energies

MDPI

*Article*

# Does Environment Matter in Smart Revitalization Strategies? Management towards Sustainable Urban Regeneration Programs in Poland

**Aleksandra Jadach-Sepioło [1,2,*], Katarzyna Olejniczak-Szuster [3] and Michał Dziadkiewicz [3]**

[1] Warsaw School of Economics, 02-554 Warsaw, Poland
[2] Poland and Institute of Urban and Regional Development, 03-728 Warsaw, Poland
[3] The Management Faculty, Czestochowa University of Technology, Armii Krajowej 19B, 42-201 Czestochowa, Poland; k.olejniczak-szuster@pcz.pl (K.O.-S.); michal.dziadkiewicz@pcz.pl (M.D.)
* Correspondence: a.jadachsepiolo@gmail.com

**Abstract:** The article presents the course of the evolution of the concept of urban renewal's emergence into its current, mature, integrated form of sustainable regeneration (sustainable urban regeneration—SUR). We present how the determination of renewal areas and its goals began to be based on particular indicators, and how the importance of these analyses gradually increased in managing the implementation of urban regeneration programs. Analytical techniques using GIS were used in the analyses of the differentiation of crisis phenomena inside cities before they became popular in smart city tools. Despite the wide use of GIS to analyze the diversity of crisis phenomena within the city, the availability of data means that different spheres are characterized with different accuracy. Starting from the significance of individual spheres, the focus has primarily been on the environment, which is underappreciated in Poland. Municipalities (urban, rural, urban–rural) with regeneration programs do not perceive negative environmental phenomena as significant in assessing a crisis in a degraded area. Nevertheless, municipalities that do analyze environmental issues in regeneration programs also see the need for action and implementation of projects in the environmental sphere. In order to verify the hypothesis, the Statistics Poland (formerly known in English as the Central Statistical Office; Polish: Główny Urząd Statystyczny, abbreviated and known as GUS) data on the regeneration process was analyzed, with reference to the relationships between renewal areas and the natural environment. In order to check these dependencies (or the lack thereof), the Yule φ coefficient and Spearman's rank correlation coefficient were used. As a result, this study showed that analysis of the level and degree of degradation of the environmental sphere is not carried out frequently enough in municipalities. Secondly, the difficulties of municipalities, especially small ones (urban-rural and rural), in their analysis of the environmental sphere are the result of poor data availability. Thirdly, it is noted that there is a relationship between the designation of environmental zones and the type of municipality. This is of particular importance for the enhancement of smart city tools for the regeneration of existing cities, esp. small ones.

**Keywords:** urban regeneration; renewal; indicators; smart city; regeneration program; environment; sustainability; sustainable regeneration; sustainable development goals (SDGs)



**Citation:** Jadach-Sepioło, A.; Olejniczak-Szuster, K.; Dziadkiewicz, M. Does Environment Matter in Smart Revitalization Strategies? Management towards Sustainable Urban Regeneration Programs in Poland. *Energies* **2021**, *14*, 4482. https://doi.org/10.3390/en14154482

Academic Editor: Ricardo J. Bessa

Received: 30 June 2021
Accepted: 21 July 2021
Published: 24 July 2021



## 1. Introduction

The evolution of the concept of urban regeneration has been taking place for about a hundred years [1] and has been proceeding differently in different countries [2–5]. The way of defining and the scope of regeneration is largely a derivative of local challenges, but also of the model of urban policy in a given country [6–8]. The shape of regeneration policy in Europe has developed during over an almost seventy-year evolution, during which experience was shared and local conditions changed [9–11]. The rules for carrying out such policy with respectto the involvement of various actors have also changed [12,13].

The final impact of the evolution of the aim and scope of regeneration is the development of integrated area approaches in the countries of the "old Union" [14], and the striving for integration of the activities of all stakeholders in a regeneration area [15].

Regardless of how this evolution meandered, with respect to contemporary approaches to regeneration, the starting point for this public debate on the need for renewal in each country was poor housing conditions and poor quality of housing [3,5,8,15,16]. A phenomenon that severely affected densely populated cities, especially in Europe and North America in the first half of the 20th century, was the state of degradation (blight). Initially, in the 1920s, the term blight was used to describe public health threats due to poor sanitary conditions in a specific area of the city. Literally, the term blight meant the plague spreading among crops. Due to poor housing conditions in densely populated districts of industrial cities, the plague of civilization's diseases (mainly tuberculosis) was growing. [17]. The solution was to be demolition programs, both in the United States [18,19] and in Europe [20,21]. The reform of buildings was to be a response to all the problems of technically degraded areas, without infrastructure, and suffering from high unemployment and economic stagnation [22]. Research conducted in the areas affected by these activities showed that they did not change the circumstances of their inhabitants, who were still politically and economically weaker and prone to marginalization in social life [23]. The phenomenon of gentrification became common; the word was first used in the 1960s [24] and has been invariably studied in areas where regeneration activities are carried out as a side effect [25–28]. Gradually, along side the spread of regeneration activities in developing countries, other unwanted side effects also appeared, such as poverty and homelessness caused by the demolition of slums [29,30] or massive logging and disturbance of existing ecosystems due to the redevelopment of large areas [31,32]. Regardless of the side effects of regeneration processes, it is nonetheless considered integrally related to improving of the quality of the environmental sphere, while at the same time being a decisive argument in selecting areas for regeneration [33,34]. This obtains because the protection of the natural environment is a universal element of the revitalization process [35], and activities aimed at the renewal of an area, and often re-recovery of areas (e.g., post-industrial ones), contribute to the improvement of the environmental parameters [36,37].

Due to the growing importance of challenges related to changing natural environments, the aim of the article is to analyze the relationship between the way environmental degradation is treated in regeneration programs and the number of projects included in regeneration programs that affect this sphere.

It should be remembered that regeneration is extremely complex and idiosyncratic, consequence of the individual characteristics of an area and many different factors affecting it [38,39]. Academic research to date shows that the emergence and maturation of new concepts in urban policy is most often accompanied by initially limited access to data, which has hindered monitoring the effects of such undertaken action. [39–41]. Practitioners, on the other hand, need guidelines on how to plan activities in order to achieve the desired effects as quickly as possible [42]. Therefore, models or sets of indicators have begun to appear in the literature, enabling the assessment of the successfulness of urban development activities, including regenerative ones [43].

In Polish literature, as in other countries, an evolving set of spheres and indicators reflects a maturing approach to regeneration, and it's approach of the environmental sphere is relatively new to Polish practice [34,44]. Meanwhile, environmental challenges are becoming more and more important. Cities are perceived, both internationally and locally, as places where modern solutions in the field of environmental protection are created, and there is socio-economic pressure to limit climate change through focused investment. Therefore, there is a need to analyze the relationship between the importance of this sphere in regeneration programs and the scale of undertakings implemented on their basis. To which end, our main research question is: are the municipalities that use tools within the framework of the smart city for the analysis of environmental data better prepared for the implementation of environmental projects? The authors note that it has

been difficult for Polish municipalities to take into account environmental factors [45]. Authors in other countries point to similar problems, emphasizing how big a challenge is ensuring the measurability of environmental phenomena [39,46]. Diversification of approaches in different countries, and verification of the what extent to which smart city tools are useful in this type of analysis, is a gap for further research to close. Taking into consideration the above issues, the current study may provide new insights on the management of regeneration programs in Poland, but also inspire similar analyses in other countries.

On the basis of foreign literature, a thesis was proposed that views the resultant environmental sphere of sustainable urban regeneration as the result of the evolution of the specific approach of the country examining it. Most often, the inclusion of the environmental sphere in revitalization programs results directly from the availability of data, and not from the awareness of environmental challenges and sustainable development goals in the municipality [47–50]. National policies do not help in this respect, because, in their case, an "evidence-based approach" is also limited by the availability of data [51]. Therefore, it can be hypothesized that municipalities do not describe the problems that actually occur, but those that they can describe using available data. These data are often available only for the entire municipality, without the possibility of presenting the intra-municipal differentiation. As a result, municipalities do not have the tools to propose, on this basis, measures that respond to the challenges of specific districts, especially degraded ones, where environmental problems are often of a complex nature (e.g., contamination after industrial use, empty buildings constructed with obsolete technologies using asbestos). Smart city tools can be helpful because they allow the collection of data from the environmental sphere, and with the granularity of individual addresses [52,53]. In order to assess their usefulness from the Polish perspective, it was necessary to analyze the extent to which Polish municipalities use data relating to the environment in urban regeneration. Regeneration programs are the only documents in Poland that must take into account the intra-municipal diversity of their analyzed phenomena. Therefore, they were selected as the subject of the analysis [32,39,54–56]

## 2. Literature Review

By definition, regeneration is a holistic renewal process that takes into account various aspects, including ones social, economic, environmental, technical and spatial [1,6,7,39,41]. Roberts [10] is of the opinion that regeneration includes detailed and comprehensive actions that lead to solving the problems of a given area and improving its conditions. For this reason, it is considered to be the most effective way of solving a wide range of problems (urban, rural, urban–rural) [57]. The literature on the subject emphasizes that regeneration is an integral part of global sustainable development and it is widely recognized that sustainable development should promote regeneration strategies and activities [58]. In view of the above, the term sustainable urban regeneration appeared, the use of which was to emphasize the comprehensive and integrated nature of the process [48,57]. However, the research invariably noticed that, despite the declared integrated nature of the projects, which aimed to solve the socio-economic problems of the inhabitants of regeneration areas, they focused primarily on improving the technical indicators characterizing those areas [59]. Difficulties in defining sustainable urban regeneration were pointed out [60] and a set of indicators was sought that would allow for a comprehensive approach to this process and the assessment of the progress of its implementation [39,61]. British research shows that, in the UK's implemented regeneration projects, the greatest emphasis was placed on improving housing conditions, however, the guidelines for carrying out revitalization activities also referred to social, economic and environmental issues [62]. This approach to sustainable urban regeneration is deeply rooted in the findings of the Brundtland Commission of 1987. A necessary condition for the application of the principle of sustainable development is an integrated view combining economic, social and environmental issues.

According to La Rosa et al. [58], sustainable regeneration is oriented towards the sustainable development of cities, in particular the improvement of living conditions, increasing energy efficiency, modernizing the existing infrastructure or rebuilding public spaces, but also improving the delivery of public services and related ecosystem services.

The integrated approach is also the foundation of the Polish model of urban regeneration [1,5,7,63]. Regeneration is defined as the process of recovering degraded areas from a crisis state, conducted in a comprehensive manner through integrated activities for the local community, space and economy, territorially focused, and carried out by regeneration stakeholders on the basis of the municipal regeneration program [63]. The first stage of the renewal process in Poland, in accordance with the regeneration act currently in place, is to designate the areas of concentration of negative phenomena in a municipality, i.e., the degraded areas [64]. The act defines an area in crisis as being due to the concentration of negative social phenomena, in particular, unemployment, poverty, crime, and low levels of education or social capital, as well as insufficient levels of participation in public and cultural life. Analysis of the distribution of negative phenomena is carried out for the entire municipality, using objective, measurable and verifiable indicators. The reference level for each indicator is the average value for the city in question. The basis for demarcating a degraded area is the occurrence of crisis phenomena in the social sphere. In order to designate degraded land (i.e., brownfield), economic, environmental, technical or spatial problems that are more severe than in other parts of the city must also be identified. In the next step of such analysis, the area for regeneration is determined. According to the law, it should be characterized by a particular concentration of negative phenomena mentioned above and be of significant importance for local development.

A similar approach has become widespread in urban policy in Europe and has been supported by scientific analyses [65–67]. There have been attempts to select indicators that illustrate crisis phenomena and can be used to improve degraded areas. Synthetic indicators and sets of key performance indicators have also been created to monitor success [42,43,68]. A breakthrough, in this respect, was the work of Hemphill et al. [68], which presented the relationship between indicators illustrating the SUR process. Their groups of indicators included: involvement of local communities, use of public transport to stimulate the real estate market, improving the energy efficiency of buildings and stimulating private investment. Changes demanded of the environmental sphere concerned thermal modernization and rehabilitation of buildings, and this topic is gaining more and more importance in the literature. Both European Union documents [69] and scientific studies [70] emphasize that residential buildings are responsible for the majority of final energy consumption and greenhouse gas emissions. In this context, regeneration activities are becoming more and more important, as scientific analyses show that it is possible to reduce up to 75% of final energy consumption and greenhouse gas emissions as a result of improving the parameters of buildings and their impact on their surroundings [71,72].

The scope of environmental analyses undertaken in SUR models is broad and covers a varety of issues. Concerning energy, and beyond housing efficiency, there are greenhouse gas emissions related to transport [73,74] and the availability of green spaces [46,47,75]. More and more attention is being paid to the issue of accessibility of green areas in the scientific literature; the factors (governance tools, organizational leadership, culture and political leadership) that influence the satisfaction of the residents' needs in this area are increasingly being analyzed. The authors point to the discrepancies between planning green areas in theory and practice [76]; in the context of findings on the availability of green areas and the decisions of authorities shaping this [76,77], the analysis of data used in the assessment of environmental problems in a municipality in terms of intra-municipal diversity takes on a special importance and can be a valuable voice in international discussions. Even more so, as the availability of green spaces is becoming one of the most important needs of urban communities, in not only large but also smaller cities, in connection with the challenges that have emerged as a result of the COVID-19 pandemic [78].

Most of the aforementioned analyses would not be possible without the use of smart cities' tools. Initially, the concept referred only to the use of technology, but it soon became clear that, thanks to such use, city authorities can better manage development by virtue of access to data [79,80]. The challenge is for these data to meet a number of criteria, including those detailed in research by A. Sharifi: comprehensiveness, context sensitivity, strategic alignment, uncertainty management, interlinkages and interoperability, temporal dynamism, flexibility and feasibility [81]. They also point out that without constant presentation of these results to the local community, in a legible form and with the involvement of stakeholders to co-decide on prospective changes, smart city tools are worthless gadgets [82]. Data helps to better illustrate challenges, including the ones related to the energy efficiency of buildings in regeneration areas [83]; however, in order to use them, it is necessary to provide an information infrastructure and an appropriate number of data points, which is a particular difficulty in Central and Eastern European cities [37]. This is an important context for the analysis in this article. We analyzed whether Polish local governments used environmental data for the purposes of developing regeneration programs and project implementation, but we also assessed whether it was possible to talk about the use of smart city tools to diagnose environmental crisis phenomena in Poland.

## 3. Materials and Methods

The scale of programs for regeneration activities in Poland, since the adoption of the Revitalization Act in 2015, is huge. According to the data of Statistics Poland, at the end of 2018, the total number of regeneration programs in Poland was 1494. Most cities received government grants to develop programs, which made it possible to carry out complex analyses taking into account intra-municipal diversity, something that had not previously been done in cities on this scale. Crisis phenomena in the social, economic, environmental, technical and spatial-functional spheres were assessed with the use of various indicators. It was also possible to disseminate participatory document development. In most cities, the communities of a regeneration area and its other stakeholders were involved at every stage of the renewal program's development (from diagnosis and designation of the regeneration area to consultation on the final version of the program). Given such a scale, the Polish regeneration model provides an impetus to assess to the extent to which planned activities adhere to sustainable urban regeneration, combining all the above-mentioned spheres in such assessment.

A survey by Statistics Poland, conducted at the end of the regeneration programming process, allowed the collecting of a number of data, including information about the extent to which crisis phenomena in particular spheres (social, economic, environmental, technical and spatial-functional) influenced the designation of degraded areas [60]. The results of the Statistics Poland survey were the basis for the formulation of the detailed research hypotheses in this article. The whole number of regeneration programs (1494) was divided into two types of programs (Table 1); 1167 regeneration programs, developed on the basis of the Act on Municipal Self-Government (PR/LPR; in Poland, these abbreviations refer to: revitalization program and local revitalization program, respectively), and 327 municipal regeneration programs (in Poland abbreviated as GPR and sometimes referred to as 'gmina revitalization programme'), developed on the basis of the Revitalization Act, were distinguished. Less than 22% of municipalities conducted regeneration activities according to the specifications documented in the act; the remaining municipal councils decided that, during the transitional period (until 31 December 2023), they would carry out regeneration activities based on a simpler doctrine.

The key determinant of designating degraded areas (and, consequently, areas of regeneration) were negative phenomena in the social sphere (Table 2).

**Table 1.** Two types of urban regeneration programs in Poland (PR/LPR and GPR).

| | **The Type of Urban Regeneration Program** |
|---|---|
| PR/LPR | 1.167 (78%) |
| GPR | 327 (22%) |
| Total | 1.494 (100%) |

Source: Own study based on [63].

**Table 2.** The impact of individual spheres on the designation of degraded areas.

| | **The Impact of Negative Phenomena** | |
|---|---|---|
| Sphere | Decisive | Significant |
| social | 81.7% | 96.9% |
| economic | 34.9% | 79.6% |
| spatial and functional | 39.7% | 81.1% |
| technical | 28.7% | 69.6% |
| environmental | 22.6% | 62.6% |

Source: Own study based on [63].

As many as 81.7% of municipalities with adopted regeneration programs showed that it was the main factor determining the demarcation of brownfields, while 96.9% of municipalities indicated that it was a significant one. Thus, it clearly can be stated that the intention of the legislation, to make negative phenomena in the social sphere foundational for the evaluation of degradation in a municipality, was internalized by municipalities.

Negative economic phenomena had a decisive impact on the demarcation of degraded lands in 34.9% of municipalities, and 79.6% of municipalities indicated that they were significant in this process. It is worth paying attention to the balanced distribution of indications—for many municipalities, degradation in the economic sphere was of secondary importance (665 municipalities), however, this group is slightly smaller than the group of municipalities for whom the significance of this sphere was key (520 municipalities). Degradation in the spatial and functional sphere was of similar importance in demarcating degraded areas in municipalities to the same in the economic sphere, with a slightly greater share in the distribution of indications of municipalities for which this sphere had a decisive influence (39.7% of municipalities) or significant impact (81.1% of municipalities). Negative phenomena in the technical sphere were even less important when demarcating brownfields or other degraded areas; 28.7% of municipalities indicated that they were decisive, while 69.6% of municipalities regarded them as significant. The share in the structure of municipalities for which the technical sphere was of marginal or no importance in designating these areaa is clearly higher than in the case of the above-analyzed spheres—30.4%. This contradicts a stereotypical opinion about such demarcation from the perspective of renovation need. Where modernization was a reason for demarcating these areas, projects concerned with, in particular, urban structures (streets, squares, etc.), were motivated, among other things, by investments improving the condition of technical and/or social infrastructure. The environmental sphere had by far the least influence on the selection of degraded areas. Its decisive influence on the demarcation of a degraded area was indicated by 22.6% of municipalities, and 62.6% of municipalities indicated that they were important in this process. At the same time, for 37.4% of municipalities, negative phenomena in this area were of marginal or no importance [64].

At the same time, in the environmental sphere, approximately one quarter of the planned projects were implemented at the end of 2018. The level of implementation for these projects was much higher than in other spheres. It is a consequence of two factors—a relatively low number of projects from this sphere, and their having been implemented mainly with external funding from competitions that were largely resolved from the outset, from the financial perspective. These conclusions lead us to investigate whether crises in the environmental sphere or other non-substantive factors best explained the implementation of these projects.

The first step in searching for an answer to the main objective of the research proposed in the introduction was to develop a set of research questions based on a literature review. Only the environmental sphere was selected for detailed analysis, other spheres were excluded the. There were several reasons for this choice. Firstly, there was a discrepancy between the low importance of the environmental sphere in designating degraded areas and the high number of these projects Poland completed. Secondly, the Polish literature on the subject clearly indicates that there is already good quality data in other spheres [44,45,61,63,64]. Thirdly, with regard to the environmental sphere, the most difficult thing for Polish municipalities is obtaining data illustrating intra-city diversity [61,63,64]. Most often, these data are presented on the basis of single measurements for the entire municipality [84], which may be a significant obstacle in the use of smart city tools. Individual factors in the environmental sphere (e.g., energy efficiency, energy poverty) were not distinguished, because data sets in public statistics did not allow for this. These issues were left for further research, emphasizing, at the same time, that the importance of this type of analysis in the context of environmental activities of the European Union towards the housing stock is growing [85].

In the next step, data from Polish official statistics corresponding to the research objectives was prepared for analysis. And so, for the purposes of the study, using the data of Statistics Poland, the authors analyzed the impact of the following factors on the maturity of environmental analyses in regeneration programs:

1. the type of regeneration program (GPR/PR) and the importance of the environmental sphere in demarcating the degraded area;
2. the type of the municipality (urban municipalities, rural municipalities and urban–rural municipalities) and the importance of the environmental sphere in demarcating the degraded area;
3. the type of the municipality and the surface area of green spaces in regeneration areas;
4. the importance of the environmental sphere in demarcating the degraded area and the number of planned environmental projects, and where found important, whether there was such a relationship with the particular type of municipalities (urban, rural and urban–rural municipalities);
5. the number of projects planned for implementation in the environmental sphere and those at least begun.

Based on the literature on the subject and preliminary statistical data analysis, the following detailed hypotheses were formulated:

1. Municipalities (urban, rural, urban–rural) with regeneration programs do not perceive negative environmental phenomena as significant in assessing crisis in a degraded area.
2. In municipalities (urban, rural, urban–rural) with a larger surface area of green spaces, no negative environmental phenomena are experienced in degraded areas.
3. The extent of assessment of the environmental threat experienced in the degraded area is closely related to greater numbers of planned projects in the area.
4. The growing strength of negative phenomena in the environmental sphere contributes to an increase in the number of projects in an area.

In the correlation study, Spearman's correlation coefficient was used, taking into account the occurrence of many related pairs for data using an ordinal scale. The value of this coefficient is in the closed range [–1, 1]. The closer it is to the ends of this range, the stronger the correlation between the features. For strictly qualitative data, the φ-Yule correlation coefficient was used, based on the $\chi^2$ statistic. For the number of lines not greater than two, the value of φ-Yule does not exceed one, for the number of lines greater than two, it may be greater than one. The values of the correlation coefficients were tested each time, taking into account the significance level $\alpha = 0.05$. Additionally, in the case of four-field association tables for qualitative data, the possible impact of too low values in individual cells was minimized thanks to the application of the Yates correction [86].

By tracing these relationships, it was possible to accurately characterize environmental aspects of regeneration programs in Poland.

The discussion of the results traced the evolution of the Polish approach to measuring crisis phenomena with the use of indicators, primarily in the environmental sphere. The authors characterized this approach with difficulty in obtaining data on the environmental sphere—difficulty faced by Polish municipalities wanting to use smart city tools to diagnose the needs characterizing this sphere in regeneration programs.

## 4. Results

Taking into account the type of regeneration program (GPR/PR) and the importance of the environmental sphere in demarcating the degraded area, the analysis covered three types of municipalities: urban, rural, and urban–rural (Table 3).

**Table 3.** Values of φ–Yule correlation coefficients between the impact of negative environmental phenomena and the type of regeneration program in urban, rural and urban–rural municipalities.

| | **The Impact of Negative Environmental Phenomena** | | | |
|---|---|---|---|---|
| Measure | 0 | 0 | 0 | 0 |
| | Urban municipalities | | | |
| φ | 0.096 | −0.002 | 0.059 | −0.133 * |
| $\chi^2$ | 2.015 | 0.001 | 0.760 | 3.899 |
| p | 0.156 | 0.976 | 0.383 | 0.048 |
| | Rural municipalities | | | |
| φ | −0.083 * | −0.083 * | −0.083 * | −0.083 * |
| $\chi^2$ | 4.776 | 4.776 | 4.776 | 4.776 |
| p | 0.029 | 0.029 | 0.029 | 0.029 |
| | Urban-rural municipalities | | | |
| φ | −0.034 | −0.034 | −0.034 | −0.034 |
| $\chi^2$ | 1.671 | 1.671 | 1.671 | 1.671 |
| p | 0.196 | 0.196 | 0.196 | 0.196 |

*—significant value at the significance level $\alpha = 0.05$.

The conducted analysis (Table 3) showed that there is a statistically significant correlation between the type of regeneration program and the strong importance of the environmental sphere in the demarcation of a degraded area in urban municipalities ($\varphi = -0.133$; $\chi^2 = 3.899$; $p = 0.048$). It proves that, in municipalities having a municipal regeneration program compliant with Article 14 of the Revitalization Act (GPR), the strong impact of negative environmental phenomena on an area of regeneration is perceived significantly less frequently. The relationship between the strength of the impact of negative environmental phenomena and the type of regeneration program in rural municipalities is slightly different.

As can be seen, there is a statistically significant correlation ($\varphi = -0.083$; $\chi^2 = 4.776$; $p = 0.029$) between the type of revitalization program and the lack of importance of the environmental sphere in determining the degraded area in rural municipalities. It proves that in municipalities having a municipal regeneration program compliant with Article 14 of the Revitalization Act (GPR), the lack of impact of negative environmental phenomena is felt significantly less frequently. This may indicate a certain lack of awareness, in this regard, in the examined group of rural municipalities for neglecting the activities specified in the act.

With respect to urban–rural municipalities, no statistically significant relationships were confirmed between the type of regeneration program and the assessment of the significance of the environmental sphere when designating a degraded area.

The described relationships were also examined in aggregate terms (Table 4). No statistically significant relationships were confirmed between the type of municipality and the assessment of the importance of the environmental sphere in demarcating brownfields in urban–rural municipalities (Rs = 0.025; $p = 0.038$).

**Table 4.** Values of the R–Spearman correlation coefficients between the type of a municipality and the assessment of the importance of the environmental sphere in demarcating a brownfield in urban–rural municipalities.

| | Measure | | | |
|---|---|---|---|---|
| Variable | $R_s$ | $t_{(N-2)}$ | $p$ | |
| marking the environmental zone in Polish municipalities | 0.025 | 0.959 | 0.338 | 0.025 |

*—significant value at the significance level $\alpha = 0.05$.

In the course of further analyses, no statistically significant relationships were confirmed between the surface area of green spaces and the assessment of the importance of the environmental sphere in demarcating the degraded area in urban and rural municipalities (Table 5).

**Table 5.** Values of φ-Yule correlation coefficients between the impact of negative environmental phenomena and the surface area of green spaces in urban, rural and urban–rural municipalities.

| | The Impact of Negative Environmental Phenomena | | | |
|---|---|---|---|---|
| Measure | 0 | 1 | 2 | 3 |
| | urban municipalities | | | |
| φ | 0.074 | 0.075 | −0.068 | −0.047 |
| $\chi^2$ | 1.188 | 1.229 | 1.010 | 0.477 |
| p | 0.276 | 0.268 | 0.315 | 0.490 |
| | rural municipalities | | | |
| φ | −0.042 | −0.008 | 0.059 | −0.032 |
| $\chi^2$ | 1.205 | 0.042 | 2.406 | 0.719 |
| p | 0.272 | 0.839 | 0.121 | 0.396 |
| | urban-rural municipalities | | | |
| φ | −0.087 * | −0.047 | 0.110 * | −0.002 |
| $\chi^2$ | 3.867 | 1.141 | 6.166 | 0.002 |
| p | 0.049 | 0.285 | 0.013 | 0.968 |

*—significant value at the significance level $\alpha = 0.05$.

There is a statistically significant correlation between the surface area of green spaces and the lack of importance of the environmental sphere in determining the degraded area in urban–rural municipalities ($\varphi = -0.087$; $\chi^2 = 3.867$; $p = 0.049$). It proves that in municipalities with a larger surface area of green spaces, the lack of influence of negative environmental phenomena is felt significantly less frequently; in turn, we also note a statistically significant correlation between the surface area of green spaces and a moderate (2) assessment of the importance of the environmental sphere when demarcating a degraded area ($\varphi = 0.110$; $\chi^2 = 6.166$; $p = 0.013$). Therefore, in further analysis of this field, the Spearman correlation coefficient was used (Table 6).

There is a statistically significant correlation between the type of municipality and the surface area of green spaces in urban–rural municipalities ($Rs = -0.154$; $p < 0.001$). In rural municipalities, there are significantly more green spaces in regeneration areas. However, the existence of a correlation between the size of green areas and the impact of negative environmental phenomena was not confirmed.

In each of the studied approaches, a statistically significant positive correlation was observed between the impact of negative environmental phenomena and the number of planned environmental projects (Table 7). A higher assessment of threat is associated with a greater number of planned projects.

**Table 6.** Values of R–Spearman correlation coefficients between the impact of negative environmental phenomena and the type of municipality and the surface area of green spaces in urban–rural municipalities.

| | Measure | | |
|---|---|---|---|
| Variable | $R_s$ | $t_{(N-2)}$ | $p$ |
| type of municipality | −0.154 * | −5.900 | 0.000 |
| assessment of the importance of the environmental sphere | 0.012 | 0.459 | 0.646 |

*—significant value at the significance level $\alpha = 0.05$.

**Table 7.** Values of R–Spearman correlation coefficients between the impact of negative environmental phenomena and the surface area of green spaces in urban, rural and urban–rural municipalities.

| | The Impact of Negative Environmental Phenomena | | |
|---|---|---|---|
| Approach | $R_s$ | $t_{(N-2)}$ | $p$ |
| urban | 0.230 * | 3.488 | 0.001 |
| rural | 0.213 * | 4.924 | 0.000 |
| urban-rural | 0.158 * | 4.217 | 0.000 |
| Total | 0.187 * | 7.212 | 0.000 |

*—significant value at the significance level $\alpha = 0.05$.

The research also confirmed a statistically significant, strong, positive relationship between the number of projects planned for implementation in the environmental sphere and those at least started (Rs = 0.523; $p < 0.001$).

## 5. Discussion

The difficulties of small municipalities (urban-rural and rural) in the analysis of the environmental sphere are the result of poor data availability. Analytical requirements in Poland have increased significantly in the last 20 years, especially with regard to the delimitation of regeneration areas.

Poland's accession to the European Union was associated with access to EU funds, including those for the implementation of projects that were to result from urban, post-industrial and post-military regeneration programs. The principles of project eligibility were derived from the requirements specified in the URBAN program. The project had to result from a regeneration program developed for an area in the city of over 20,000 residents who meet at least one of the defined scarcity criteria:

- unemployment rate higher than the national average,
- high level of poverty and difficult living conditions,
- high crime rate,
- low level of education of the inhabitants,
- particularly polluted environment [87].

Regeneration programs could present a diagnosis for the entire municipality, without differentiation in its basic components (districts, housing estates, urban units).

The situation changed in the financial perspective between 2007–2013, when the managing authorities of regional operational programs were given the opportunity to create a regeneration policy by formulating separate guidelines for renewal programs. The criteria for designating brownfield sites (i.e., degraded areas) were derived from Article 47 (1) of Regulation (EC) No 1828/2006:

(a) high levels of poverty and exclusion;
(b) high rate of long-term unemployment;
(c) unfavorable demographic trends;
(d) low level of education, a clear deficit of qualifications and a high dropout rate;
(e) high levels of delinquency and offenses;
(f) a particularly high degree of environmental degradation;

(g) low business activity rate;
(h) high numbers of immigrants, ethnic and minority groups or refugees;
(i) comparatively low value of the housing stock;
(j) low level of energy efficiency of buildings [88].

For area action to be co-financed, an area had to meet at least three of the criteria mentioned, including at least two of the points in a–h. The above-mentioned indicators were to be collected at the national level by member states, and the reference values were agreed with by the European Commission. In Poland, the above-mentioned criteria have been limited to five in the Guidelines of the Ministry of Regional Development on the programming of housing related activities (the original title in Polish: Wytyczne Ministra Rozwoju Regionalnego w zakresie programowania działań dotyczących mieszkalnictwa):

(a) high levels of poverty and exclusion,
(b) high rate of long-term unemployment,
(c) high levels of delinquency and offenses,
(d) low business activity rate,
(e) comparatively low value of the housing stock [89].

Reference indicators have been defined for them at the regional level. Individual regions in Poland used different approaches to demarcating degraded areas, selecting which indicators should be used in relation to particular criteria. Reference values were also often specified.

Currently, after the adoption of the Act on Revitalization, regeneration areas are demarcated on the basis of individually selected indicators [62,90]. The Act specifies the spheres of crisis phenomena analysis and the main scopes of analysis. Municipalities most often analyzed a crisis occurring in the environmental sphere with the use of three indicators:

- percentage of low-emission buildings in the total number of buildings,
- percentage share of buildings connected to the heating network,
- number of buildings per capita containing asbestos that have not been dismantled [91].

Indicator analysis of the level and degree of degradation of the environmental sphere has been rarely undertaken, especially with so many aspects and at the municipal level. The indicators enabling the analysis of the crisis in this sphere were mostly included in the analysis of the crisis of the functional-spatial or technical sphere, and these spheres are intertwined in municipalities.

To analyze crises of the environmental sphere, in the delimitation of both degraded areas and regeneration areas in municipalities, the most frequently used indicators were: the percentage of low-emission buildings in the total number of buildings, water consumption, low-emission heating systems and the surface area of green spaces [91]. As in the case of transport accessibility and spatial order, theoretically there is a lot of data on the quality of the environment at the municipal level, however, it cannot be obtained from the level of public statistics. An example is the number of days in a year when air quality standards are met. Due to the number of measurements, it is possible to obtain these data only at the level of the entire municipality, although it would be desirable to study it with greater diversity. Data in the environmental sphere is poorly available. For example, the data on air pollutant emissions in rural and urban–rural municipalities are often based on only one measuring point. Therefore, it is not possible to conduct an analysis with division into smaller units (basic fields) of air pollutants [45]. On the other hand, the data on energy performance cannot be shown, because only the data for municipal buildings, i.e., only part of the buildings in municipalities, is available. The availability of data is the most important challenge hindering in-depth analysis in Polish regeneration programs [61,64,92]; however, the literature provides detailed formulas on how to conduct analyses with the use of smart city tools in the environmental sphere [70–80,83,85,93]. To make this possible, Poland needs a better information infrastructure. Analytical difficulties mean that the assessment of the impact of environmental projects is based on intuition and general analyses rather than on indicator values. The phenomenon of environmental degradation should be considered,

inter alia, as a result of human economic activity constantly exploiting the environment. This complexity of the phenomenon and such interdependencies were taken into account in the theoretical concept of the Environmental Kuznets Curve, in short EKC [94] According to this approach, the level of pollution increases as income increases, until the latter reaches a certain level, above which the increase in income causes the level of pollution to fall [95]. It is also assumed that the environmental Kuznets curve most often takes the shape of an inverted U letter, which means that at a low level of income, the intensity and degree of environmental degradation are low [96].

In Poland before 1989, environmental issues were of secondary importance. This was related to the development of heavy industry, located in areas exploiting mineral deposits, mainly in the vicinity of large cities [97]. The high degree of industrial concentration and urbanization caused permanent transformations in many areas of Poland at the time. The pro-ecological impact of economic growth in Poland has only been noticeable since 1989. As far back as in 1988, Poland was classified as one of the most polluted countries in Europe; this was related to the emission of sulfur dioxide into the atmosphere (4 million tons in 1988). Currently, there is significant improvement in SO2 concentrations; only in 2017 was there a deterioration in results from the Silesian zone [98]. Environmental regulations in Poland place particular emphasis on reducing carbon dioxide (CO2) emission from the combustion of fossil fuels (mainly hard coal and lignite) [95,99]. A longer perspective (Figure 1) on Poland's economic growth and CO2 emissions are indicated by the shape of the letter U; therefore the EKC hypothesis is not correct [100].

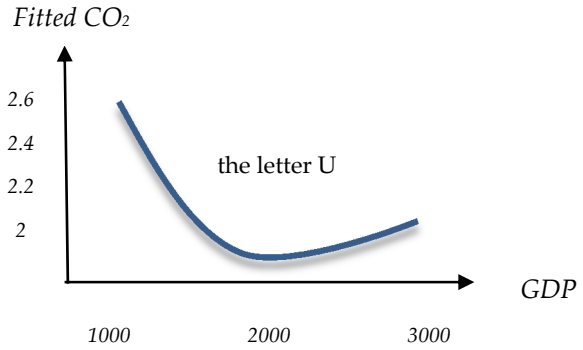


**Figure 1.** EKC hypothesis for Poland, Own study based on [100].

This implies a further area of research in relation to the environmental sphere, because the issues related to the anthropogenic impact of humans on the environment, expressed by the Kuznets curve, are completely unanalyzed with reference to degraded areas. As it has been shown, anthropopression does not decrease, but intensifies; so it is worth examining what data are missing from the intra-city picture, in order to make detailed analyses possible. This, in turn, opens another field for the use of smart city tools.

## 6. Conclusions

On the basis of this study, a number of emerging difficulties concerning the environmental zone, faced by Polish municipalities (urban, rural, urban–rural), were identified. This is of particular diagnostic importance to the environmental sphere of regeneration programs, as well as for the advancement of the smart city. The authors of this study note that the key determinant of demarcating degraded areas (and, consequently, regeneration areas) was negative phenomena in the social sphere. Secondly, the environmental sphere, despite its increasing importance, is often overlooked, especially in degraded areas. At the same time, it was noticed that a city can be treated as "smart" when it undertakes investments not only in social capital and infrastructure, but also in the environmental sphere, especially in degraded areas. Thirdly, thanks to the analysis of the relationships between environmental assessment when designating a degraded area and the type of renewal program, as well as the type of municipality, the importance of the environmental sphere

when designating a degraded area and the number of planned environmental projects in individual municipalities, a characterization of the environmental aspects in regeneration programs in Poland was made. The conducted research confirmed that analysis of the level and degree of degradation of the environmental sphere is not undertaken frequently in municipalities, which is related to the poor availability of data. For the same reason, it is still rare in Polish conditions to use smart city tools in order to analyze environmental phenomena. This often results in the randomness or wishfulness of undertaken investment projects in the environmental sphere. Small municipalities, especially, face difficulties in accessing environmental data in terms of intra-city diversity. The current laws in Poland stimulate proper consideration of environmental issues in these analyses; the problem is data availability. Therefore, we recommend the creation of as many measurement points as possible. Due to the need to expand them, it would be worth analyzing, in separate research, what forms of anthropopressure on the environment should be studied (air pollution, greenhouse gas emissions, etc.).

**Author Contributions:** Conceptualization, A.J.-S., K.O.-S. and M.D.; methodology, K.O.-S., M.D.; software, A.J.-S., K.O.-S. and M.D.; validation, A.J.-S., K.O.-S. and M.D.; formal analysis, A.J.-S. and K.O.-S.; investigation A.J.-S., K.O.-S. and M.D.; resources, A.J.-S., K.O.-S. and M.D.; data curation, A.J.-S., K.O.-S. and M.D.; writing—original draft preparation A.J.-S., K.O.-S. and M.D.; writing—review and editing, A.J.-S., K.O.-S. and M.D.; visualization, A.J.-S., K.O.-S. and M.D.; supervision, A.J.-S., K.O.-S. and M.D project administration, A.J.-S., K.O.-S. and M.D.; funding acquisition, K.O.-S. and M.D All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Palicki, S. *Rewitalizacja Miast. Perspektywa Rynku Nieruchomości Mieszkaniowych*, 1st ed.; Wydawnictwo Uniwersytetu Ekonomicznego w Poznaniu: Poznań, Poland, 2020.
2. Swyngedouw, E.; Moulaert, F.; Rodriguez, A. Neoliberal Urbanization in Europe: Large-Scale Urban Development Projects and the New Urban Policy. *Antipode* **2002**, *34*, 547–582. [CrossRef]
3. Allen, T. The Politics of Regeneration. *Hous. Theory Soc.* **2001**, *18*, 136–147. [CrossRef]
4. Andree, D. Europäische Stadtpolitik und lokale Massarbeit. Integrierte Stadtentwicklung im Rahmen Europäischer Strukturpolitik am Beispiel von Luckenwalde. Masterthesis am Institut für Stadtund Regional Planning, Institut für Soziologie der Technischen Universität, Berlin, Germany, 2004.
5. Kaczmarek, S. *Demolowanie w Kontekście Teorii Rewitalizacji Miast*, 1st ed.; Wydawnictwo Uniwersytetu Łódzkiego: Lodz, Poland, 2019.
6. Herbst, I.; Jadach-Sepioło, A. Modele rewitalizacji miast w Polsce—Ocena założeń. In *Rewitalizacja Miast Polskich—Diagnoza*, 1st ed.; Ziobrowski, Z., Jarczewski, W., Eds.; Instytut Rozwoju Miast: Krakow, Poland, 2010; pp. 191–228.
7. Jadach-Sepioło, A. *Model Rewitalizacji Miast Polskich na tle Doświadczeń Niemieckich*, 1st ed.; Instytut Rozwoju Miast i Regionów: Krakow, Poland, 2021.
8. Van den Berg, L.; Braun, E.; van der Meer, J. *National Policy Responses to Urban Challenges in Europe*, 1st ed.; Ashgate: Rotterdam, The Netherlands, 2007.
9. Jacquier, C. On Relashionship between Integrated Policies for Sustainable Development and Urban Governance. *Tijdschr. Econ. Soc. Geogr.* **2005**, *96*, 363–376. [CrossRef]
10. Roberts, P.; Skyes, H. *Urban Regeneration: A Handbook*; British Urban Regeneration Association; SAGE Publications: London, UK, 2000.
11. Couch, C. *Urban Renewal: Theory and Practice*; Macmillan: London, UK, 1990.
12. Holland, B. Typologies of national urban policy: A theoretical analysis. *Cities* **2015**, *48*, 125–129. [CrossRef]
13. Sagan, I. *Miasto: Nowa kwestia i Nowa Polityka*, 1st ed.; Wydawnictwo Naukowe Scholar: Warsaw, Poland, 2018.
14. Andersson, R.; Musterd, S. Area-based Policies: A Cirtical Appraisal. *Tijdschr. Econ. Soc. Geogr.* **2005**, *96*, 377–389. [CrossRef]

15. Herbst, I. Warunki finansowania procesów rewitalizacji w gospodarce rynkowej. In *Finansowanie i Gospodarka Nieruchomościami w Procesach Rewitalizacji*, 1st ed.; Bryx, M., Ed.; Instytut Rozwoju Miast: Krakow, Poland, 2010; pp. 117–156.
16. Cameron, S.; Doling, J. Housing Neighborhoods and Urban Regeneration. *Urban Stud.* **1994**, *31*, 1211–1223. [CrossRef]
17. Fisher, E.M. Aspects of Zoning, Blighted Areas and Rehabilitation Laws. *Am. Econ. Rev.* **1942**, *32*, 331–340.
18. Chronopoulos, T. Robert Moses and the Visual Dimension of Physical Disorder: Efforts to Demonstrate Urban Blight in the Age of Slum Clearance. *J. Plan. Hist.* **2014**, *13*, 207–233. [CrossRef]
19. Gordon, C. Blighting the way: Urban renewal, economic development, and the elusive definition of blight. *Urban Law J.* **2004**, *32*, 308–314.
20. Andritzky, M. Stadtsanierung oder Stadtzerstörung? In *Urbanistik—Neue Aspekte der Stadtentwicklung*, 1st ed.; Glaser, H., Ed.; Verlag C.H. Beck: München, Germany, 1974.
21. Verkasalo, A.; Hirvonen, J. Post-war urban renewal and demolition fluctuations in Sweden. *Plan. Perspect.* **2017**, *32*, 425–435. [CrossRef]
22. Linehan, D. An archaeology of dereliction: Poetics and policy in the governing of depressed industrial districts in interwar England and Wales. *J. Hist. Geogr.* **2000**, *26*, 99–114. [CrossRef]
23. De Marco, M. Welcome to the neighborhood: Does where you live affect the use of nutrition, health and welfare programs? *J. Sociol. Soc. Welf.* **2009**, *36*, 141–166.
24. Glass, R. *London: Aspects of Change*; MacGibbon & Kee: London, UK, 1964.
25. Smith, N.; Williams, P. *Gentrification of the City*; Allen and Unwin: Boston, MA, USA, 1986.
26. Atkinson, R.; Bridge, G. *Gentrification in a Global Context. The New Urban Colonialism*, 1st ed.; Routledge: London, UK, 2005.
27. Lees, L.; Slater, T.; Wyly, W. *Gentrification*, 1st ed.; Routledge: London, UK, 2008.
28. Jadach-Sepioło, A. 2009, Gentryfikacja w kontekście rewitalizacji. In *Demograficzne i Społeczne Uwarunkowania Rewitalizacji Miast w Polsce*, 1st ed.; Zborowski, A., Ed.; Instytut Rozwoju Miast: Krakow, Poland, 2008; pp. 125–135.
29. Adekola, P.; Azuh, D.; Adeloye, D.; Amoo, E. Urban renewal in Nigeria: A slash and burn approach? *Environ. Dev. Sustain.* **2019**, *21*, 2165–2182. [CrossRef]
30. Nwanna, C.R. Gentrification in Lagos State: Challenges and prospects. *Br. J. Arts Soc. Sci.* **2012**, *5*, 163–176.
31. Sundaram, M.A. Urban green-cover and the environmental performance of Chennai city. *Environ. Dev. Sustain.* **2011**, *13*, 107–119. [CrossRef]
32. Lin, K.-L. Determining Key Ecological Indicators for Urban Land Consolidation. *Int. J. Strateg. Prop. Manag.* **2010**, *14*, 89–103. [CrossRef]
33. Dale, A.; Newman, L. Sustainable development for some: Green urban development and affordability. *Local Environ.* **2009**, *14*, 669–681. [CrossRef]
34. Gołąb-Korzeniowska, M. Czynnik środowiskowy w programach rewitalizacji miejskiej, Czasopismo Techniczne. *Architektura* **2012**, *109*, 319–325.
35. Zheng, H.W.; Shen, G.Q.; Wang, H. A review of recent studies on sustainable urban renewal. *Habitat Int.* **2014**, *41*, 272–279. [CrossRef]
36. Burinskine, M.; Bielinskas, V.; Podviezko, A.; Gurskiene, V.; Maliene, V. Evaluating the Significance of Criteria Contributing to Decision-Making on Brownfield Land Redevelopment Strategies in Urban Areas. *Sustainability* **2017**, *9*, 759. [CrossRef]
37. Rădulescu, C.M.; Rădulescu, G.M.T.; Rădulescu, A.T.G.M.; Rădulescu, M.V.G.M.; Ştefan, O. Consideration on the contribution of GIS urban regeneration management of brownfield sites. *Proc. Int. Multidiscip. Sci. GeoConf. SGEM* **2016**, *3*, 135–142.
38. Yildiz, S.; Kivrak, S.; Arslan, G. Contribution of built environment design elements to the sustainability of urban renewal projects: Model proposal. *J. Urban Plan. Dev.* **2019**, *145*. [CrossRef]
39. Hemphill, L.; Berry, J.; McGreal, S. An Indicator-based Approach to Measuring Sustainable Urban Regeneration Performance: Part 1, Conceptual Foundations and Methodological Framework. *Urban Stud.* **2004**, *41*, 725–755. [CrossRef]
40. Imrie, R.; Thomas, H. Changes in Local Governance and Their Implications for Urban Policy Evaluation. In *Urban Policy Evaluation: Challenge and Change*; Hambeton, R., Thomas, H., Eds.; Paul Chapman Publishing: London, UK, 1995; pp. 123–138.
41. Oatley, N. Urban regeneration. *Plan. Pract. Res.* **1995**, *10*, 261–269. [CrossRef]
42. Bristow, H. Developing the tools to measure success. *Urban Environ. Today* **1999**, *62*, 13.
43. Brownhill, D.; Rao, S. *A Sustainability Checklist for Developments: A Common Framework for Developers and Local Authorities*; CRC Ltd.: Watford, UK, 2002.
44. Janas, K.; Jarczewski, W.; Wańkowicz, W. *Model Rewitalizacji Miast*; Instytut Rozwoju Miast: Krakow, Poland, 2010.
45. Jadach-Sepioło, A.; Spadło, K.; Kułaczkowska, A. *Monitorowanie Procesów Rozwoju na Poziomie Wewnątrzmiejskim*; Instytut Rozwoju Miast i Regionów: Warsaw, Poland, 2020.
46. Guo, R.; Song, X.; Li, P.; Wu, G.; Guo, Z. Large-Scale and Refined Green Space Identification-Based Sustainable Urban Renewal Mode Assessment. *Math. Probl. Eng.* **2020**, *2020*, 12. [CrossRef]
47. Bansal, V.; Bansal, S.; Sen, J. Assessing the role of urban design in a rapidly urbanizing historical city and its contribution in restoring its urban ecology: The case of Varanasi, India. In *Urban Ecology. Emerging Patterns and Social-Ecological Systems*; Verma, P., Singh, P., Singh, R., Raghubanshi, A., Eds.; Elsevier: Amsterdam, The Netherlands, 2020; pp. 413–434.
48. Akotia, J.; Opoku, A.; Egbu, C.; Fortune, C. Exploring the knowledge 'base' of practitioners in the delivery of sustainable regeneration projects. *Constr. Econ. Build.* **2016**, *16*, 14–26. [CrossRef]

49. Carpenter, J. Money's too tight to mention? Urban regeneration in a recession and beyond: The case of Oxford. *J. Urban Regen. Renew.* **2011**, *4*, 228–239.
50. Lombardi, D.R.; Porter, L.; Barber, A.; Rogers, C.D.F. Conceptualising Sustainability in UK Urban Regeneration: A Discursive Formation. *Urban Stud.* **2011**, *48*, 273–296. [CrossRef]
51. Howes, M.; Davidson, J.; Dedekorkut-Howes, A.; Nunn, P.; Potts, R.; Serrao-Neumann, S.; Smith, T.; Wortley, L. Environmental Sustainability: A Case of Policy Implementation Failure? *Sustainability* **2017**, *9*. [CrossRef]
52. Estrada, E.; Rocio, M.; Ochoa, A.; Bernabe-Loranca, B.; Oliva, D.; Larios, V. Smart City Visualization Tool for the Open Data Georeferenced Analysis Utilizing Machine Learning. *Int. J. Comb. Optim. Probl. Inform.* **2018**, *9*, 25–40.
53. Garau, C.; Pavan, V.M. Evaluating Urban Quality: Indicators and Assessment Tools for Smart Sustainable Cities. *Sustainability* **2018**, *10*. [CrossRef]
54. Hemphill, L.; McGreal, S.; Berry, J. An Indicator-based Approach to Measuring Sustainable Urban Regeneration Performance: Part 2, Empirical Evaluation and Case-study Analysis. *Urban Stud.* **2004**, *41*, 757–772. [CrossRef]
55. CLG. *Transforming Places; Changing Lives: A framework for regeneration. Communities and Local Government (CLG)*; Her Majesty's Stationery Office: London, UK, 2008.
56. Lambrechts, W.; Mitchell, A.; Lemon, M.; Mazhar, M.U.; Ooms, W.; van Heerde, R. The Transition of Dutch Social Housing Corporations to Sustainable Business Models for New Buildings and Retrofits. *Energies* **2021**, *14*, 631. [CrossRef]
57. Chahardowli, M.; Sajadzadeh, H.; Aram, F.; Mosavi, A. Survey of Sustainable Regeneration of Historic and Cultural Cores of Cities. *Energies* **2020**, *13*, 2708. [CrossRef]
58. La Rosa, D.; Riccardo, P.; Barbarossa, L.; Greca, P.L. Assessing spatial benefits of urban regeneration programs in a highly vulnerable urban context: A case study in Catania, Italy. *Landsc. Urban Plan.* **2017**, *157*, 180–192. [CrossRef]
59. Dixon, T. Integrating Sustainability into Brownfield Regeneration: Rhetoric or Reality? An analysis of the UK Development Industry. *J. Prop. Res.* **2006**, *23*, 237–267. [CrossRef]
60. Brandon, P.S.; Lombardi, P. *Evaluating Sustainable Development: In the Built Environment*, 2nd ed.; Wiley and Sons Publication: London, UK, 2011.
61. Jadach-Sepioło, A. (Ed.) *Badanie Systemu Zarządzania i Wdrażania Procesów Rewitalizacji w Polsce*; Ministerstwo Funduszy i Polityki Regionalnej: Warsaw, Poland, 2020.
62. Ustawa z dnia 9 października 2015 r. o rewitalizacji (t.j. Dz.U. z 2020 r. poz. 802, 1086). Available online: http://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20150001777/U/D20151777Lj.pdf (accessed on 22 July 2021).
63. Bal-Domańska, B.; Buciak, R. *Dane Statystyczne z Zakresu Rewitalizacji na Poziomie Gmin. Raport Końcowy*; Główny Urząd Statystyczny: Warsaw, Poland, 2018.
64. Jadach-Sepioło, A. (Ed.) *Ewaluacja Systemu Zarządzania i Wdrażania Procesów Rewitalizacji w Polsce*; Instytut Rozwoju Miast i Regionów: Krakow, Poland, 2021.
65. Carbonaro, G.; D'Arcy, E. Key issues in property-led urban restructuring: A European perspective. *J. Prop. Valuat. Invest.* **1993**, *11*, 339–353. [CrossRef]
66. ODPM. *Sustainable Communities: Building for the Future*; ODPM: London, UK, 2003.
67. Wong, C. Indicators in use: Challenges to urban and environmental planning in Britain. *Town Plan. Rev.* **2000**, *71*, 213–239. [CrossRef]
68. Hemphill, L.A.; Berry, J.N.; McGreal, W.S. An aggregated weighting system for evaluating sustainable urban regeneration. *J. Prop. Res.* **2002**, *19*, 353–373. [CrossRef]
69. European Commission. The European Green Deal. Available online: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en (accessed on 18 June 2021).
70. Anderson, J.E.; Wulfhorst, G.; Land, W. Energy analysis of the built environment—A review and outlook. *Renew. Sustain. Energy Rev.* **2015**, *44*, 149–158. [CrossRef]
71. Hachem, C. Impact of neighbourhood design on energy performance and GHG emissions. *Appl. Energy* **2016**, *177*, 422–434. [CrossRef]
72. Crilly, M.; Lemon, M.; Wright, A.J.; Cook, M.B.; Shaw, D. Retrofitting homes for energy efficiency: An integrated approach to innovation in the low-carbon overhaul of UK social housing. *Energy Environ.* **2012**, *23*, 1027–1055. [CrossRef]
73. Long, Y.; Yoshida, Y.; Fang, K.; Zhang, H.; Dhont, M. City-level household carbon footprint from purchaser point of view by a modified input-output model. *Appl. Energy* **2019**, *236*, 379–387. [CrossRef]
74. Song, X.; Guo, R.; Xia, T.; Guo, Z.; Long, Y.; Zhang, H.; Song, X.; Ryosuke, S. Mining urban sustainable performance: Millions of GPS data reveal high-emission travel attraction in Tokyo. *J. Clean. Prod.* **2020**, *242*, 118396. [CrossRef]
75. Cramer, J. The transition towards sustainable cities: The Dutch experiences. In *Eco-Cities: Sharing European and Asian Best Practices and Experiences*; Konrad Adenauer Stiftung: Singapore, 2014; pp. 169–177.
76. Boulton, C.; Dedekorkut-Howes, A.; Byrne, J. Governance Factors Shaping Greenspace Provision: From Theory to Practice. *Plan. Theory Pract.* **2021**, *22*, 27–50. [CrossRef]
77. Boulton, C.; Dedekorkut-Howes, A.; Holden, M.; Byrne, J. Under pressure: Factors shaping urban greenspace provision in a mid-sized city. *Cities* **2020**, *106*, 102816. [CrossRef]

78. Sainz-Santamaría, J.; Martinez-Cruz, A.L. Governance of Urban Green Spaces across Latin America—Insights from Semi-Structured Interviews to Managers Amid COVID-19. *CERE Work. Pap.* **2021**, *3*. Available online: https://ssrn.com/abstract=3782285 (accessed on 14 July 2021).
79. Appio, F.P.; Lima, M.; Paroutis, S. Understanding Smart Cities: Innovation ecosystems, technological advancements, and societal challenges. *Technol. Forecast. Soc. Chang.* **2019**, *142*, 1–14. [CrossRef]
80. Yigitcanlar, T.; Kamruzzaman, M.; Foth, M.; Sabatini-Marques, J.; da Costa, E.; Ioppolo, G. Can cities become smart without being sustainable? A systematic review of the literature. *Sustain. Cities Soc.* **2019**, *45*, 348–365. [CrossRef]
81. Sharifi, A. A critical review of selected smart city assessment tools and indicator sets. *J. Clean. Prod.* **2019**, *233*, 1269–1283. [CrossRef]
82. Sharifi, A. A global dataset on tools, frameworks, and indicator sets for smart city assessment. *Data Brief* **2020**, *29*, 105364. [CrossRef]
83. Tatar, M.; Kalvet, T.; Tiits, M. Cities4ZERO Approach to Foresight for Fostering Smart Energy Transition on Municipal Level. *Energies* **2020**, *13*, 3533. [CrossRef]
84. Jadach-Sepioło, A.; Krystek-Kucewicz, B.; Kaszuba, K. Ewolucja podejść do wskaźnikowego wyznaczania obszarów rewitalizacji. *Studia KPZK PAN* **2018**, *192*, 31–82.
85. Lucchi, E.; D'Alonzo, V.; Exner, D.; Zambelli, P.; Garegnani, G. A Density-Based Spatial Cluster Analysis Supporting the Building Stock Analysis in Historical Towns. In Proceedings of the 16th IBPSA International Conference and Exhibition, San Francisco, CA, USA, 25–27 September 2019. [CrossRef]
86. Szajt, M. *Przestrzeń w Badaniach Ekonomicznych*; SWWZPCz: Czestochowa, Poland, 2014.
87. Siemiński, W.; Topczewska, T. *Rewitalizacja Miast w Polsce Przy Wsparciu Funduszami UE w Latach 2004–2008*; Difin: Warsaw, Poland, 2009.
88. Rozporządzenie Komisji (WE) nr 1828/2006 z dnia 8 grudnia 2006 r. ustanawiające szczegółowe zasady wykonania rozporządzenia Rady (WE) nr 1083/2006 ustanawiającego przepisy ogólne dotyczące Europejskiego Funduszu Rozwoju Regionalnego, Europejskiego Funduszu Społecznego oraz Funduszu Spójności oraz rozporządzenia (WE) nr 1080/2006 Parlamentu Europejskiego i Rady w sprawie Europejskiego Funduszu Rozwoju Regionalnego. Available online: https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:02006R1828-20100625&from=PL (accessed on 18 June 2021).
89. Ministerstwo Rozwoju Regionalnego. *Wytyczne Ministra Rozwoju Regionalnego w Zakresie Programowania Działań Dotyczących Mieszkalnictwa*; MRR: Warsaw, Poland, 2008.
90. Ministerstwo Rozwoju. Wytyczne Ministerstwa Rozwoju w Zakresie Rewitalizacji w Programach Operacyjnych na Lata 2014–2020, Warsaw. 2016. Available online: https://www.funduszeeuropejskie.gov.pl/strony/o-funduszach/dokumenty/wytyczne-w-zakresie-rewitalizacji-w-programach-operacyjnych-na-lata-2014-2020/ (accessed on 18 June 2021).
91. Lokalny Program Rewitalizacji Gminy Dobiegniew do 2023 r., Załącznik do Uchwały nr XLIII/252/18 rady Miejskiej w Dobiegniewie z dnia 24 maja 2018 r., s. 66. Available online: http://www.dobiegniew.pl/download/news/LokalnyProgramRewitalizacji.pdf (accessed on 18 June 2021).
92. Turek, A.; Jaroszewicz, J. Concept of a geographic information system for the purposes of spatial planning of degraded areas. In Proceedings of the 14th SGEM GeoConference on Informatics, Geoinformatics and Remote Sensing, Albena, Bulgaria, 17 June 2014; pp. 521–528.
93. Kauko, T. How to pick relevant sustainability criteria for the built environment: A bottom-up approach. *Urbanism Arhit. Construcţii* **2019**, *10*, 11–22.
94. Genstwa, N. Środowiskowa krzywa Kuznetsa: Przegląd teoretyczno-metodyczny. *Rozw. Reg. Polityka Reg.* **2020**, *49*, 39–50. [CrossRef]
95. Jankowska, E. Środowiskowa krzywa Kuznetsa w dekarbonizacji europejskich gospodarek. *Studia Ekonomiczne Zesz. Nauk. Uniw. Ekon. Katowicach* **2016**, *289*, 51–61.
96. Gruszecki, L.; Jóźwik, B. Teoretyczne rekonstrukcje środowiskowej krzywej Kuznetsa. *Gospod. Nar.* **2019**, *299*, 95–117. [CrossRef]
97. Dwilewicz, Ł. Polityka państwa polskiego wobec przemysłu 1918–2018. *Kwart. Kol. Ekon. Społecznego Studia I Pr.* **2018**, *35*, 61–80.
98. Kobus, D.; Iwanek, J.; Skotak, K. *Ocena Jakości Powietrza w Strefach w Polsce za rok 2019, Zbiorczy Raport Krajowy z Rocznej Oceny Jakości Powietrza w Strefach Wykonanej Przez GIOŚ Według Zasad Określonych w Art. 89 Ustawy-Prawo Ochrony środowiska*; Główny Inspektorat Ochrony Środowiska: Warsaw, Poland, 2020.
99. Piłatowska, M.; Włodarczyk, A.; Zawada, M. The Environmental Kuznets Curve in Poland—Evidence from Threshold Cointegration Analysis. *Dyn. Econom. Models* **2014**, *14*, 51–70. [CrossRef]
100. Piłatowska, M.; Włodarczyk, A. The environmental Kuznets curve in the CEE countrie—The threshold cointegration approach. *Argum. Oeconomica* **2017**, *39*, 307–340. [CrossRef]