with rehabilitating contaminated sites, brownfields included and led to the formation of the CABERNET network and the RESCUE project (Nathanail, 2010). CLARINET provides a network on the sustainable management of contaminated land in Europe. The network brings together the combined knowledge and expertise of academics, national policy makers, government experts, consultants, industrial landowners and technology developers from 16 European countries. Key objectives of CLARINET are to identify the means for the effective and sustainable management of contaminated land in order

- A) to ensure the safe re-use of these lands
- B) to decrease water pollution

C) to maintain the functionality of soil and groundwater ecosystems (Ferber & Grimski, 2002).

CLARINET focuses on procedures for land management in European countries (Ferber & Grimski, 2002).

8. NOTIONS OF RESCUE, TIMBRE, HOMBRE AND SUCH

There are other interesting and promising policy-relevant research projects related to brownfields. Many of these projects on the EU level have resulted in positive impacts in regions as well as in more awareness about the successful brownfield development. Regeneration is also supported by the European Commission under the Seventh Framework Programme (Del Rio et al., 2010 & Bartke et al., 2012). Brownfields have long been considered as a development problem. The attention was focused primarily on the issue of cities before such as the remains of factories and mining activities. Research to regenerate these areas is associated with a number of research projects and initiatives (Vojvodíková, Mihola, n.d.). The reuse and development of brownfields is a major building block in strategies to achieve such political objectives. This is reflected by EU investment under the Seventh Framework Programme in two key projects:

- 1) Tailored Improvement of Brownfield Regeneration in Europe (TIMBRE)
- 2) Holistic Management of Brownfield Regeneration (HOMBRE), both focusing on enhanced uptake of innovative and existing methods, technologies and decision-support instruments (European Commission, 2013).

According to European Commission (2019), HOMBRE seeks to achieve a shift in sustainable brownfield land management practice. How to achieve this goal?

- A) It is important to better understand why, how, where and when brownfields are formed in order to avoid future brownfields
- B) Better solutions for long term land use of current and potential future brownfields are required
- C) Development of more sustainable integrated regeneration technologies for successful brownfield regeneration is needed ¹⁰

(European Commission, 2019) says, that TIMBRE (An Integrated Framework of Methods, Technologies, Tools and Policies for Improvements of Brownfield Regeneration in Europe) will overcome existing barriers to brownfield regeneration by developing and providing customised problems and target oriented packages of approaches, technologies and tools.¹¹ TIMBRE is concerned about sites previously used

¹⁰ European Commission, 2019, retrieved online from <https://cordis.europa.eu/project/id/265097>

¹¹ European Commission, 2019, retrieved online from http://cordis.europa.eu/projects/rcn/97552_en.html

for military, mining, industrial or commercial purposes that are often plagued by high levels of contamination. Also, one of TIMBRE's main goals is the collection, evaluation and classification of the accessible literature and data dealing with the regeneration and revitalisation of brownfields. TIMBRE delivers the needed information and tools for brownfield owners, developers, regulators and other parties involved in the brownfield regeneration process (Bartke et al., 2012).

RESCUE is a research project funded under key action IV "*Cities of tomorrow and cultural heritage*" of energy, environment and sustainable development within the 5th Framework Programme of the European Community. The RESCUE consortium comprises 14 partner institutions from France, Germany, Poland and the UK representing a wide range of different stakeholder interests and competences in brownfield regeneration (Pahlen & Glöckner, n.d.). RESCUE analyses the current practice in brownfield regeneration against the background of sustainability (Franz et al., 2006). RESCUE analyses strengths and weaknesses of the current practice in brownfield regeneration and develops tools for the practical work of real estate owners, planners, architects, engineers and public authorities involved in the complex processes of brownfield projects (Pahlen & Glöckner, n.d.).

RESCUE developed an approach that makes the concept of sustainability viable for the context of brownfield regeneration. This approach is based on the recognition of four dimensions to sustainability: environmental, economic, social and institutional (Franz et al., 2006). RESCUE developed the Sustainability Assessment Tool (SAT) for brownfield regeneration projects to assess future brownfield regeneration projects in terms of site-specific sustainability and thereby support future funding or permission decisions in brownfield projects (Franz et al., 2006). RESCUE is the first project which was designed to integrate the diverse disciplines and stakeholders which are involved in brownfield regeneration in order to satisfy both the demands of sustainable development and the different socio-economic, legal and political conditions in its participating countries (Franz et al., 2006).

In the 1990s, CARACAS brought together scientists, regulators and policy makers to define the state of the art of contaminated land risk assessment across Europe and to develop a consensus on what such risk assessment involved (Nathanail, 2010).

NICOLE is the network for industrially contaminated land in Europe, the project COBRAMAN focuses on project managers who will guide and support land recycling processes (Doerle, 2012; Vojvodíková & Mihola, n.d.).

9. COMPARISON OF CONTAMINATED SITES IN THREE PARTICULAR COUNTRIES

Czech Republic, France and Germany have their own database of brownfields and each country approaches the problem of brownfields in a different manner which reflects in the actual and real data concerning the number of brownfields. The number of brownfields doesn't represent the actual number of contaminated sites especially in the Czech Republic where all the data are not available for public.

This part is the mix of examples, graphs, information about the history of brownfields in each country, the current situation in regions, the evolution of brownfield regeneration, examples of some brownfield projects that were financed from the EU funds.

9.1. Czech Republic

The countries of Central and Eastern Europe still partially face the historical background of industrial production. Brownfields have been present in developed European countries since the 1960s, in other countries of the former Eastern Bloc and in the Czech Republic in particular, it appeared 25-30 years later in the 1990s, when the Czech economy transitioned from planned to market economy and also due to the changes in the political regime after 1989 when the communism era ended. That was the time, around 1990s, when the public and the private sectors have started to be somehow interested in the regeneration of industrial brownfields. The Czech Republic together with the former German Democratic Republic used to be the most industrialized countries in the area. Therefore, brownfields may be considered as the remains of changes in the economy and in society in the last 40 years. The switch to a market economy and the wave of privatisation of state-owned enterprises brought along especially many abandoned industrial and agricultural complexes, production facilities and warehouses that became brownfields afterwards (CzechInvest, 2018; Kunc et al., n.d.; Lišková et al, 2016; Vojvodikova et al., 2019). The Czech Republic has always been the industrial heart of Europe. The one third of the current Czech GDP consists of industry. Nevertheless, it causes an occurrence of old factory premises (CzechInvest, 2018). After the decline of engineering, metallurgy and mining, industrial brownfields emerge, agricultural and military brownfields appear after leaving military areas for example (Lišková, 2016).

In the Czech Republic, CzechInvest agency currently deals with the issue of brownfields. That is where the most information can be found regarding brownfields. The CzechInvest agency main aim is the promotion of business and investments that focuses on brownfields at the national level in the Czech Republic. CzechInvest has been involved with the issue of brownfields since 1990s (CzechInvest, 2018; NSRB 2024, 2019).

The national brownfield database registers sites that meet the brownfield definition. But this database registers only a part of the actual number of brownfields. Its purpose is to provide an overview of the number, character and development of brownfields in the Czech Republic. It was established primarily for the purpose of offering brownfields as investment opportunities for investors. The non-public part is used for statistical purposes and overviews on the support of brownfield regeneration (NSRB 2024, 2019).

But the number of brownfields registered in the database doesn't represent the overall number of contaminated sites in the Czech Republic. We can get a better perspective idea about the number of contaminated and potentially contaminated sites from the SEKM database. It is a project system for evidence of contaminated sites. According to the SEKM database, there are more than 11 750 contaminated and potentially contaminated sites but according to Pérez et al. (2018), there might be more than 20 000 potentially contaminated sites because many sites are not registered in the system.

Usually, the number of contaminated sites is much higher and not all the sites are registered which makes it harder to analyze the overall problem of brownfields. The large range of results is mainly due to the setting of the minimum area of the brownfield and the estimation of the average size of the areas (NSRB 2024, 2019).

In the Czech Republic, we can distinguish between regions that are more or less active in brownfield regeneration. Moravian-Silesian, South Moravia, Zlín, Liberec and Olomouc regions are more active in supporting the regeneration of brownfields than the others. For instance, the Moravian-Silesian region was the first region to gain experience in using the Jessica financial instrument and the Urban development fund for brownfield regeneration projects which followed. The Zlín region approved its own strategy for the use of brownfields (NSRB 2024, 2019). But for example, Pardubice has a good database of brownfields located in its region. In Pilsen region, the regional self-government's interest in this area declines due to the depletion of potentially developing brownfields by

investors. However, problematic rural and large industrial areas in the cities in the region remain (NSRB 2024, 2019).

The situation regarding brownfields in Ústecký region is complicated. This region is structurally affected with a high number of brownfields such as the Moravian-Silesian, but it has given up systematic support for brownfield regeneration and has limited its activities to a zone near the city of Žatec. The database in the region is not updated, it is limited only to the offer of selected localities to investors. The city of Ústí nad Labem itself has a brownfield database. It keeps statistics about the number and areas of brownfields (NSRB 2024, 2019).

It is assumed that main brownfield locations in the Czech Republic would be located in industrial regions. There are two regions famous for their industrial history. These regions are Ústecký region and Moravian-Silesian region around Ostrava. These two regions are traditional industrial and heavily urbanized regions. Ústecký and Ostrava region are perceived as the "black lungs" of the country with power plants burning coal. But dozens of successfully regenerated buildings in the city may be found despite an increased contamination. Inhabitants living in the Ostrava and Ústí regions meet with negative impacts of mining and black coal almost on a daily basis therefore they perceive the existence of the unused and decaying areas much more sensitively than in other regions (Kunc et al., n.d.).

Brownfields in the Brno agglomeration are perceived as a much smaller problem (Kunc et al., n.d.). The city of Brno is seen as a nice example in the approach to brownfields in the Czech Republic. There are many brownfields in Brno. One of the largest shopping centers in Brno is Vaňkovka shopping center and it is another successfully revitalized brownfield. Since 2005, it has been a shopping and culture center. (Česko v datech, 2017).

Picture 3 – Vaňkovka before



Source: Brněnský deník.cz

Picture 4 – Vaňkovka today



Source: E15.cz

The city of Brno is the second largest city of the Czech Republic. It is the geographical and administrative centre of the South Moravian region. Intensive industrialization throughout the 19th and most of the 20th century was the leading factor of urbanization. In the late 19th century, there were many textile industries, during the following periods of industrialization (1918–1989), other industrial sectors such as machinery engineering and chemical industries started to appear and played more important roles in the urban economy. The city was called “*Manchester of Moravia*”. Many textile factories were

situated around Brno and after they shut down in 1990s, they are left, and they decay¹². Brno's urban development during the era of socialism (1948–1989) was determined by the centrally planned economy, which supported development of heavy and engineering industry, railway transportation, the military sector and an intensive development of prefabricated housing estates. Therefore, the process of deindustrialization was delayed in comparison with western societies. After the return to the market economy, the system of post-socialist cities went through a rapid and complicated transition which was characterized by fundamental changes in all socio-economic structures (Frantál et al., 2015). The transformation period from centrally planned economy to the market economy was accompanied by serious problems such as the bankruptcies of many companies, unemployment growth, labour migration and the emergence of brownfields. Despite these negative circumstances, Brno was transformed quite successfully, especially regarding the development of new industrial sectors, universities and innovation centres (Frantál et al., 2015).

The biggest issue but also an obstacle concerning the Moravia-Silesian region is the predominant private ownership of brownfields (NSRB 2024, 2019). In the case of Karvina, the city in the Moravian-Silesian region where the western and southern parts of the city is heavily affected by mining, lack of other job opportunities for less qualified people means that mining is perceived as the most stable job regardless of the anticipated exhaustion of the reserves in the near future. Representatives of local city administration are supporters of further expansion of mining in the area instead of the building of new residential areas (Martinat et al., 2016), because if the mining industry is not supported, it will disappear and many workers will lose their jobs if the companies are closed down. After the political changes of 1989 mining activity in the former Czechoslovakia was sharply reduced but it still is one of the most important sectors for local economy. It has been the most important employer not only in Karvina, but in the whole Moravian-Silesian region. Employment in this sector illustrates the importance of industrial activities for the development of the city (Martinat et al., 2016).

¹² Střed Brna je královstvím opuštěných továren. Oživovat se je daří pomalu, 2017, idnes.cz, available online on https://www.idnes.cz/brno/zpravy/centrum-brna-brownfieldy-opustene-tovarny.A170325_2314878_brno-zpravy_krut

Post-mining brownfields are primarily located in peripheral locations within the western and southern parts of the city of Karvina such as the Doly, Louky and Darkov neighbourhoods where many houses were demolished and artificial lakes created due to the mining while industrial brownfields can be found in proximity to housing estates built up during the socialist era (the Nove Mesto and Hranice neighbourhoods). In the centrally located parts of Karvina (Frystat) are brownfields with historical and architectural value (the Janackuv mlyn mill, the Larischovy konirny stables). Geographical proximity plays crucial role in the perception of the urgency of regeneration of any given brownfield which is the mostly visible in the case of post-mining brownfields in Karvina but since these sites are located in distant locations from the residential areas of the city, the urgency of their regeneration is reduced (Martinat et al., 2016). Within the Karvina area, effects of coal mining have created hydrological changes in the area, artificial lakes, slag heaps and other devastated areas. Such wider devastated sites are located in the neighbourhoods of Doly, Darkov, and Louky and are much larger than the brownfields identified (Martinat et al., 2016). Most of these sites are post-industrial former coal mines. Karvina is a city that has lately experienced sharp population decreases. Despite these population decreases, the number of houses consistently rises, except in neighbourhoods heavily affected by ongoing mining in Doly, Darkov, Louky. The mining company (OKD) is the largest owner of land and buildings around the area. Another neighbourhood of Karvina with a strong brownfield presence is the area of Nove Mesto. An example of a brownfield is the former House of culture where social events for the local population used to take place but which is now abandoned (Martinat et al., 2016).

The perceptions and the life around brownfields in Moravian-Silesian region and Ústecký region are not very different for local inhabitants due to the similar mining industry history.

There are other forms of former brownfields uses. Our largest sport hall O2 Arena in Prague is located on the site of the former Czechoslovakia engineering company, the ČKD Lokomotivka company (Česko v datech, 2017). An example of a “temporary” use of brownfields is the location hosting giant concerts in 2004 which revived the premises of the former foundries of ČKD not far from the O2 Arena. Since then, the place has been waiting for its more permanent use. In Zlín region, the area of the former Baťa plant has been redeveloped by architects and urban planners. Today, there are renovated buildings such as house offices, galleries, a university and private entities (Česko v datech, 2017).

Picture 5 – Baťa plant before the redevelopment



Source: CzechInvest, 2019

Picture 6 – Baťa plant after the regeneration process



Source: CzechInvest, 2019

From the Liberec region, an example of Textilana is worth mentioning. The textile factory was located in this area for about two centuries. It was founded in the beginning of the 19th century. In the early 1990s, it was the largest producer of woolen fabrics in the country and the company was famous for the production of textiles all over the world.

The production itself ended in 2001 because Textilana was not able to repay its obligations so the demolition of almost all buildings in the area followed.¹³

Except for a few buildings, the entire complex was demolished in 2003. The wool weaving mill was preserved but it has been falling into disrepair without any use. Today, a tram line leads to Jablonec nad Nisou through this extensive area (Stránský, n.d.). In 2018, the area was acquired by the investment company Middle Europe Investments (MEI). The company plans to build more than 1,000 flats there and intends to use part of it for offices and a business incubator (Tesař, 2018). The intention of the new owner is the revitalization of this area but it is unclear when the process of redevelopment will really begin.

Picture 7 Textilana factory



Source : <https://www.nasliberec.cz/komentare/z-egonova-blogu/2697-neco-malo-z-dejin-liberecke-textilany>

¹³ <https://investujpodjestedem.cz/lokality/textilana-na-bide/>

Picture 8 – Textilana in 2003



Source : Mapy.cz, 2003

Picture 9 – Textilana in 2020



Source : Mapy.cz, 2020

9.1.1. Examples of brownfield financing from the EU in the Czech Republic

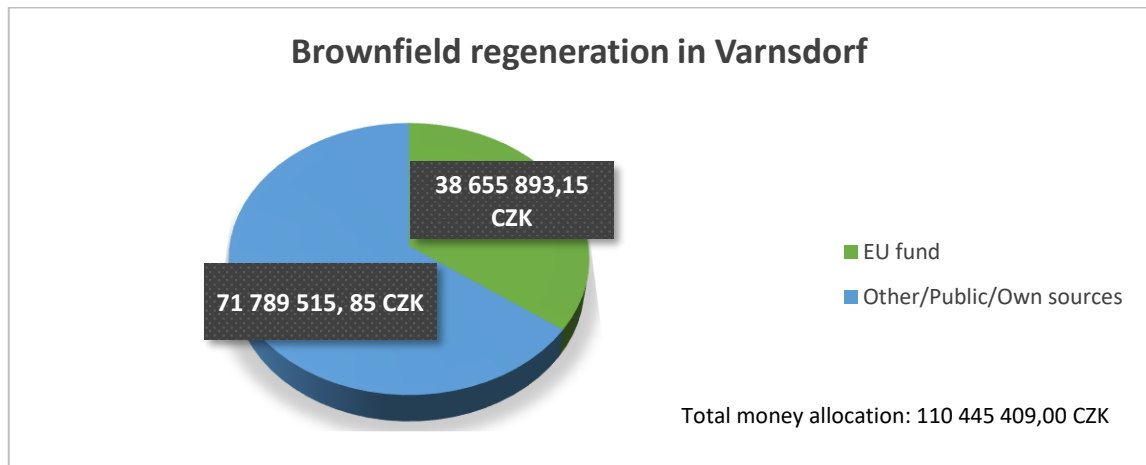
9.1.1.1. Brownfield regeneration in Varnsdorf

The aim of the project was the revitalization of a brownfield site, the demolition of existing buildings and the construction of a new production facility in which the production of textile products will take place. It is located near Varnsdorf, the city situated in a less developed region of Ústí nad Labem. The project falls under the operation programme Enterprise and Innovation for Competitiveness (OPEIC) which is the main financial tool for brownfield support in the Czech Republic. The project was finished in 2018.

Benefits of the project were

- revitalization of the industrial area
- economic development of the company
- creation of new jobs in the economic problem region with above-average unemployment

Graph 4

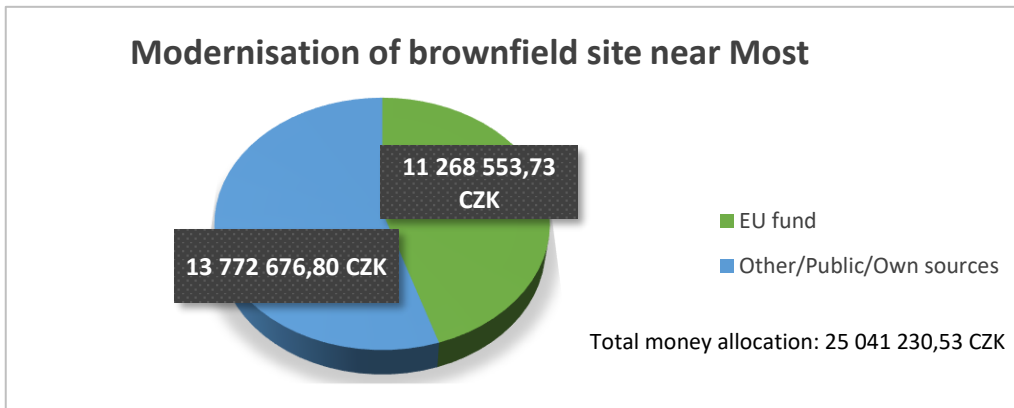


Source: DotaceEU

9.1.1.2. *Modernisation of brownfield site near Most*

The aim of another project from Ústecký region was the modernisation of spatially and technically unsuitable brownfield building in the former production area near the city of Most. One building was demolished, the other ones were reconstructed. The project should have created new jobs in this poorer Czech region. The project falls under the Real Estate programme of OPEIC.

Graph 5

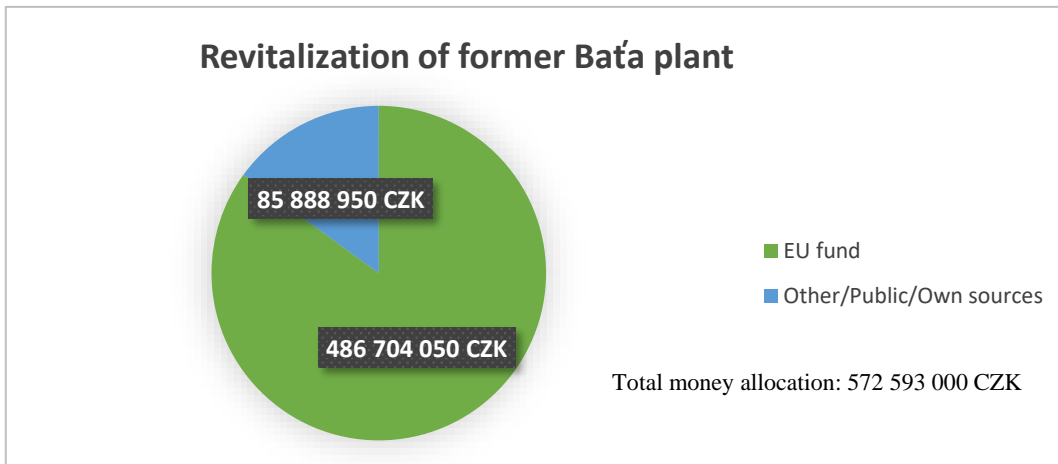


Source: DotaceEU

9.1.1.3. Revitalization of former Baťa plant

The reconstruction was conducted for the new use of buildings of the former Baťa plant in Zlín. The buildings were left unused and their technical condition showed signs of brownfields. They would become dangerous to their surroundings if unattended for more time. The total money allocation for the regeneration of Baťa building is 572 593 000 CZK. Most of the money (85%) came from the EU fund.

Graph 6



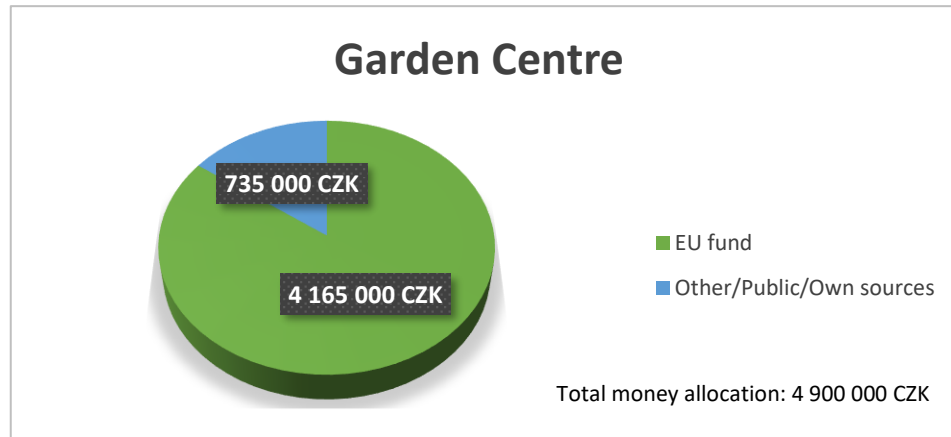
Source: DotaceEU

9.1.1.4. Garden Centre

I was doing my internship in the Centre for Regional Development in Liberec, Czech Republic. Project managers work on projects that fall under the Operation programme integrated Regional Operational Programme (IROP). IROP doesn't focus on brownfield redevelopment but it is possible to fund some brownfield projects via this OP. I put one example of brownfield redevelopment.

The goal of this project that happened in 2018 was the creation of a new social enterprise based on the building of facilities for the correct operation of social enterprise activities. For this purpose, the brownfield in the town of Jirkov in Ústecký region was revitalized and a new garden center was opened there.

Graph 7



Source: DotaceEU

9.2. Germany

The Federal Republic of Germany consists of 16 federal states called "*Länder*". Each one of them has a high degree of autonomy therefore every federal state has developed its own strategy towards the problems of contaminated sites (EEA, 2000). Soil and groundwater contamination have been for many years the most dominant aspect of brownfields in industrialized country such as Germany. Also, Germany is a highly industrialised and densely populated country, its soil resources may be in danger mainly through the input of hazardous compounds in industrial and rural areas, the expansion of urban areas and transport infrastructures play its role as well (Gentile et al., 2009; Grimski & Dosch & Klapperich, n.d.). Germany has been affected by far-reaching demographic and economic structural changes such as low birth rates, a dwindling population in old industrialized regions, an increasing number of smaller households, an aging population. All these aspects lead to a more differentiated demand for land and residential, commercial and industrial buildings therefore a shift away from land consumption to policies fostering the redevelopment of existing buildings and land is happening (Grimski & Dosch & Klapperich, n.d.).

Dealing with the issue of contaminated sites requires a look into the history of how existing brownfields appeared and when they were created. Industrialization in Germany

in the 19th and upcoming 20th century led to the mixture of traditional urban structures and large production sites. Industries developed in the vicinity of residential areas. The driving force of industrialization was the invention of the steam engine and the conveyor belt. Many workers were needed which led to an enormous increase in population and to an extension of cities. The cities grew around the industries and production sites. When industrialization took place, trains started to be used and supported the industrialization process by carrying heavy goods for production processes. As the production sites used to be located in the cities, tracks and train stations were constructed by the city centres connecting production sites, cities and dismantling areas. Later in the 20th century, when the tertiary sector developed, offices were built and started to replace the industrial and often contaminated sites. But industries haven't disappear and they might be found in many areas of developed cities (Doerle, 2012).

Since the 1990s, more attention in Germany has been given to the revitalization of brownfield properties with real or perceived contamination. Some cleanup methods and strategies have been developed. All levels of government and the private sector try to be included in the regeneration process. In Germany, the brownfield management means integrated approaches to remediation, sustainable redevelopment, reuse and financing (Grimski & Dosch & Klapperich, n.d.).

In Germany, The German government has developed a legal scheme for the management of contamination. The Federal Government has promoted the reuse of industrial, military or railway wasteland in inner cities with mixed-use, environmentally sound, cost and space-saving types of construction. The urban development and policy of Germany has a history of brownfield regeneration since the 1970's and constantly drives urban renewal at federal, lander and municipal level. But Germany has no federal statistics on brownfields, their re-use potential or on-site recycling. There is neither any law requiring the redevelopment, how to proceed, no procedure regarding the initiation of brownfield revitalization projects. The brownfields are managed via the Federal Office for Building and Regional Planning and the German Federal Environment Agency (Grimski & Dosch & Klapperich, n.d.: Maliene et al., 2012).

In Germany in 2018, more than 260 883 suspected sites were registered to be potentially contaminated but it is estimated to be there around 485 856 sites where polluting activities took place (Pérez et al., 2018). In 2020, more than 271,000 contaminated sites in Germany

are suspected of being contaminated¹⁴. I used data available on contaminated and potentially contaminated sites in Germany from the website of the Federal Environment Agency. According to these statistics, there were a total of 283,678 contaminated and potentially contaminated sites in Germany in 2018-2019¹⁵.

The location of brownfields depends on the spatial structure of the area. Regions with a historic industrial structure in Germany such as the Ruhr area, Saar region, Stuttgart area or Eastern Germany are among more affected regions by industrial and structural changes that rural parts of Germany. East Germany's brownfields are considered as a long-term and highly complex issue with a societal impact. Heavily contaminated sites from mineral mining, concentration of finishing industry based on these natural resources, in particular energy production, brown coal refining, metallurgical industry, potash industry, and chemical industry, in connection with old waste and industrial deposits formed a considerable part of the ecological and economic burdens. Economically significant regions, such as the chemical triangle Leuna-Buna-Bitterfeld around the city of Leipzig/Halle in Saxony-Anhalt are associated with environmental hazards. All industrial areas in East Germany contain sites with severe soil and water contamination. Consequently, many sites were put out of operation in late 1990 and brownfield remediation remains one of the major tasks of East German's economic and environmental cycle (Grimski & Dosch & Klapperich, n.d.: Intereg Central Europe, n.d.). Many inhabitants of Leipzig left the city after the German reunification in 1989 due to societal transition with de-industrialisation and massive unemployment and out-migration to the western parts of the country. Population numbers decreased heavily. Ongoing de-industrialisation and massive demolition programmes of vacant houses during the 1990s produced new spatial patterns such as urban structures with brownfield sites, demolition corridors or housing islands (Kabisch, 2019).

Berlin Tempelhof airport is also a nice example of an abandoned area which is now used for some other activities. The airport was closed in 2008. Today, it is a park of an area of

¹⁴ <https://www.bmu.de/themen/wasser-abfall-boden/bodenschutz-und-altlasten/bodenschutz-und-altlasten-worum-geht-es/altlasten-situation-und-massnahmen/>

¹⁵ <https://www.umweltbundesamt.de/daten/flaeche-boden-land-oekosysteme/boden/altlasten-ihre-sanierung>

approximately the size of New York's Central Park where many activities may be done (Hilbrant, 2017).

Picture 10 – Ancient Tempelhof airport



Source: Rbb24.de

East Germany, especially Saxony has many abandoned sites. It resembles to the brownfield situation in the Czech Republic. Stuttgart is one of the most important industrial locations in Germany and the city must deal with these impacts until today. It is the city with one of the highest concentrations of contaminated and suspected sites in Germany. This is due to industrialization and development processes during the past two centuries. The city of Stuttgart is limited to growth due to its geomorphologic setting nevertheless the growth takes place (Doerle, 2012).

Brownfield sites in Germany are often heavily contaminated, causing soil, groundwater and indoor air pollution. These contaminations usually are difficult to locate especially contaminations caused by volatile organic compounds like chlorinated hydrocarbons (Doerle, 2012). Many brownfields in Germany have pollution problems that arise from their previous industrial use therefore the contamination and other problems such as reuse options, costs, duration for remediation, liability might be serious obstacles for brownfield redevelopment which may or may not be solved within the regeneration process (Grimski & Dosch & Klapperich, n.d.).

To conclude a little bit, in large cities especially these that were somehow affected by transitional economies, such as the cities of post-1989 Eastern Europe. There are wider spatial problems connected with the dynamics of de-industrialization and economic restructuring, residential and commercial suburbanization and re-urbanization, which resulted in significant migration flows, the expansion of the city into the surrounding countryside, changing built-up and social structures within the inner parts of cities and

within the housing estates. Industrial activities that are considered as the strongest driving force behind the formation of the original urban areas naturally appeared around historical city cores which lead to the appearance of abandoned or underused sites depending on the fluctuations of the industrial business cycle (Frantál et al., 2015).

9.3. France

Since the late 1970s, France has faced a change in the structure of its economy. The decline of industry has resulted in several abandoned industrial sites that represent a danger to the population and the environment (Vyškovská, 2013). Up to the beginning of the 1990s, contaminated sites were a major concern in France (EEA, 2000). Up to the present, the soil pollution remains a big issue. The number of brownfields differ in France. Usually, the sources state the number of potentially contaminated sites between 200 000 and 300 000. BASIAS (French historical regional inventory of former sites of industrial and service activities likely to be contaminated) identifies all industrial sites likely to cause pollution of the environment. There were around 250,000 abandoned and potentially contaminated sites in 2019¹⁶. According to the BASIAS database from 2020, there were 322 400 ancient industrial sites that are regarded as brownfield sites. So, the real number differs among sources. These sites are not included in the BASOL database. BASOL is the French national database for contaminated sites requiring public intervention. The database counts 14 635 contaminated sites across France and its overseas territories in August 2020.

The most affected regions are former industrial regions such as Nord-Pas-de-Calais, Rhône Alpes, Champagne-Ardenne, Lorraine and Ile-de-France (Vyškovská, 2013). The Ile-de-France and the region Rhône Alpes are within the list because of extensive urban development. Most of the available information on brownfields management like regional procedure, location of brownfields, regional database, examples of sites reclamation are usually provided by the regional authorities. Long-term policies and programmes regarding brownfields exist in the traditional industrial regions piloted by the region

¹⁶<https://france3-regions.francetvinfo.fr/hauts-de-france/reconversion-friches-industrielles-picardie-1629652.html>

Lorraine (Ferber & Grimski, 2002; Tendero & Bazart, 2018). The most brownfield sites used to be in the Nord-Pas-de-Calais. The region was focused on the mining, metallurgy and textile. The textile industry was concentrated within the cities of Roubaix, Tourcoing, Lille, Calais and the south of the Nord department. The mining and metallurgical industry was concentrated in the Bassin Minier area, the Vallée de la Chambre and Dunkirk (Vyškovská, 2013).

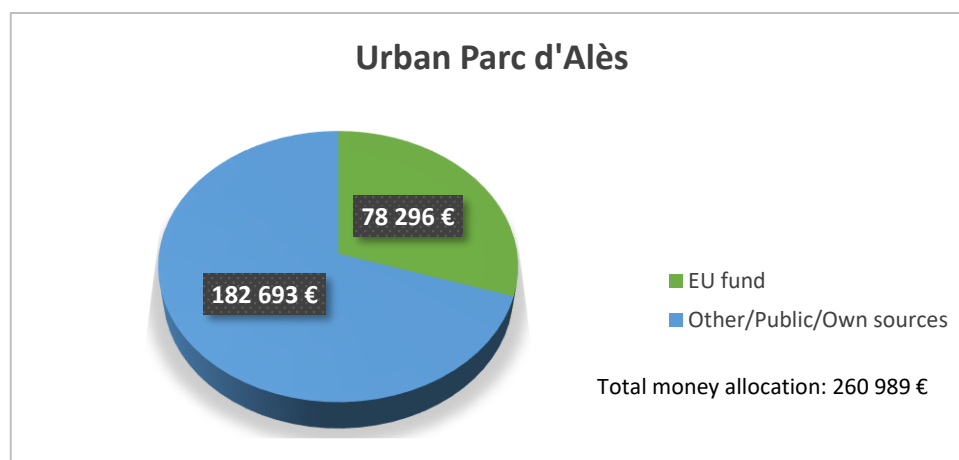
Differences regarding former industrial regions such as Grand-Est and Hauts-de-France where there are manufacturing and industrial plants as well as regions characterized by an extensive and fast urban development such as Île-de-France. Grand-Est and Hauts-de-France were regions characterized by coal and steel industries in the past and nowadays, Île-de-France region is characterized by an important urban growth (Tendero & Bazart, 2018).

9.3.1. Examples of brownfield financing from EU funds

9.3.1.1. Urban Parc d'Alès 2016

This project of Urban Park was co-financed by the EFRD in 2016. It used to be an industrial brownfield, but it was reconverted into an indoor leisure place. EFRD fund contributes to the brownfield regeneration through its goals of innovation, support of small and medium-sized enterprises, social inclusion, urban or rural development or protecting the environment. The revitalization of this industrial brownfield contributes to the better propagation of the neighbourhood by offering a cultural and sporting choices to its inhabitants.

Graph 8

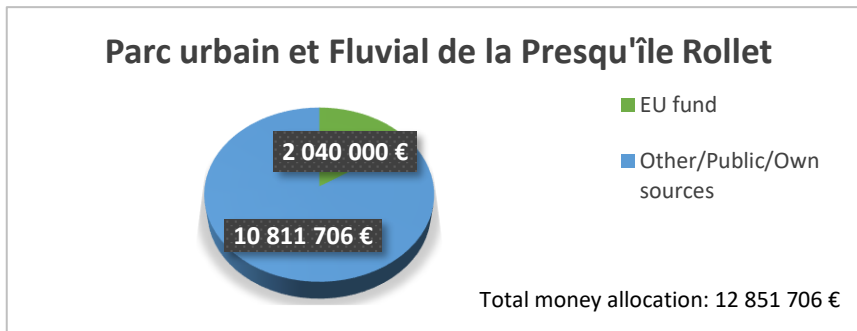


Source: Europe en France

9.3.1.2. Parc urbain et Fluvial de la Presqu'île Rollet

The main purpose of this project in Normandy was to regenerate the former industrial site into an urban leisure park. The rehabilitation included the creation of a small wood, insect houses to promote pollination, bird nesting boxes, bat shelters. The ambition was to preserve biodiversity through the diversity of plant and animal species. The access to pedestrians was provided through paths and the creation of gardens.

Graph 9



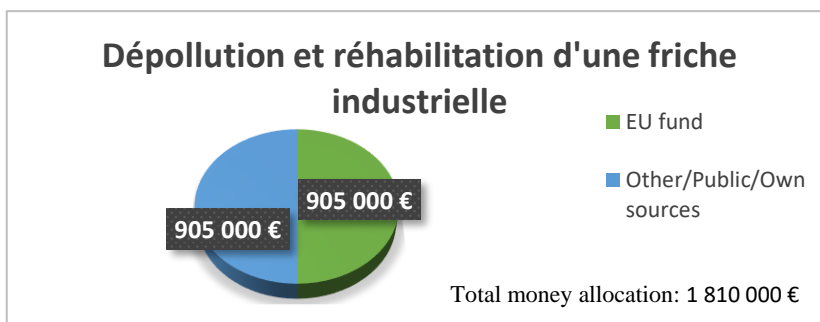
Source: Europe en France

9.3.1.3. Décontamination and regeneration of an old industrial building in Saint-Étienne

The aim of this project as part of the economic activities and urban development in the region from Saint-Étienne was to redevelop this industrial brownfield to establish there a new scientific and technological campus.

Some projects might be financed partially, some of them are financed with less or more money from the EU funds. It depends on the category of particular region if they are situated in more developed, transition or less developed regions.

Graph 10



Source: Europe en France

10. OWN RESEARCH

10.1. Brownfield financing

Distribution of money to fund its own projects is always a difficult and long process. From the EU, each member state gets funding through national, interregional and regional programmes.

France receives 27,5 billion € from the EU budget. Czech Republic is allocated around 23,8 billion €. And Germany gets around 27,9 billion € from the EU. All this money is distributed to countries' budgets from ESIF funds.

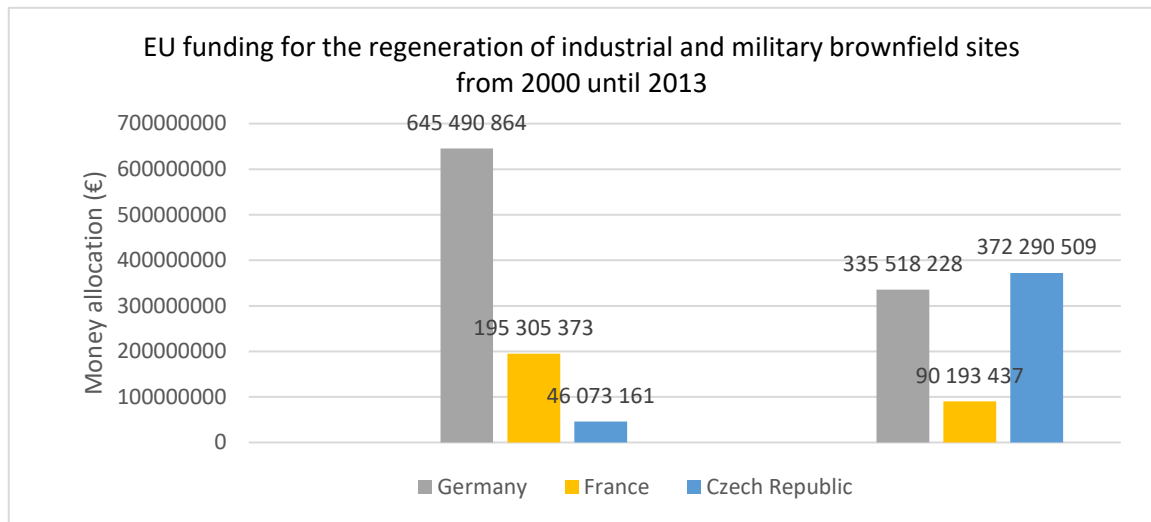
Although Czech Republic is a small country in comparison with France and Germany, it gets a lot of money from the EU. It is true that the Czech Republic has a right to get funding from Cohesion Fund (CF) which aims at some EU countries that have their Gross national Income per inhabitant lower than 90% of the EU average. France and Germany don't belong to this category. The CF supports mainly two categories. Trans-European transport network and environment. Brownfield sites can be funded from environment category.

Table 2 - Funding of industrial and military site regeneration

Funding of industrial and military site regeneration		
Funding	2000-2006	2007-2013
Germany	645 490 864 €	335 518 228 €
France	195 305 373 €	90 193 437 €
Czech Republic	46 073 161 €	372 290 509 €

Source: European Court of Auditors, 2012

Graph 11



Source: European Court of Auditors, 2012

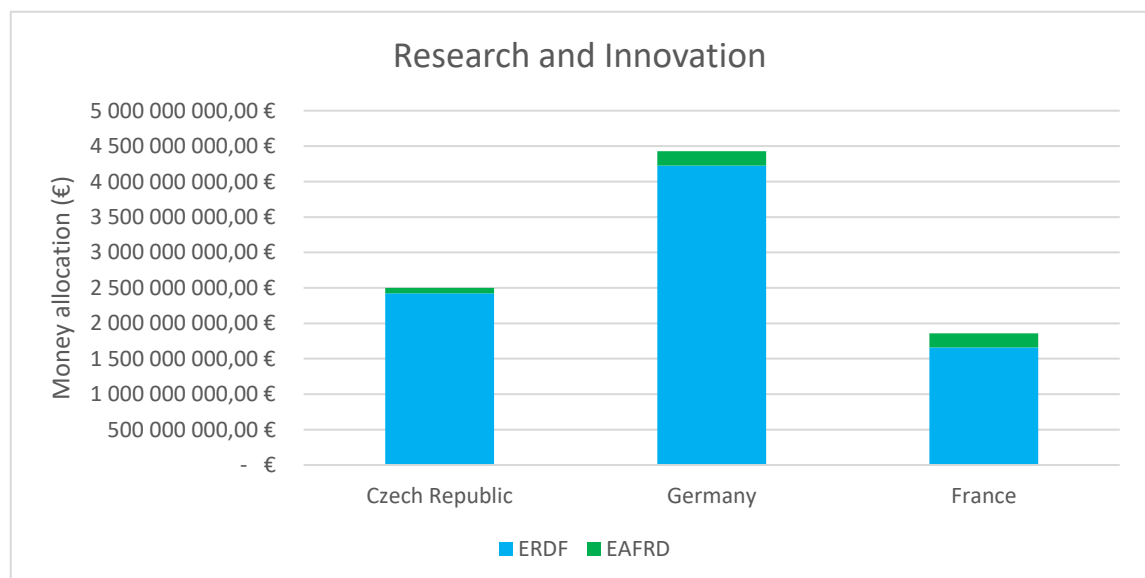
This graph shows us the money allocation for industrial and military sites and their regeneration. Most money from the EU in the period 2000-2006 were allocated to Germany. I didn't find any reasons why the amount of money is so different in Germany and France when these countries are more or less the same. But Germany seems to be more engaged in the revitalization process of old industrial brownfield sites than France. Less money for the Czech Republic is the reason of the Czech Republic entry to the EU in 2004. On the other hand, in the next period between years 2006-2013, Czech Republic received more money than Germany or France for regeneration of old industrial sites which is surprising. It shows that Czech Republic has gotten better in receiving European money via many operational programmes that exist in the Czech Republic.

In the funding period 2014-2020, there are 11 thematic objectives that focus on the distribution of finances within the ESIF (Research and Innovation, Information and Communication Technology, Competitiveness of SMEs, Low-Carbon Economy, Climate Change Adaptation and Risk Prevention, Environment Protection and Resource Efficiency, Network Infrastructure in Transport and Energy, Sustainable and Quality Employment, Social Inclusion, Educational and Vocational Training, Efficient Public Administration). I didn't find any specific latest data for the brownfield financing so I decided to use those thematic objectives to make a comparison. I decided to use thematic objectives Research and Innovation, Competitiveness of SMEs, Environment protection and Social Inclusion to make a comparison. I chose those four objectives because

brownfields are usually located in socially poorer regions but it is not always the case, it usually has an environmental impact, if regenerated, it can enhance the image of that site, firms are usually the ones trying to revitalize old buildings and by that, they innovate, develop old sites.

It doesn't mean that brownfields are funded only via these four objectives. It is hard to choose because it depends on each brownfield, for what purpose it will be used after the regeneration. Brownfields might be funded from various themes and operational programmes which makes it harder to find the exact money allocation for brownfield regeneration. Also, for example from the EU objective Competitiveness of SMEs, many other projects might be funded and not all the money to support SMEs go for brownfield revitalization. But it is as close as I can get. Another difficulty is the fact that every country handles the brownfield issue in a different way. Operational Programmes that exist in the Czech Republic don't have to exist in Germany nor France which makes the comparison of money allocation for brownfield regeneration more complicated. I didn't find any specific programmes of money allocation for brownfield revitalization in Germany nor in France. It is estimated that brownfield sites are funded partially from most of these 11 thematic objectives. In the next couple of graphs, I compare money funding from selected objectives concerning the Czech Republic, Germany and France.

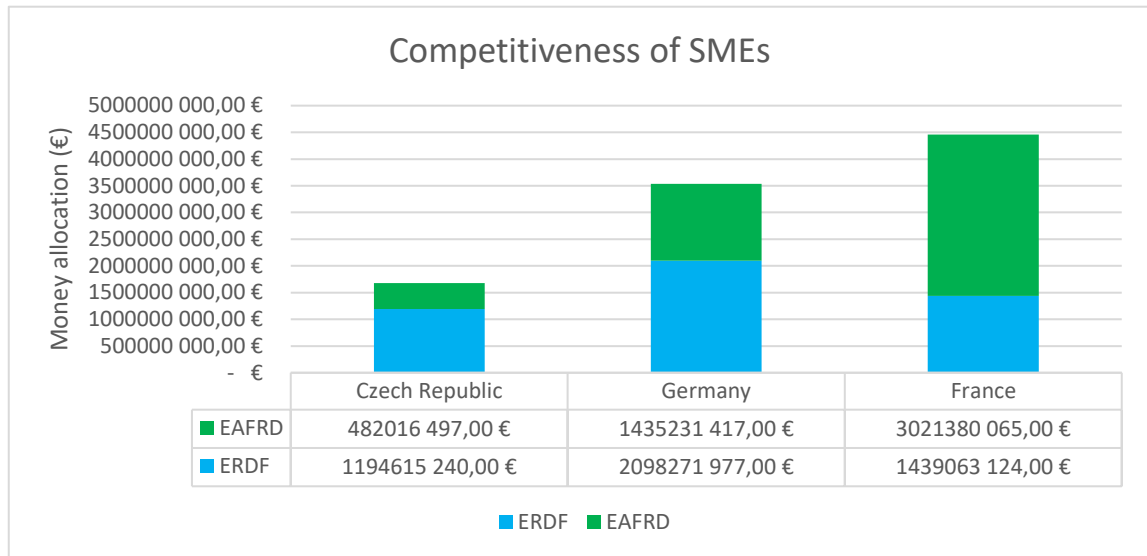
Graph 12



Source: Cohesiondata.ec.europa.eu

Germany receives the most money from the EU for research and innovation. Small amount of money goes to each country from EAFRD. ERDF is the main source of money allocation for research, innovation and development. Brownfields will be funded mostly for urban and local development, innovation of old sites and buildings.

Graph 13

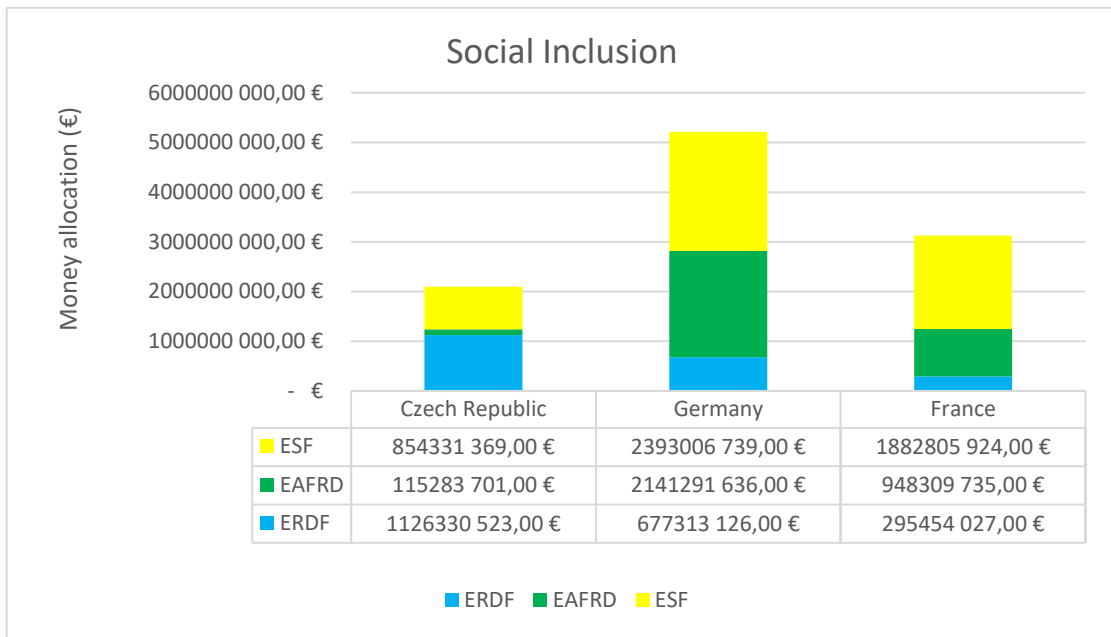


Source: Cohesiondata.ec.europa.eu

Money funding for the Competitiveness of SMEs

The biggest amount of money goes to France via EAFRD. ERDF supports and gives the most to enterprises that renovate old buildings in Germany. Concerning brownfields within the SMEs, I can say that France is the most active in trying to eliminate environmental burden of sites via EAFRD. From the theme Competitiveness of SMEs, only a small part of money truly goes to brownfield regeneration but it can give us at least an idea how much money goes to the Czech Republic, Germany and France and what country is possibly the most engaged in brownfield revitalization when comparing data for the competitiveness of SMEs.

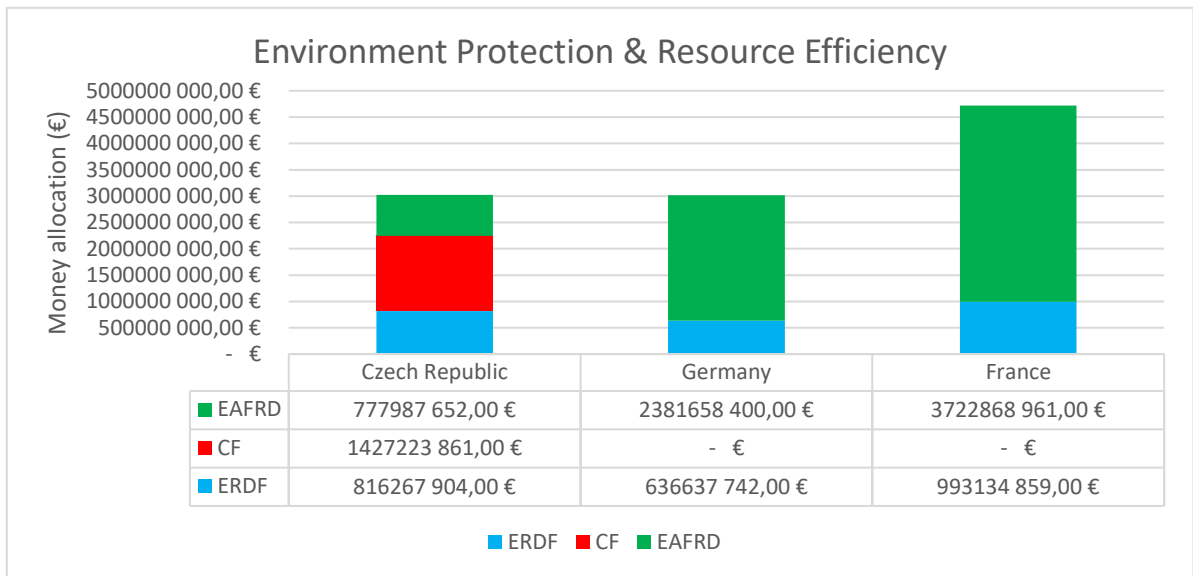
Graph 14



Source: Cohesiondata.ec.europa.eu

Concerning the theme Social Inclusion, money usually goes through European Social Fund. Brownfields within this theme will include old decaying sites in industrial and poorer regions where the infrastructure is bad and it needs renovation so that it can return to its utility and eventually can be used again. Most money from the EU is allocated to Germany via ESF. Czech Republic receives most from the ERDF. Czech Republic gets even more from ERDF for social inclusion than Germany and France but one reason for that might be that Germany and France are viewed to be more developed countries.

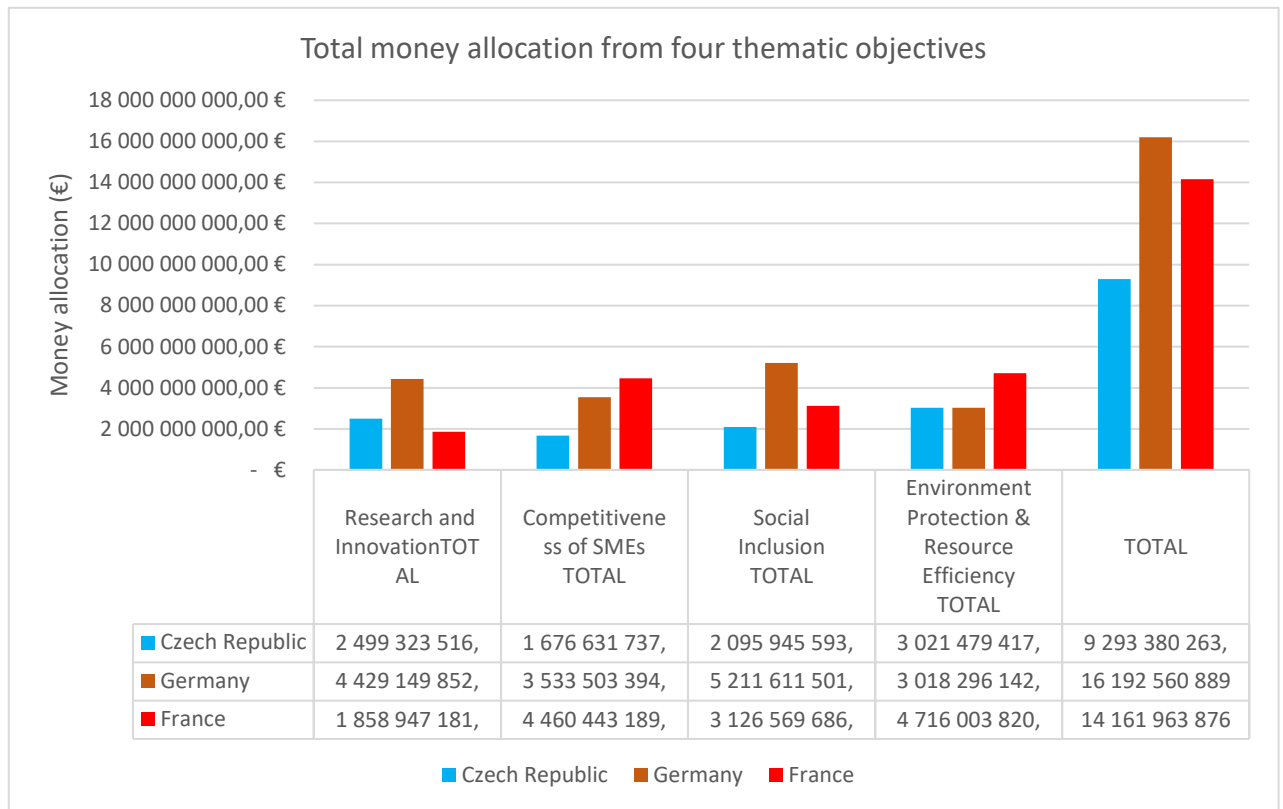
Graph 15



Source: Cohesiondata.ec.europa.eu

Regarding Environment protection, Czech Republic can take advantage of money funding from the Cohesion Fund (CF). Germany and France receive a lot of money for the environment protection via EAFRD. Again, money for environmental protection might be used for elimination of ecological burden of brownfield sites. I can also say from the graph that with the help of CF, Czech Republic gets more money from the EU than Germany for environmental protection.

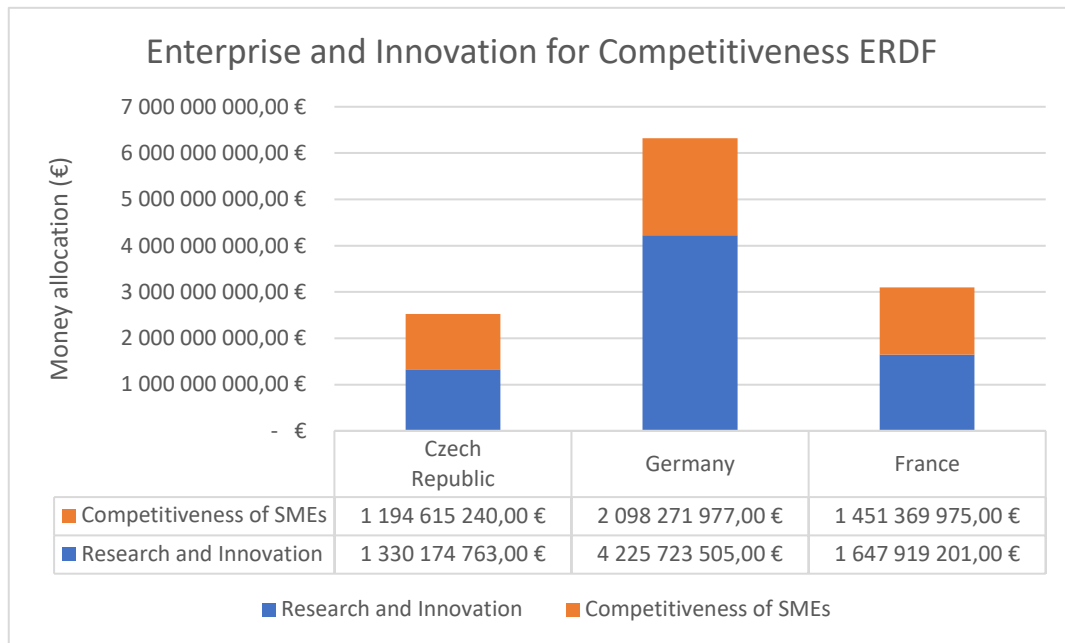
Graph 16



Source: Cohesiondata.ec.europa.eu

This graph is the summary of all graphs regarding money funding from ESIF, more concretely, from four thematic objectives that in a certain way, finance brownfields. The conclusion is that the Czech Republic as the smallest country apparently gets less money from the EU than Germany or France but can surpass Germany in the Environment protection objective with the help from CF or France in Innovation and Research for example. Most money from the four objectives chosen as the most probably financing brownfield sites receive Germany followed by France. France profits a lot from the Environment and Competitiveness of SMEs support, on the other hand, Germany receives most money for Research and Innovation and Social Inclusion. Czech Republic lags behind but it is understandable. The reasons for different money allocation might be land area, population or the economic stability. Of course, all that money doesn't go to the brownfield regeneration itself. Only a small part of that money goes to brownfields.

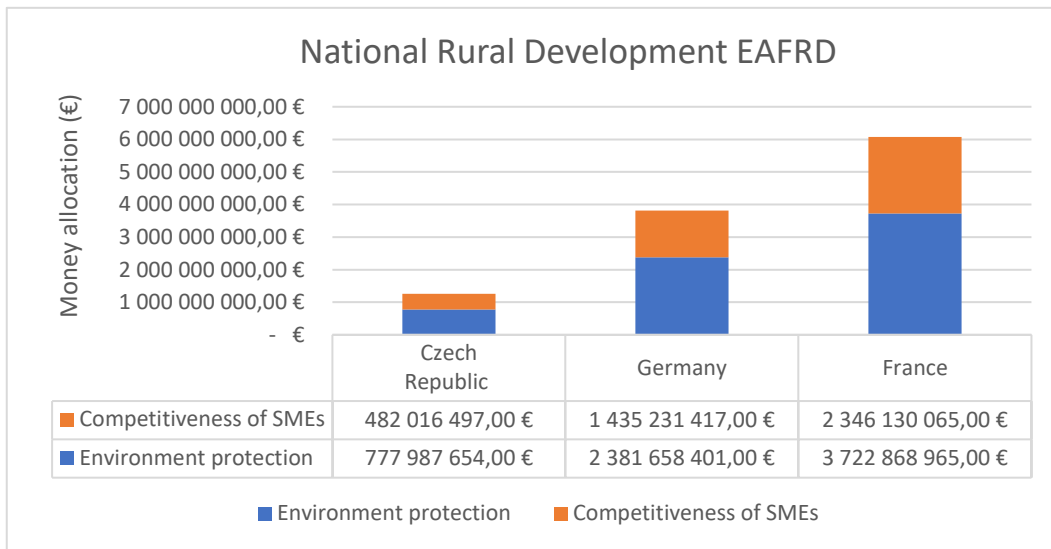
Graph 17



Source: Cohesiondata.ec.europa.eu

Even better comparison might be to analyse more in detail the Operational programme (OP) that focuses on brownfield redevelopment. In the Czech Republic, it is called Enterprise and Innovation for Competitiveness funded from EFRD. Within this programme, I chose two thematic objectives that are most probable to fund brownfields, Competitiveness of SMEs and Research and Innovation. Because Germany or France don't have the same OP, I used data from EFRD for every German and French region and counted the money funding from Competitiveness of SMEs and Research and Innovation. In Germany, it was 16 German states, in France, 28 regions, French departments beyond the seas included). The reason that Germany receives the most money, followed by France and the Czech Republic is also that Czech Republic receives money in a different way than Germany and France due to the different proportion and division of regions in each country. That is the biggest difference.

Graph 18



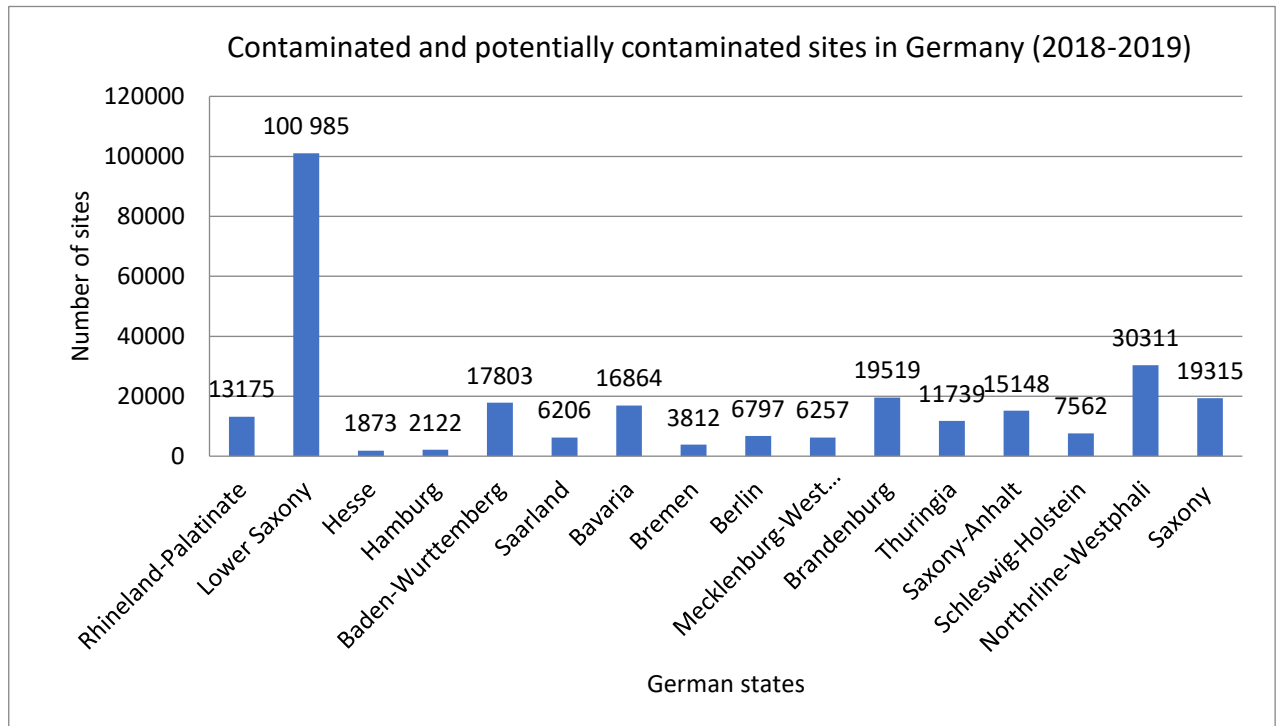
Source: Cohesiondata.ec.europa.eu

I did the same research for money funding from EAFRD focuses more on environmental side. I chose two thematic objectives within National Rural Development that are most probable to fund brownfields, Competitiveness of SMEs and Environmental Protection and did the same money counting for Germany (Hamburg doesn't provide any data regarding EU funding from EAFRD) and France. It was not necessary to count each region in the Czech Republic because according to the data provided, the Czech Republic gets money funding as for a whole country which is divided into 8 NUTS 2 regions. The result is that France profits the most from the EAFRD help and receives the most money for National Rural Development.

10.2. Number of brownfields

10.2.1. Situation in Germany

Graph 19



Source: umweltbundesamt.de

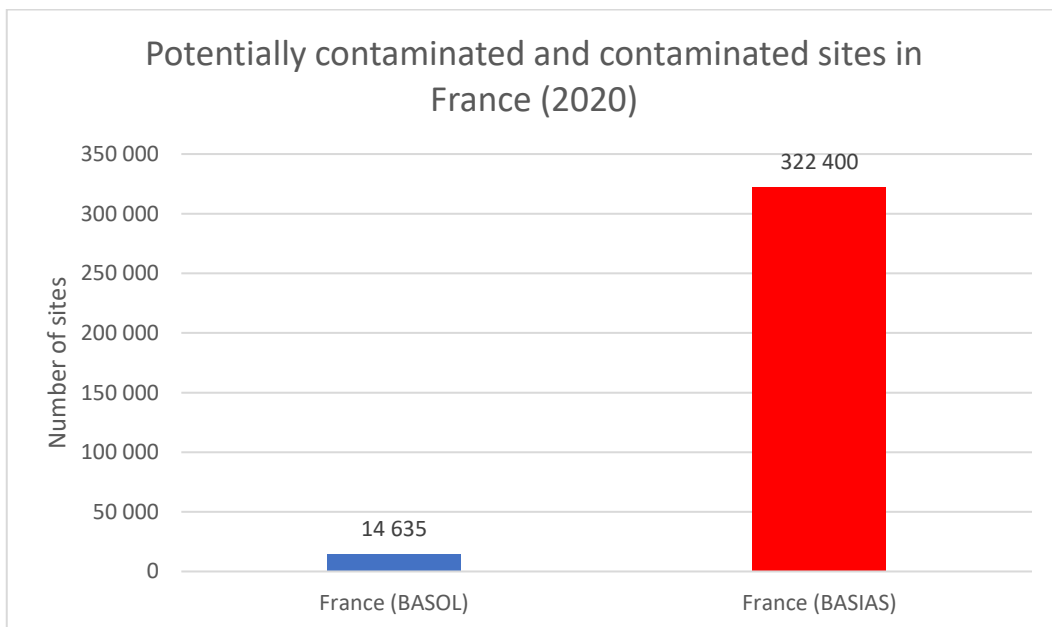
This graph shows us brownfield sites together with potentially contaminated sites in Germany in 2018-2019. The data were gathered from the website of German Federal agency for environment¹⁷. It is the latest data all together that I found regarding contaminated and potentially contaminated sites in Germany. In the graph, we have 16 German states and the number of sites. From the graph, we can say that one number makes a huge difference. It is Lower Saxony where it is located 100 985 locations suspected of being contaminated. The majority of these locations (90 559) are sites such as buildings, old unused sites. Such a higher number can be explained by the second largest area of land after Bavaria and industrial cities such as Hanover, Brunswick or Wolfsburg. The automotive industry plays an important role in Hanover region. It is a logistics German

¹⁷ <https://www.umweltbundesamt.de/daten/flaeche-boden-land-oekosysteme/boden/altlasten-ihre-sanierung>

hub that can create easily industrial sites. But it is surprising that it is such a high number. Generally, the number of contaminated sites is high in Germany. The reason for that is that Germany has a long industrial history and possibly also the density of the regions, especially in the western part of Germany in North-Rhine Westphalia. On the other side of Germany, the higher number of sites is in Brandenburg, the region around Berlin and Saxony where the reason for that is probably the existence of German Democratic Republic. The East Germany was part of the Eastern Bloc during the Cold war and it lagged behind more developed Western German states. The revitalisation of sites has taken more time after the destruction of Berlin Wall and the consequences might be visible until today. The situation in East Germany seems similar to the situation in the Czech Republic, especially in border areas of Saxony. Many old decaying buildings without any use waiting for demolition or possible remediation which is not very probable due to the complexity of the regeneration process. To conclude, the number of contaminated sites in Germany is high. It will definitely be one of the highest numbers in Europe.

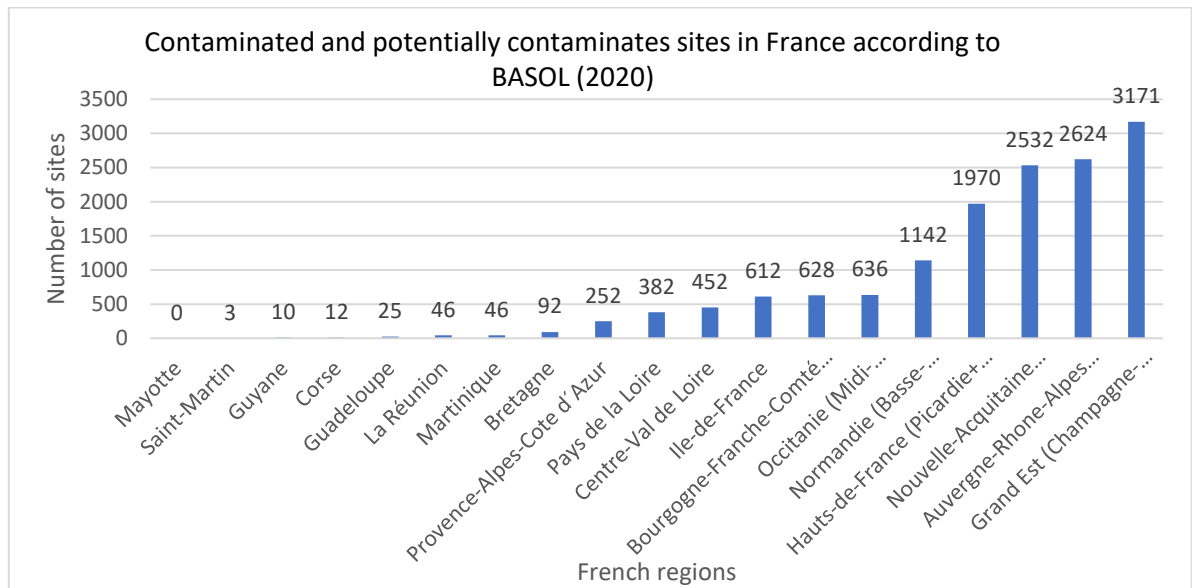
10.2.2. Situation in France

Graph 20



Source: BASOL, georisques.gouv.fr

Graph 21



Source: BASOL

France deals with the problem of brownfields differently than Germany. I found two databases regarding contaminated and potentially contaminated sites in Germany. BASOL¹⁸ and BASIAS¹⁹. BASOL registers contaminated and potentially contaminates sites and soils that requires public intervention. BASIAS focuses more on ancient industrial sites and activities. In BASOL database, there are 14 365 registered sites in August 2020. In July 2020, BASIAS registers 322 400 ancient industrial sites. The BASOL database is updated regularly which is great but the number of sites doesn't change very often.

There are two databases for similar activities. I don't understand the reason for that. It is confusing because it makes harder the comparison with other countries. Which database is better to use? Nevertheless, I didn't find specific numbers of each region for contaminated sites in BASIAS database, only the total number for the whole country. On the other hand, BASOL represents French regions and I could use more data from this database. At least, I could get some perspective that helped me made some notes and eventually found out the number of contaminated sites. The number is low and it doesn't

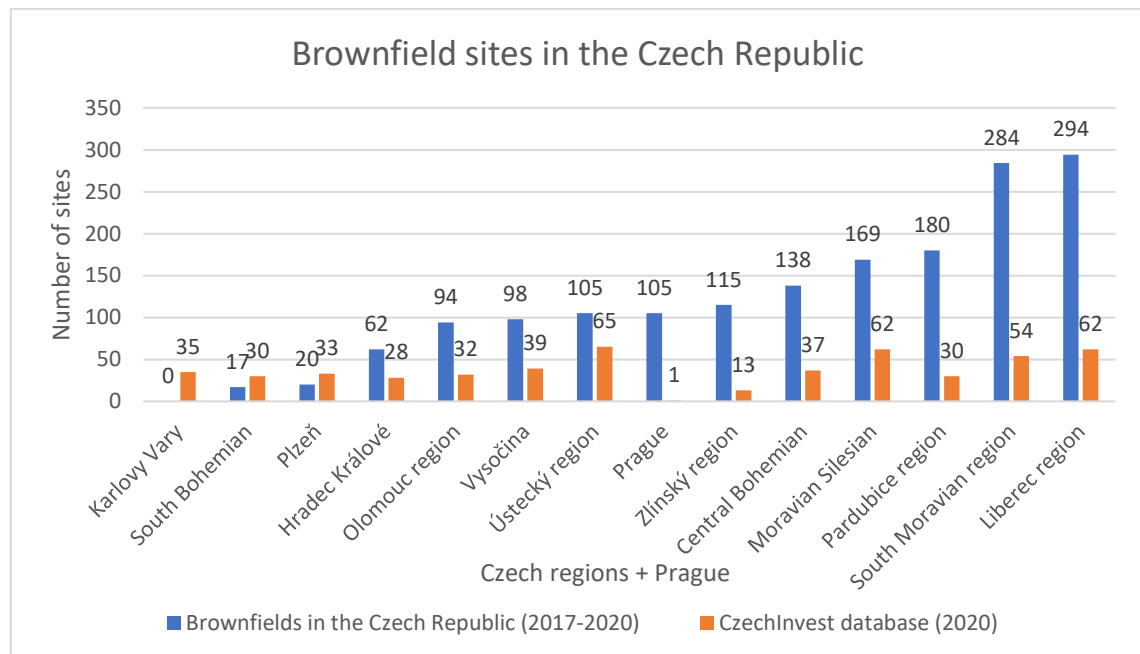
¹⁸ Base de données sur les sites et sols pollués ou potentiellement pollués

¹⁹ Base de données des ancient sites industriels et activités de service

represent all brownfield sites in France, but whether the number is correct or not, it confirmed previous information where most brownfields are situated. I found out that most contaminated sites are located in Eastern France, in French region of Grand-Est consisting of three departments of Alsace, Lorraine and Champagne-Ardenne, following by the region Auvergne-Rhone-Alpes, Nouvelle-Aquitaine and Hauts-de-France. From the information above about brownfield sites in France, we can confirm the fact that most brownfields are located in regions of Grand-Est, Auvergne-Rhone-Alpes and Nord-Pas-de-Calais. Grand-Est and Nord-Pas-de-Calais have been industrial hubs for many years focused on coal, steel, mining and metallurgy. Also, the population density around cities of Lille and Roubaix and Belgium borders is quite high and might be the reason of higher occurrence of industrial contaminates sites. Lyon, the capital of Auvergne-Rhone-Alpes is viewed as an important urban city.

10.2.3. Situation in the Czech Republic

Graph 22



Source: CzechInvest, Cesko v datech analysis (2017), own region databases, newest data available

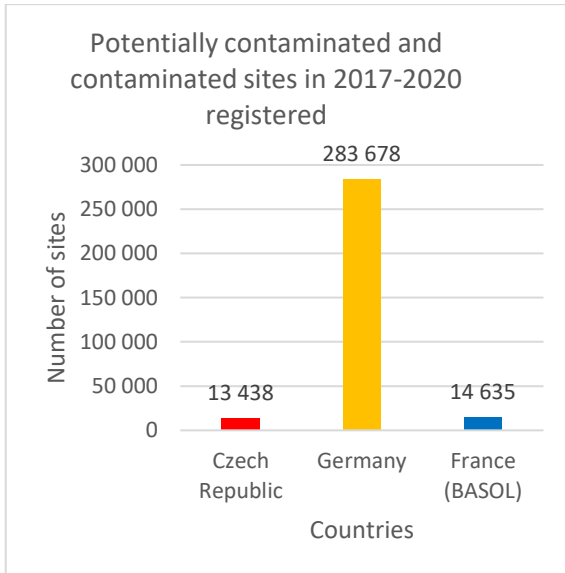
The situation concerning brownfields in the Czech Republic is complicated. The data are not updated, there is no database such as I found for Germany or France that would show

all brownfields together within each region. CzechInvest doesn't provide that latest data and the data used in this thesis come also from the "*Cesko v datech*" analysis from 2017. Even though CzechInvest copes with the issue of brownfield sites in the Czech Republic and there is a database of brownfields on CzechInvest website, the final number of brownfields displayed in this database is low and it doesn't correspond to the reality. To put a brownfield into the CzechInvest database, set of criterions must be fulfilled which may be difficult to comply with. Most of the regions in the Czech Republic usually have their own brownfield database or they have its own website devoted to brownfield sites from where I got newer data as well apart from Karlovy Vary region, Plzeň region, Olomouc, Zlín region and Prague. Data from 4 regions and the city of Prague come from the analysis of "*Cesko v datech*" from 2017. Data regarding Karlovy Vary can be obtained only from CzechInvest database. Again, different and not updated data make it harder to make a good comparison. I didn't find any newest data for these regions regarding occurrence of brownfield sites therefore the data are from 2017 and even though, the list of brownfields can be found in the CzechInvest database, the number doesn't correspond to the real number of brownfields. Therefore, data from CzechInvest database differ from other databases that are managed by region authorities. For example, national brownfield database of CzechInvest shows only one case of brownfield in the capital city of Prague but in 2017, Prague had 105 brownfield sites according to "*Cesko v datech*" analysis.

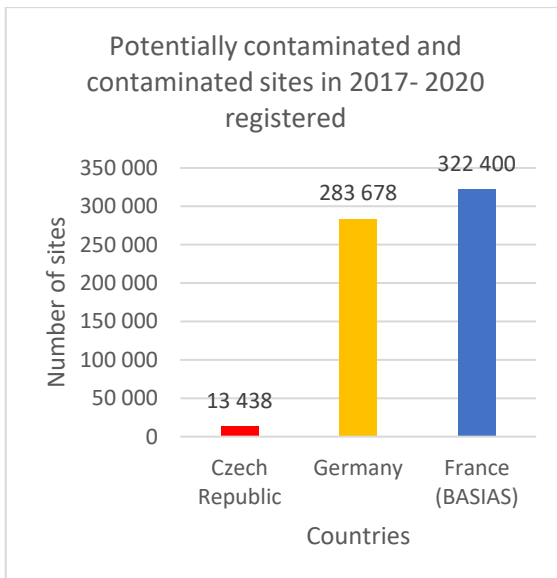
The graph describes the number of brownfields in the Czech Republic from regional databases or regional websites devoted to brownfields and from CzechInvest database. The data come from years 2017 (from "*Cesko v datech*" analysis) till 2020 (regional databases or websites). The most brownfields are located in Liberec region (294), following by South Moravian region (284), Pardubice region (180) and Moravian-Silesian region (169). The reason for so many brownfield sites in Liberec region is not very clear to me. One of the reasons might be industrial history such as glass and textile industry. Regarding South Moravian region, I found on its website devoted to brownfields 173 sites. Brno as such was not included in the database. From different source from 2017, I used the data saying that 111 brownfield sites were in Brno. Brno is known for its own approach to brownfield regeneration. Surprisingly, high number comes from Pardubice region. Many brownfield sites can be found in Moravian-Silesian region due to the history of mining. On the other hand, Ústecký region counts only with 105

brownfield sites in its own database which is little knowing that it is known for coal mining and it is a poorer border region.

Graph 23



Graph 24



Source: SEKM, CzechInvest, BASOL, georisques.gouv.fr, umweltbundesamt.de

These two graphs show us potentially contaminated and contaminated sites in the Czech Republic, Germany and France all together between 2017 and 2020. The number of 13 438 sites represents the total number of contaminated and potentially contaminated sites from the SEKM database plus the number of brownfields in the Czech Republic

from 2017 to 2020. 283 678 sites in Germany represent the total number of contaminated and potentially contaminated sites from the German official database of Federal agency for environment. In the case of France, the only difference is that one graph shows the brownfield sites according to BASOL, the second one according to BASIAS. It is estimated that 322 400 sites are more valid number due to the land area.

11. CONCLUSION

In my master thesis, I focused on the issue of brownfields, its financing, its occurrence, its possible impacts on infrastructure and on the environment, an important part was devoted to the brownfield redevelopment. The aim of the thesis was to give an overview about brownfield sites, show how brownfields are funded from the EU and to familiarise more with its issues and possible regeneration because if a brownfield site wants to be used again, it must go through the process of revitalization.

In the conclusion part, I would like to respond to the research questions that I set in the beginning of the thesis, in the introduction section.

A) What are the financial sources of brownfield redevelopment?

There are many financial sources to get funding for brownfield regeneration. Each country has its own approach to deal with it. There are public and private sources and the mix of these sources. I concentrated more on public funds because they are more common and probably more used as well. The distribution of money usually goes via EU funds. Money for brownfield regeneration comes in most cases from Research and Innovation, Competitiveness of SMEs from EFRD, Environment Protection from EAFRD and Social Inclusion from ESF. In the Czech Republic, Operational Programmes such as OPEIC focus on brownfields, in France or Germany, it might be Rural Development programme. We may also include among public funds supporting brownfield regeneration municipalities, regions or state budgets.

B) What are the steps that help remediate brownfields?

There are plenty of steps that need to be conducted from the beginning until the end of brownfield redevelopment. To succeed, we must go step by step in the regeneration process and carry out all necessary actions. It is not mandatory to use every single step. It depends on the dimension of regenerated brownfield site. We begin the process with site selection and identification whether the site has aspects of brownfield site, a site assessment follows during which we also conduct environmental site assessment to find out if the site is contaminated or not which might also include some sites analyses if necessary. When this part is over, we continue with plans how the site will be redeveloped, and methods of possible funding are mentioned and determined later. Then, the site is cleaned-up and it is decided what techniques will be used for the site remediation. After that, the site is redeveloped and when it is finished, the final

assessment is conducted and when everything checks out, the site might be used again. The last step is the site establishment into a normal service and its control.

C) What is the impact of brownfields on the environment and possibly on citizens?

If the contamination is verified on the site, it is indeed a problem and for many possible engaged parties, it is a decisive moment whether they want to regenerate a site or not. Groundwater contamination is perceived as a serious problem and the complete decontamination of site might take many years. Prices of properties might be influenced a lot by the contamination and possible properties buyers decide on these specific aspects. Brownfields are sites that usually nobody wants. They are not attractive. Interest parties prefer to start building on greenfields than to redevelop a brownfield. Brownfield are usually located in poorer regions where the infrastructure is not so well-developed. Brownfields evoke old industrial and decaying buildings without any use, nobody is interested in its revitalization. Industry plays a major role in creating brownfield sites. If the industry used to be important in a region, it leaves old buildings behind sooner or later and these abandoned sites will have to be dealt with in the future. In general, brownfields are viewed negatively especially in industrial regions where the perspective of brownfield regeneration is lower. There are some accomplished projects for sure but it doesn't substitute for many more abandoned sites that there are, plus without any money funding from the EU for example. Unfortunately, brownfields are perceived today as useless buildings with many problems, with no real perspective into the future which worsens the possible interest in the regeneration process. The main reasons for that are the occurrence of contamination and the lengthy process of revitalization.

Generally, estimated numbers of brownfields in the Czech Republic, France and Germany more or less correspond to the statistics on the official websites devoted to these sites. Usually, the number of potentially contaminated sites or sites where some form of polluting activities took place is higher than the reality because the regeneration process has not taken place yet therefore we can not say for sure if the site has elements of brownfield definition.

To conclude, brownfields represent a possibility to use a site again, but they have many unanswered questions that usually appear during the regeneration process. If the brownfield revitalization is finished and if it results to be successful, it usually has economic or social benefits from what may profit citizens and everyone who uses the site. To compare the approach to brownfields in the Czech Republic, Germany and France, Germany together with France seem to have a really good and updated databases and seem to be a step ahead in solving the issue of brownfields. Czech Republic lags behind.

Key words: brownfield, contamination, environment, regeneration, operational programme, European Union

REFERENCES

Literature

- Adams, D., De Sousa, C., & Tiesdell, S. (2009). Brownfield Development: A Comparison of North American and British Approaches. *Urban Studies*, 47(1), 75–104. doi:10.1177/0042098009346868
- Ahmad, N., Zhu, Y., Ibrahim, M., Wagas, M., Waheed, A. (2018). Development of a Standard Brownfield Definition, Guidelines, and Evaluation Index System for Brownfield Redevelopment in Developing Countries: The Case of Pakistan
- Atkinson, G., Doick, K., Burningham, K., France, Ch. (2013). Brownfield regeneration to greenspace: Delivery of project objectives for social and environmental gain. *Urban Forestry & Urban Greening*. 13. 10.1016/j.ufug.2013.04.002
- Atkinson, G., Doick, K. (2014). Planning for brownfield land regeneration to woodland and wider green infrastructure
- AUCAME. (2016). Les friches : Entre contrainte et potentiel de renouvellement urbain. Observatoire. Foncier
- Baloun, R. (2018). Sborník z Konference, Brownfieldy 2018. Agentura pro podporu podnikání a investic CzechInvest
- Baloun, R. (2020). Sborník z Konference, Brownfieldy 2019. Agentura pro podporu podnikání a investic CzechInvest
- Bartke, S., Rizzo, E., Giubilato, E., Pizzol, L., Critto, A., Marcomini, A. (2012). Improvement of Brownfield Regeneration in Europe Through Tailored Information Platform. Communication, Prioritisation and Assessment
- BenDor, T.K., Metcalf, S.S., Paich, M. (2011). The Dynamics of Brownfield Redevelopment. *Sustainability* 3: 914-936. doi: 10.3390/su3060914. This study is free to view at: www.mdpi.com/2071-1050/3/6/914
- Böhm, M. (n.d.). Brownfield Sites in the City of Brno. 2nd International Conference on Managing Urban Land
- Bosák, V., Slach, O., Nováček, A., Krtička, L. (2019). Temporary use and brownfield regeneration in post-socialist context: from bottom-up governance to artists exploitation. *European Planning Studies*

Brownfield Handbook. (2010). Cross-disciplinary educational tool focused on the issue of brownfields regeneration – Educational tool for Latvia and Lithuania. Faculty of Civil engineering, Technical University of Ostrava

CABERNET. (2006). Sustainable Brownfield Regeneration. CABERNET Network Report. University of Nottingham

Carroll, D. A., & Eger, R. J. (2006). Brownfields, Crime, and Tax Increment Financing. *The American Review of Public Administration*, 36(4), 455–477. <https://doi.org/10.1177/0275074006289645>

CzechInvest. Reichl, P. (2019). Regenerace a podnikatelské využití brownfieldů

Dehoorne, O., Cao, H., Ilies, D. (2016). Brownfields, friches urbaines et recompositions territoriales, la durabilité en question

Del Rio Merino, M., Gracia, P. I., Azevedo, I. S. W. (2010). Sustainable construction: construction and demolition waste reconsidered. *Waste Management and Research*. 28: 118-129. DOI: 10.1177/0734242 X09103841

Doerle, M., J. (2012). Economic Perspectives of Brownfield Development in Germany, An Integrated Approach - Case Study Stuttgart-Feuerbach

Dvořáková, Líšková, Z., Škodová, Parmová, D., Dvořák, P., Klufová, R. (2018). Globalization And Economic Conditions Of Brownfields Regeneration In The Visegrad Group Countries

Dvořáková, Líšková, Z., Vojvodíková, B., Majstriková, T. (2016). Základy brownfieldů v ekonomických souvislostech, Faculty of Economics, University of South Bohemia in Ceske Budejovice

Dvořáková, Líšková, Z., Humlerová, V., Klufová, R. (2015). Future perspectives of brownfields – case study from South Bohemia. Department of Regional Management. Department of Applied Mathematics and Informatics. Faculty of Economics. University of South Bohemia. Czech Republic

European Commission. (2013). Science for Environment Policy. Brownfield Regeneration. Issue 39

European Commission. (2016). Science for Environment Policy. No net land take by 2050? Retrieved from

https://ec.europa.eu/environment/integration/research/newsalert/pdf/no_net_land_take_by_2050_FB14_en.pdf

European Court of Auditors. (2012). Have EU Structural Measures Successfully Supported the Regeneration of Industrial and Military Brownfield Sites? Retrieved from https://www.eca.europa.eu/Lists/ECADocuments/SR12_23/SR12_23_EN.PDF

European Environmental Agency. (2000). Gundula, P., Schamann, M., Edelgaard, I. Management of contaminated sites in Western Europe

European Environmental Agency. EEA Signals. (2019). Land and soil in Europe

Federal Environmental Agency (FEA). (2005). The Future lies on Brownfields. Reactivation of Urban Land Reserves - Redevelopment Potentials and Practical Information for Investors. Builder-Owner and Real Estate Owners

Ferber, U., Grimski, D. (2002). Brownfields and redevelopment of urban areas, Austrian Federal Environment Agency, on behalf of CLARINET

Federation of Canadian Municipalities. (2006). EPA. Anatomy of Brownfields Redevelopment. Brownfields Solutions Series. 10-step guide to developing a municipal brownfield inventory. Leadership in Brownfield Renewal Program Guidebook Series. Green Municipal Fund

Frantál, B., Greer-Wootten, B., Klusáček, P., Krejčí, T., Kunc, J., Martinát, S. (2015). Exploring spatial patterns of urban brownfields regeneration: The case of Brno, Czech Republic. *Cities*, 44, 9–18. doi: 10.1016/j.cities.2014.12.007

Franz, M., Pahlen, G., Nathanail, P., Okuniek, N., & Koj, A. (2006). Sustainable development and brownfield regeneration. What defines the quality of derelict land recycling? *Environmental Sciences*, 3(2), 135–151. doi:10.1080/15693430600800873

Gentile, R., A., Barceló-Cordón, S., Van Liedekerke, M. (2009). Soil Country Analyses Germany. JRC scientific and Technical Reports. European Environmental Agency

Grimski, D., Dosch, F., Klapperich, H. (n.d.). Strategic Land Management in Germany: One Key for Brownfield Clean-up and Sustainable Development

Grimski, D., Ferber, U. (2001). Urban brownfields in Europe

- Grimski, D., Zügel, T., Ferber, U., Ertel, T., Millar, K., Geffers, G., Nathanail, P., Jilleba, G. (2007). Towards More Effective and Sustainable Brownfield Revitalisation Policies. 2nd International Conference on Managing Urban Land
- Groenendijk, N. (2007). An early assessment of JESSICA: Love at first sight?
- Haninger, K., Timmins, Ch. (2014). The Value of Brownfield Remediation. Journal of the Association of Environmental and Resource Economists. University of Chicago Press. vol. 4(1), pages 197-241
- Hilbrandt, H. (2017). Insurgent participation: consensus and contestation in planning the redevelopment of Berlin-Tempelhof airport. *Urban Geography*, 38(4) pp. 537–556
- Interreg Central Europe. ReSites. (n.d.). Analysis of current situation of brownfield in functional urban area Halle (Saale) – Germany. Activity A.T1.1.4-6. Retrieved from <https://www.interreg-central.eu/Content.Node/ReSites/WPT1--GreenerSites-Brownfield-analysis-of-Halle-FUA.pdf>
- Jackson, J., Hermann, G. (n.d.). Towards Integrated Regeneration Policies and Brownfields Advocacy in the Czech Republic. 2nd International Conference on Managing Urban Land
- Kramarova, Z. (2019). Technical Infrastructure of the Area in the brownfield Cataloguing Process. IOP Conference Series: Materials Science and Engineering
- Kunc, J., Tonev, P., Martinát, S., Frantál, B., Klusáček, P., Dvořák, Z., Chaloupková, M., Jaňurová, M., Krajíčková, A., Šilhán, Z. (n.d.). Industrial legacy towards brownfields: historical and current specifics, territorial differences (Czech Republic)
- Kurtović Folić, N., Perovic, S. (2012). Brownfield regeneration – imperative for sustainable urban development, *GRAĐEVINAR*, 64 (5), doi: <https://doi.org/10.14256/JCE.656.2012>
- Maliene, V., Wignall, L., & Malys, N. (2012). Brownfield regeneration: Waterfront site developments in Liverpool and Cologne
- Martinat, S., Dvorak, P., Frantal, B., Klusacek, P., Kunc, J., Navratil, J., ... Reed, M. (2016). Sustainable urban development in a city affected by heavy industry and mining? Case study of brownfields in Karvina, Czech Republic. *Journal of Cleaner Production*, 118, 78–87

- Medda, F.R., Caschili, S., Modelewska, M. (2012). Financial mechanisms for Historic City Core Regeneration and Brownfield Redevelopment in The Economics of Uniqueness: Investing in Historic City Cores and Cultural Heritage Assets for Sustainable Development. Eds. Licciardi, G. & Amirtahmasebi, R. Washington D.C: World Bank
- Micle, C., I., Ungureanu M. (n.d.). The reconversion and diversification of the Brownfield sites in the Guragont- Halmagi depression through tourism. Case study
- Národní strategie regenerací brownfieldů 2019-2024. (2019). NSRB 2024, Ministerstvo průmyslu a obchodu a Agentura CzechInvest, Ministerstvo pro místní rozvoj, Ministerstvo zemědělství, Ministerstvo životního prostředí
- Nathanail C.P. (2010). Sustainable Brownfield Regeneration. Dealing with Contaminated Sites. Springer, Dordrecht. https://doi.org/10.1007/978-90-481-9757-6_25
- Nathanail, P., Thornton, G. and Millar, K. (2003). What's in a Word: UK and international definitions of brownfield
- Nathanail, P., Millar, K., Grimski, D., Ferber, U. (2007). 1.7 'Key findings from CABERNET—Europe's sustainable brownfield regeneration network'. *Managing Urban Land*, 59
- Navratil, J., Picha, K., Martinat, S., Nathanail, P. C., Tureckova, K., Holesinska, A. (2018). Resident's preferences for urban brownfield revitalization. Insights from two Czech cities
- Oliver, L., Ferber, U., Grimski, D., Millar, K., Nathanail, P. (2005). The Scale and Nature of European Brownfields
- Osman, R., Frantál, B., Klusáček, P., Kunc, J., & Martinát, S. (2015). Factors affecting brownfield regeneration in post-socialist space: The case of the Czech Republic
- Pahlen, G., Glöckner, S. (n.d.). Sustainable regeneration of European brownfield sites. Montan-Grundstücksgesellschaft mbH, Germany
- Pérez, P., A., Rodríguez, E., N. (2018). Status of local soil contamination in Europe. European Commission. JRC technical reports
- Peric, Ana & Furundžić, Danilo. (2013). Collaboration in the Brownfield Regeneration Process – Legally Binding or Informal Approach?

- Petríková, D., Vojvodíková, B. (2012). *Brownfields – Handbook*. Browntrans. Faculty of Civil engineering. Technical University of Ostrava
- Pins, M. (n.d). *Iowa Brownfield Redevelopment Program. Site Redevelopment Process*. Environmental Services Division. Iowa Department of Natural Resources
- Pizzol, L., Zabeo, A., Klusáček, P., Giubilato, E., Critto, A., Frantál, Bartke, S. (2016). *Timbre Brownfield Prioritization Tool to support effective brownfield regeneration*. *Journal of Environmental Management*, 166, 178–192. doi: 10.1016/j.jenvman.2015.09.030
- Planeta. (2007). *Regenerace brownfields*. Ministerstvo životního prostředí. Ročník XV. Číslo 3/2007
- Rizzo, E., Pesce, M., Pizzol, L., Alexandrescu, F. M., Giubilato, E., Critto, A., ... Bartke, S. (2015). *Brownfield regeneration in Europe: Identifying stakeholder perceptions, concerns, attitudes and information needs*. *Land Use Policy*, 48, 437–453. doi: 10.1016/j.landusepol.2015.06.012
- Ruelle, C., Halleux, J-M. & Teller, J. (2012). *Landscape Quality and Brownfield Regeneration: A Community Investigation Approach Inspired by Landscape Preference Studies*. *Landscape Research*. Doi: 10.1080/01426397 .2011.647898
- Schädler, S., Morio, M., Bartke, S., Rohr-Zänker, R., Finkel, M. (2011). *Designing sustainable and economically attractive brownfield revitalization options using an integrated assessment model*. *Journal of Environmental Management*, 92(3), 827–837. doi: 10.1016/j.jenvman.2010.10.026
- Skála, J., Vácha, R., Čechmánková, J., Horváthová, V. (2013). *Various Aspects of the Genesis and Perspectives on Agricultural Brownfields in the Czech Republic*. *Moravian Geographical Reports*. 21. 10.2478/mgr-2013-0010
- Tendero, M., Bazart, C. (2018). *Empty lands? Social representations of contaminated brownfields in France*
- The government of British Columbia. (n.d.). *The basics of brownfield redevelopment. A guide for local governments in British Columbia*

- Thornton, G., Franz, M., Edwards, D., Pahlen, G., & Nathanail, P. (2007). The challenge of sustainability: incentives for brownfield regeneration in Europe. *Environmental Science & Policy*, 10(2), 116–134. <https://doi.org/10.1016/j.envsci.2006.08.008>
- Turečková, K., Nevima, J. (2018). Perceiving the Impact of Brownfields on the Real Estate Prices: A Case Study from Four Locations in the Czech Republic. *Geographia Technica*. 13. 138-151. 10.21163/GT_2018.132.11
- Turečková, K., Nevima, J., Skrabal, J., Tuleja, P. (2019). Categorization of Impact of the Selected Variables for Potential Brownfield Regeneration in the Czech Republic by Means of Correspondence Analysis
- Turečková, K., Martinat, S., Skrabal, J., Chmielova, P., Nevima, J. (2017). How local Population Perceive Impact of Brownfields on the Residential Property Values: Some Remarks from Post-Industrial Areas in the Czech Republic. *Geographia Technica*. 12. 150-164. 10.21163/GT_2017.122.13.
- Turvani, M., Toni, S. (n.d.). Brownfield remediation and redevelopment: valuing the costs and the benefits. 2nd International Conference on Managing Urban Land
- Vaniček, I., Jirásko, D. (n.d.). Approach to brownfield revitalization for small cities in the Czech Republic. 2nd International Conference on Managing Urban Land
- Vojvodíková, B., Tichá, L., Fojtik, R., Szeligova, N. (2019). Brownfields in Function Urban Area Ostrava. *IOP Conference Series: Materials Science and Engineering*. 471. 102023. 10.1088/1757-899X/471/10/102023
- Vojvodíková, B., Mihola, M. (n.d.). Brownfieldy, jako jeden z faktorů rozvoje obce. *Brownfields as a Municipal Development Factor*
- Vyškovská, M. (2013). Využití francouzského přístupu pro regenerace brownfields v ČR. XVI. Mezinárodní kolokvium o regionálních vědách. DOI: 10.5817/CZ.MUNI.P210-6257-2013-29
- Workshop on Re-using Brownfield Sites and Buildings, Regions for Economic Change Conference. (2010). European Union

Internet sources

Brownfields a greenfields v Libereckém kraji. (2019). Retrieved from https://investujpodjstedem.cz/wp-content/uploads/2019/11/02_LK_BF_GF.pdf

Brownfield redevelopment and inner urban development. (2015). Retrieved from <https://www.umweltbundesamt.de/en/topics/soil-agriculture/land-use-reduction/brownfield-redevelopment-inner-urban-development#brownfield-reuse-greenfield-protection>

Česko v datech. (2017). Země brownfieldů: V Česku je téměř 500 lokalit připravených pro investory. Retrieved from <https://www.ceskovdatech.cz/clanek/59-zeme-brownfieldu-v-cesku-je-temer-500-lokalit-pripravenych-pro-investory/>

Dumesnil, F., Ouellet, C. (2002). La réhabilitation des friches industrielles: Un pas vers la ville viable?. Retrieved from <https://journals.openedition.org/vertigo/3812>

European Commission. (2019). Retrieved from <https://cordis.europa.eu/project/id/265097>

European Commission. (2019). Retrieved from http://cordis.europa.eu/projects/rcn/97552_en.html

European Commission. (2019). Retrieved from <https://cordis.europa.eu/project/id/265364>

European Environment Agency (EEA) (2011). Progress in management of contaminated sites. Retrieved from <http://www.eea.europa.eu/data-and-maps/indicators/progress-in-management-of-contaminated-sites/progress-in-management-of-contaminated>

European Structural and Investments Funds. Data. <https://cohesiondata.ec.europa.eu/>

Federation of Canadian Municipalities. (2016). Brownfield Roadmaps. Alberta. Retrieved from <https://fcm.ca/sites/default/files/documents/resources/tool/roadmaps-for-redeveloping-brownfields-alberta-original-gmf.pdf>

Greenfield vs. Brownfield: What's Better for Your Manufacturing Facility? (n.d.). Retrieved from <https://www.gray.com/insights/greenfield-vs-brownfield-whats-better-for-your-manufacturing-facility/>

Gutierrez, G. (2014). Friches industrielles : les avancées de la loi Duflot. Retrieved from <https://www.latribune.fr/opinions/tribunes/20140320trib000821076/friches-industrielles-les-avancees-de-la-loi-duflot.html>

Kabisch, N. (2019). Transformation of urban brownfields through co-creation: the multi-functional Lene-Voigt Park in Leipzig as a case in point. *Urban Transform* 1, 2 <https://doi.org/10.1186/s42854-019-0002-6>

La reconversion des friches industrielles. (2019). Retrieved from <https://france3-regions.francetvinfo.fr/hauts-de-france/reconversion-friches-industrielles-picardie-1629652.html>

Měsíčník EU aktualit. (2017). Retrieved from https://www.csas.cz/static_internet/cs/Evropska_unie/Mesicnik_EU_aktualit/Mesicnik_EU_aktualit/Prilohy/mesicnik_2017_09.pdf

Najibi, H. (2019). La reconversion des friches industrielles en Picardie. Retrieved from <https://france3-regions.francetvinfo.fr/hauts-de-france/reconversion-friches-industrielles-picardie-1629652.html>

Obchody místo parních turbín. Brněnská galerie Vaňkovka oslavila 15. narozeniny. (21.3.2020). Retrieved from <https://www.e15.cz/magazin/obchody-misto-parnich-turbin-brnenska-galerie-vankovka-oslavila-15-narozeniny-1367830>

Reconversion des friches industrielles, une approche globale pour créer de la valeur dans les zones urbaines. (2019). Retrieved from <https://www.usinenouvelle.com/article/tribune-reconversion-des-friches-industrielles-une-approche-globale-pour-creer-de-la-valeur-dans-les-zones-urbaines.N801410>

Rbb24.de. SPD-Politiker werben für Randbebauung am Tempelhofer Feld. (2019). Retrieved from <https://www.rbb24.de/politik/beitrag/2019/07/bebauung-rand-tempelhofer-feld-spd-vorschlag.html>

Stránský, J. (n.d.). Na území Textilany by měla vzniknout plnohodnotná čtvrť s byty, obchody, službami, ale i s pracovními příležitostmi. Retrieved from <https://www.libereckezpravy.cz/na-uzemi-textilany-by-mela-vzniknout-plnohodnotna-ctvrt-s-byty-obchody-sluzbami-ale-i-s-pracovnimi-prilezitostmi-za-lepsi-liberec/>

Střed Brna je královstvím opuštěných továren. Oživovat se je daří pomalu. (2017). Idues.cz. Retrieved from https://www.idnes.cz/brno/zpravy/centrum-brna-brownfieldy-opustene-tovarny.A170325_2314878_brno-zpravy_krut

Tesař, T. (2018). Na obří parcele po slavné liberecké Textilaně vyrostě tisíčovka bytů. Retrieved from <https://www.seznamzpravy.cz/clanek/na-obri-parcele-po-slavne-liberecke-textilane-vyrostet-tisicovka-bytu-56069>

United States Environmental Protection Agency (EPA). Retrieved from <https://www.epa.gov/brownfields>

<https://brf-msk.cz/>

<https://investujpodjestedem.cz/gd-home/>

<http://invest-uk.cz/>

<https://www.brownfieldy-jmk.cz/>

<https://www.kr-olomoucky.cz/problematika-brownfields-cl-1124.html>

<https://www.brownfieldy-pk.cz/brownfieldy.html>

<https://geoportal.kr-zlinsky.cz/bf/>

http://www.rda-vysocina.cz/investori/brownfields/Sumar_priloha_1A.htm

<http://www.rda-vysocina.cz/investori/brownfields.html>

<https://dotaceeu.cz/cs/statistiky-a-analyzy/mapa-projektu/projekty/01-operacni-program-podnikani-a-inovace-pro-konkur/01-2-rozvoj-podnikani-a-konkurenceschopnosti-malyc/revitalizace-brownfieldoveho-arealu-ve-varnsdorfu>

<https://dotaceeu.cz/cs/statistiky-a-analyzy/mapa-projektu/projekty/01-operacni-program-podnikani-a-inovace-pro-konkur/01-2-rozvoj-podnikani-a-konkurenceschopnosti-malyc/modernizace-zastaraleho-arealu-v-lomu-u-mostu>

<https://dotaceeu.cz/cs/statistiky-a-analyzy/mapa-projektu/projekty-pred-rokem-2014/12-rop-nuts-ii-stredni-morava/12-2-integrovaný-rozvoj-a-obnova-regionu/revitalizace->

objektu-14-a-15-byvaleho-arealu-firmy

[https://www.europe-en-france.gouv.fr/fr/projets/urban-parc-lusine-sensations-au-coeur-
dales](https://www.europe-en-france.gouv.fr/fr/projets/urban-parc-lusine-sensations-au-coeur-
dales)

[https://www.europe-en-france.gouv.fr/fr/projets/depollution-et-rehabilitation-dune-
friche-industrielle](https://www.europe-en-france.gouv.fr/fr/projets/depollution-et-rehabilitation-dune-
friche-industrielle)

[https://www.europe-en-france.gouv.fr/fr/projets/parc-urbain-et-fluvial-de-la-presquile-
rollet](https://www.europe-en-france.gouv.fr/fr/projets/parc-urbain-et-fluvial-de-la-presquile-
rollet)

<https://www.brno.cz/podnikatel-investor/investicni-prilezitosti/brownfields>

[https://www.bmu.de/themen/wasser-abfall-boden/bodenschutz-und-
altlasten/bodenschutz-und-altlasten-worum-geht-es/altlasten-situation-und-
massnahmen/](https://www.bmu.de/themen/wasser-abfall-boden/bodenschutz-und-
altlasten/bodenschutz-und-altlasten-worum-geht-es/altlasten-situation-und-
massnahmen/)

LIST OF ABBREVIATIONS

API...	Agentura pro Podnikání a Inovace (Business and Innovation Agency)
BASIAS ...	Base de données des ancient sites industrial's et activités de service (French historical regional inventory of former sites of industrial and service activities likely to be contaminated)
BASOL ...	Base de données sur les sites et sols pollués ou potentiellement pollués (French national database for contaminated sites requiring public intervention)
CABERNET...	Concerted Action on Brownfields and Economic Regeneration Network
CARACAS...	Concerted Action on Risk Assessment for Contaminated Sites in the European Union
CF...	Cohesion Fund
CLARINET ...	Contaminated Land Rehabilitation Network for Environmental Technologies
EFSI ...	European Funds for Strategic Investments
ERDF...	European Regional Development Fund
EU ...	European Union
HOMBRE...	Holistic Management of Brownfield Regeneration
IROP...	Integrated Regional Operational programme
JESSICA...	Joint European Support for Sustainable Investment in City Areas
N.D....	No date
OP...	Operational programme
OPEIC...	Operational Programme Enterprise and Innovation for Competitiveness
RESCUE...	Regeneration of European Sites in Cities and Urban Environments
SEKM...	Systém evidence kontaminovaných míst (Contaminated Sites Database System)
SMEs...	Small and Medium-sized Enterprises
TIMBRE...	Tailored Improvement of Brownfield Regeneration in Europe

LIST OF PICTURES

Picture 1 - Regeneration and Commercial Use of Brownfields	33
Picture 2 – Simple scheme of brownfield redevelopment.....	51
Picture 3 – Vaňkovka before.....	79
Picture 4 – Vaňkovka today	79
Picture 5 – Baťa plant before the redevelopment.....	82
Picture 6 – Baťa plant after the regeneration process	82

Picture 7 Textilana factory	83
Picture 8 – Textilana in 2003	84
Picture 9 – Textilana in 2020	84
Picture 10 – Ancient Tempelhof airport.....	90

LIST OF GRAPHS

Graph 1.....	33
Graph 2.....	34
Graph 3.....	34
Graph 4.....	85
Graph 5.....	86
Graph 6.....	86
Graph 7.....	87
Graph 8.....	92
Graph 9.....	93
Graph 10.....	93
Graph 11.....	95
Graph 12.....	96
Graph 13.....	97
Graph 14.....	98
Graph 15.....	99
Graph 16.....	100
Graph 17.....	101

Graph 18.....	102
Graph 19.....	103
Graph 20.....	104
Graph 21.....	105
Graph 22.....	106
Graph 23.....	108
Graph 24.....	108

LIST OF TABLES

Table 1 – Examples of programmes financing brownfields in the Czech Republic	30
Table 2 - Funding of industrial and military site regeneration.....	94