land

MDPI

Article

Emergence of Centralized (Collective) and Decentralized (Individual) Environmentally Friendly Solutions during the Regeneration of a Residential Building in a Post-Socialist City

Josef Navrátil [1,*], Petr Klusáček [2], Stanislav Martinát [3] and Petr Dvořák [4]

[1] Faculty of Natural Sciences, Institute of Social and Economic Geography and Spatial Management, University of Silesia in Katowice, Będzińska 60, 41-205 Sosnowiec, Poland
[2] Department of Regional Development, Faculty of Regional Development and International Studies, Mendel University, třída Generála Píky 2005/7, 613 00 Brno, Czech Republic; petr.klusacek@mendelu.cz
[3] Department of Geography, Faculty of Science, Palacký University in Olomouc, 17. listopadu 12, 771 46 Olomouc, Czech Republic; stanislav.martinat@upol.cz
[4] Department of Social Geography and Regional Development, Faculty of Science, University of Ostrava, Chittussiho 10, 710 00 Ostrava, Czech Republic; petr.dvorak@osu.cz
* Correspondence: josef.navratil@us.edu.pl

Abstract: Our paper deals with a micro-study of one residential building in the city center of Brno (Czech Republic) where we strived to identify and better understand the main factors behind the successful implementation of environmentally friendly solutions during the regeneration process. We followed the unique, complicated, and often conflictual story of the regeneration (conducted during the years 2010–2020) of the residential building, which was originally built in the 1930s. In total, 18 solutions were discussed—all four solutions on the state level of centralization were realized, only two of six solutions on the building level of centralization were materialized, and six of eight decentralized solutions were realized during the regeneration process. In the field of energy savings requiring high investments, a significant dominance of centralized solutions (on the state level) was identified. Centralized solutions on the building level such as heat pumps or solar panels were not realized. In the area of waste management and care for community greenery (that did not require large investments), we see as the most beneficial the promotion of decentralized solutions in the form of community-funded communal composting or the planting of new greenery. The formation of various regeneration options, which is discussed in detail, appeared as an integral instrument for dealing with conflicts among residents during the planning phase.

Keywords: regeneration; decentralization; post-socialist city; environmentally friendly technologies; greening; Eastern Europe

Citation: Navrátil, J.; Klusáček, P.; Martinát, S.; Dvořák, P. Emergence of Centralized (Collective) and Decentralized (Individual) Environmentally Friendly Solutions during the Regeneration of a Residential Building in a Post-Socialist City. *Land* **2021**, *10*, 524. https://doi.org/10.3390/land10050524

Academic Editors: Anna Winiarczyk-Raźniak and Lucia Della Spina

Received: 23 March 2021
Accepted: 11 May 2021
Published: 13 May 2021

1. Introduction

Cities in the modern era were formed through the centralization of many areas, whether in architecture [1], urban planning [2], or the everyday life of its inhabitants [3]. On the other hand, the postmodern era is characterized by decentralization efforts in cities [4]. The degree of urban system centralization varies among geographical realms and national contexts [5]. A particularly special case is the cities of Central and Eastern Europe where enormous dynamics occurred in the last three decades [6–8]. However, since the fall of the Iron Curtain, substantial changes in urban development have emerged [9] and individual solutions at the expenses of collective solutions widely spread out [10,11]. One of the disadvantages of socialist systems managed via a centrally planned economy was their overall low effectiveness [12], whose effects might be clearly visible in the many post-socialist cities dealing with unsuitable housing conditions until today [13,14]. The problems of these cities are varied [15] and are especially related to underfunded, neglected, and dilapidated residential housing built in the pre-WW2 period [16].

These residential buildings are far from up-to-date living standards [17]. This is true especially regarding their energy consumption [18,19], which goes hand in hand with other environmentally friendly issues such as sanitation, water management, waste management, and the overall greening of urban spaces [20]. Environmentally friendly solutions for "old" buildings are especially desired and urgently needed in the poor neighborhoods of large cities [21] and surely are activities in the public interest [22], which is why more or less generous subsidy programs are offered by states [23] or particular cities. On the other hand, it is important to note that the adoption of environmentally friendly solutions for "old" buildings is principally voluntary, that is, not demanded directly by the state [24], and subsidies are collective or centralized. Even though there are subsidy programs for adopting environmentally friendly solutions [21], the cost of adopting such measures is still high [25], the profitability of adopting such measures is only on a long timeframe [21], and, for the owners and/or tenants of the apartments, the buildings themselves are viewed as a commons [26]. As it not only a question of "environmental" issues but also "economic" ones, adopting environmentally friendly solutions in residential buildings can also be viewed as a process of gentrification [27]. That is why conflict frequently arises among owners and/or tenants regarding the adoption of these solutions, and their realization is a question of the different and sometimes contradictory views, visions, and wider interests of stakeholders [25].

The main objective of our paper is to identify the principal factors affecting the successful implementation of centralized (collective) and decentralized (individual) environmentally friendly solutions during the regeneration process of a residential building. This case study is a micro-study of the regeneration process of a residential building in the city center of Brno, Czech Republic, which took place between 2010 and 2020.

To better specify what we mean by environmentally friendly solutions for residential buildings in our study, we defined these as any technological measure that can result in lowering the negative impact of housing on its environment during the regeneration process [28,29].

2. Conceptual Background

2.1. Environmentally Friendly Solutions for Residential Buildings and Its Adoption

The process of "greening" of the housing sector is one the most important ways to in progressing toward urban sustainable development [30], and there are many diverse solutions regarding how to transform the housing sector to be environmentally friendlier [31–33]. Substantial research was undertaken so far especially regarding the usage of energy sources, energy consumption, heating, and/or cooling of the inner environment, water heating, and energy savings of the residential buildings [34] as a consequence of the urgent need to mitigate the direct impact on the level of emissions of greenhouse gases and climate change [35].

Some environmentally friendly solutions for sustainable energy consumption (including the use of energy sources for heating/cooling of the inner environment and water heating) were already separately analyzed in depth: residential air-conditioning [36], various sources for residential heating [28,32,37], photovoltaics [38], solar thermal systems [28], and heat pumps [28]. Hand in hand with the variety of energy resources and energy consumption, the possibility for energy storage including thermal energy storage systems [39] and electric storage [28] is also studied.

Energy-saving issues of the residential buildings compromise insulation [28], high-performance windows [28], ventilation (with heat recovery) [40], and building automation and smart metering [28,41].

Although the energy-related issues are predominantly studied [29,42], other environmentally friendly solutions for residential buildings are also important for lowering the negative environmental impacts of housing [34]. They can be divided into three main types of technologies—waste management [31], greening [43], and water management [33].

Waste management is dealing with two different topics—residential food waste handling and composting [31,44,45] and graywater recycling [30,35]. Greening of urban space connected with construction of residential houses or their regeneration has also a wide variety of expressions starting with green roofs [24,46], environmentally friendly residential gardens [43,47], and for example with urban beekeeping [48]. Water management is focused (besides wastewater management) on rain- and stormwater management [33,49–51].

The above-mentioned topics of environmentally friendly solutions for residential buildings will serve us as the classification for areas of environmentally friendly solutions in our study (please see Table 1):

- Source of energy for heating and hot water,
- Energy savings,
- Waste management,
- Greenery and water management.

Table 1. Environmentally friendly solutions under study as discussed by stakeholders during the regeneration process.

Area of Environmentally Friendly Solutions	Centralized (Collective) Solutions Influenced by Urban, State, and EU Policies	Centralized Solutions at the Building Level	Decentralized (Individual) Solutions for One Owner or Groups of Owners
1. Source of energy for heating and hot water	1.1 Replacement of the building heat exchanger station	1.2 Disconnection from Brno heating plants and use of new gas heating 1.3 Disconnection from Brno heating plants and investments in a building heat pump	1.4 Modernization of individual hot water heating systems using gas or electricity in individual apartments 1.5 Separate gas heating of three new apartments under the roof 1.6 Rooftop solar collectors for generation of hot water
2. Energy savings	2.1 Insulation of the building's outer envelope and replacement of old windows with new plastic windows	2.2 Installation of remote heat readings and thermovalves in residential units 2.3 Replacement of older, central heating distribution within the building, and old cast iron heaters in housing units with new ones	2.4 Refurbishment of wooden castle windows and installation of aluminum windows with a hidden frame 2.5 Window blinds in apartments under roof
3. Waste management	3.1 New place for urban waste (garbage) bins	3.2 Building level plastic composters	3.3 Two-chamber sheet metal insulated composter
4. Greenery and water management	4.1 Possibility to use playgrounds and greenery in city parks regenerated by the use of EU funds	4.2 Green roofs 4.3 Water harvesting system	4.4 Small regeneration activities with a focus on leisure activities 4.5 Planting of new greenery

Diversified environmentally friendly solutions are (as discussed above) developing hand in hand with upgrading residential buildings toward sustainability [30]. Demand-side actors deciding about the adoption of environmentally friendly solutions are truly central to the diffusion of pro-environmental technologies into housing sector [52]. However, the actual technical potential is far from being fully utilized [30]. Enormous efficiency gaps are occurring as a consequence of severe obstacles that are usually (but not exclusively) of economic origin as are high investments, a lack of economic incentives, long payback periods, difficulties in accessing financing, financial limitations of owners, and investment risks [29]. Even if environmentally friendly technologies are implemented, such investments can certainly lead to problems, for example, with energy poverty [53] and to a deepening of gentrification and segregation processes in cities [27,54].

We already know that such intervention in environmentally friendly technologies for mass housing requires the acceptance of all concerned parties, causing a variety of possibly conflictual situations [55] because of the different power and interests of individual groups of stakeholders [29,52]. This process results in the not uniform but rather highly differentiated level of adoption of various environmentally friendly solutions [29]. Barriers for adoption differentiate among particular solutions and countries; the most distinctive differences were detected (besides Belgium) for post-socialist Poland [28]. We may say that general environmental awareness among the population in post-socialist countries is significantly lower [56] in comparison to the situation in western Europe, which stipulates

the negotiations within the groups involved in environmentally friendly regeneration projects even more difficult [57]. The post-socialist legacy [58,59] connected to a low level of trust within society seems to be one of the major obstacles in advancing with innovative environmentally friendly projects [56] and was evident in the transformation of housing estates in post-socialist cities [60–64].

These previous findings lead us to hypothesize that the level of adoption concerning various environmentally friendly solutions differs from one to the other (Hypothesis 1).

2.2. Centralized and Decentralized Residential Building Regeneration in Post-Socialist Urban Space

Under state socialism in the Czech Republic, the largest number of government investments were primarily directed at the extensive development of heavy industries and a build-up in prefabricated housing estates for workers [15]. These prefabricated housing estates were supported starting in the mid-1950s as a modern collective housing solution, where new "socialistic" relations among the residing people would arise [60]. This type of housing is typified by highly unbalanced level of technical quality in the buildings and their poor energy efficacy [65]. Following the fall of the Iron Curtain in the late 1980s, the country's cities underwent a complex process of multiple transformations [12]. Funding for the regeneration of the neglected housing stock first originated privately from the residents themselves, who were allowed to buy their apartments for set, non-market prices during the process of housing stock privatization [66]. Real, large-scale urban housing regenerations began only in the new millennium [60]. Following the EU accession in 2004, the inflow of European money was enormously important in terms of introducing, implementation, and further support for new innovative urban concepts such as creative cities [67,68], smart cities [69,70], green cities [71,72], or culture-led urban regenerations [73]. Numerous urban planning documentation has since been widely expanded and redefined; however, strong influences from a centralized (city) level on the housing regeneration possibilities are clearly visible [6,74].

Moreover, the EU money has recently been directed especially at upgrades dealing with environmental conditions, such as the adaptation of the housing stock to ongoing climate change or accommodation of energy-saving measures. One of the main driving forces behind residential building renovations in the Czech Republic at the beginning of the new millennium has been the introduction of energy performance certificates (according to the Act 406/2000). This act and its amendments substantially influenced the possibilities of dealing with housing regenerations from a centralized (national) level. Although a direct effect on property prices was not proved [75], it influenced the technical condition for obtaining subsidies for the implementation of environmentally friendly solutions at the most centralized (national) level.

Financial subsidies for environmentally friendly solutions were enabled by a program called the "Green Savings Programme", which started in 2009 and was renewed in 2013 (the condition details were changed many times), and it is funded via revenues from the sale of European Union Allowance and European Union Aviation Allowance units. In addition to investments into the building of new environmentally friendly residential family homes and buildings, it is also aimed at environmental friendly solutions for "old" residential buildings including thermal insulation of the facade, roof, and ceiling; replacement of windows and doors; solar thermal and photovoltaic systems; green roofs; use of heat from wastewater; controlled ventilation systems with heat recovery; replacement of heat sources for heat pumps; biomass boilers; and others. [76]. This program states strict conditions for the funding of environmentally friendly solutions projects—especially which funding is available to the whole residential building (with no funding for single apartments) and which funding is available to single apartments. For example, funding for thermal insulation of a facade is available only for the whole residential building, but funding for energy-saving windows is available both for the whole residential building and a single apartment [76]. This state represents centralization on the building level (but based on

the decisions of households, not from the city or national levels) and a decentralized level based only on the decisions of each household.

From a strictly environmental point of view, the renovation of "old" residential buildings is extremely problematic, as is also claimed by Dubois and Allacker: "Due to consumer preferences and budget restrictions, most renovations only induce minor energy savings: the first aim of many renovations is to improve comfort rather than energy performance" [21]. They have found that "half-way energy renovations" paid for by subsidies is a waste of public money, and thus, centralized-decentralized solutions are of crucial importance for both the economy and the environmental value of regeneration projects. Therefore, the decisions of households within a residential building are extremely important for the overall success of a regeneration project. A recent international study on the drivers and barriers toward the adoption of environmentally friendly technologies in residential buildings is extremely diversified among countries as well as technology type [28]. The impact of different centralization represented by personal motives and legal conditions was also found to be important for different technologies [28]. Based on this knowledge, we can state that the level of centralization has an influence on the realization of different environmentally friendly solutions (Hypothesis 2).

Our study complements urban regeneration studies with a unique perspective on the implementation of environmentally friendly solutions during the regeneration process. We observe this process as a complicated search for fragile balance between centralized (collective) and decentralized (individual) solutions. Our research concept and its flow are summarized in Figure 1.

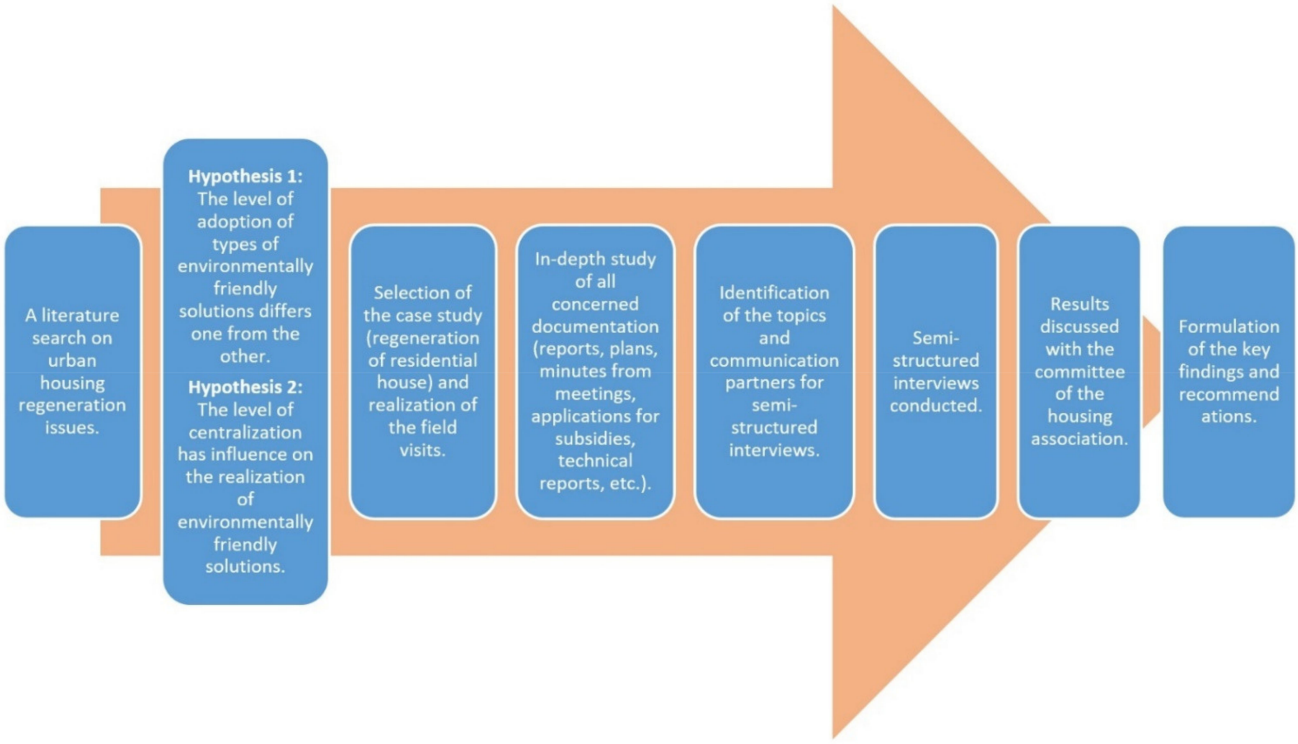

Figure 1. Research conceptualization.

3. Materials and Methods

3.1. Case Study Area

The selected residential building is located in the central part of Brno (Figure 2), which is the second-largest city in the Czech Republic (population 381,346 inhabitants as of 1 January 2020) [77].

Figure 2. Location of the studied residential building in the urban space of Brno. Author's elaboration.

Many old apartment buildings face the challenge of their regeneration so that the demanding standards of the twenty-first century in terms of environmental protection in heating, waste management, and greenery are met. The older the housing structure, the more demanding the regeneration in terms of adaptation to current environmental needs. For very old buildings (such as Baroque or Art Nouveau buildings), the protection of historical and architectural heritage takes precedence over the implementation of environmentally friendly solutions; for instance, Art Nouveau buildings cannot insulate their exteriors due to the existence of decorative facades. The studied building was chosen intentionally because it was built in the interwar period; over time, it has become extremely neglected, and environmentally friendly solutions are not in conflict with conservation needs. After the Second World War and the communist takeover in Czechoslovakia, the building was nationalized and ownership transferred to the government. With the collapse of communism in 1989, the building became the property of the city administration. All 15 apartments were rented to residents. Later on, in 1999, the city administration decided to sell the building to the residents. It was agreed that contemporary residents could buy their apartments from the city administration for a discounted price, establish a housing cooperative, and deposit their property into the cooperative as shares.

Some of the residents who bought their apartments at the time used the opportunity to make a quick profit and sold their apartments to new owners for a much higher market price. The era of the housing cooperative lasted for one decade (1999–2009), and within this period, the exchange of residents from rather more elderly and low-educated to university-educated people of an economically active age started. These newcomers became the main drivers of the following regeneration changes and the implementation of environmentally friendly solutions. This process could be viewed as evidence of a gentrification process [78] known also to post-socialist cities [10,17]. In 2010, a new era of ownership status started when the residents established an owners' housing association. The main motivation for the transition from cooperative ownership to private ownership was better management of the property—for example, easier mortgage settlements on apartments, apartment rentals, and investments in apartments. In this period, the building was in a poor technical state (Figure 3) due to the absence of major investments in the previous decades. Most of the infrastructure within the building was in an emergency condition (e.g., a dilapidated leaking roof, inefficient heating system, leaking original wooden castle windows, original common electricity distribution using aluminum wires,

etc.), which increased the urgency to regenerate the building. At the same time, options started to be considered as to how, where, and for what costs the new environmentally friendly solutions and technologies should be implemented. Finally, in June 2020, after the overall reconstruction and modernization of the building (e.g., the construction of rooftop apartments and elevators; replacement of the common electricity distribution system; replacement of gas, water, and sewerage; etc.) and the installation of many environmentally friendly solutions (insulation of the building exterior, replacement of leaking old windows, heating system repairs and remote heat consumption control, community composting), significant improvements in the quality of the residential building were achieved (Figure 4).

Figure 3. A eastern view (**A**) and an western view (**B**) of the neglected and underfinanced residential building before its reconstruction in 2010. Source: Vojtěch Šíp.

In terms of studying the behavior and the decision-making of different groups of residents, it is important to note that the building has been owned by the owners' housing association since 2010, and it was the last step from centralized socialist ownership to decentralized ownership in the market economy. All residents were continually made to decide together on all major regeneration issues, including the need for particular regeneration, implementation, the scope of environmentally friendly solutions, the creation of public subsidy applications to collect money for investments, and so on.

3.2. Data Collection and Case Study Description

This study follows up on research dealing with the issue of urban regeneration in Brno [79,80]. From a spatial point of view, attention is focused on research concerning a selected case study area and thus complements the mosaic of information published about regeneration activities in the other case study areas in Brno [70,81] located in different types of functional urban areas [12,82]. This study concentrates on the regeneration of housing, and, in the beginning, it was necessary to identify a suitable case study area. We used contacts in the Brno university environment, which were created within the previous research focused on energy vulnerability [53], and we asked members in that network to send recommendations on a suitable possible location of housing regenerations. Five apartment buildings built in the pre-WW2 period in inner-city Brno were identified,

as it was necessary to assume a higher rate of underfunding compared to residential buildings built in later periods. Subsequently, the owners of these buildings were contacted with an offer to conduct qualitative research. The members of the owners' association committee of the selected building showed the greatest willingness to cooperate. The advantage of the chosen house is that all documentation and reports (e.g., minutes from meetings of the owners' association committee, minutes from general owners' meetings, applications for subsidies in the field of energy-saving and composting, reports from specialized companies on the condition of the building) were kept in a very detailed and systematic way. The regeneration process was studied based on these available materials, and attention was focused both on the regeneration of the building itself and on the revitalization of the adjacent land, which belongs to the owners of the building. In total, 18 environmentally friendly solutions of four types were discussed during the decision and realization process (Table 1).

Figure 4. A eastern view (**A**) and an western view (**B**) of the modernized and regenerated residential building at the end of the studied period in June 2020. Source: Petr Klusáček (**A**) and Vojtěch Šíp (**B**).

The overall concept of our approach and the flow of our research are graphically shown in Figure 1. As the observation spanned ten years (2010–2020), a large number of documents were available where various opinions, statements, suggestions, and protests of different actors were recorded. We first analyzed all available materials provided by the members of the owners' association committee and, based on that information, in the second half of 2020, we also contacted two selected members of the association committee, three other selected owners, and three external actors (Table 2) involved in the regeneration process (as important sources of the decision process [28,52]) with additional questions to clarify unresolved issues, such as who invested time and money in finding information about environmentally friendly solutions and in their implementation. Selected communication partners were contacted via various methods (e.g., Microsoft Teams, telephone, and in writing) due to the COVID-19 pandemic. All statements of respondents were coded and anonymized to ensure the safety of sensitive information. The timeline of the regeneration process can be found in the Appendix (Figure A1).

Table 2. Overview of selected communication partners for interviews (anonymous style).

Interview Partner Type	Age Category	Profession	Role in the Regeneration Process	Gender
Member of the owners' association committee 1	61–70 years	architect	Leader of the regeneration process	M
Member of the owners' association committee 2	41–50 years	economist	Dealing with economic issues including subvention	F
Owner 1	31–40 years	artist	Dealing with composting issues	F
Owner 2	41–50 years	teacher	Dealing with greenery issues	M
Owner 3	31–40 years	GP	Owner of two apartments and an investor in the new attic apartments	M
External actor 1	31–40 years	economist	Consultant in the field of public subsidies	F
External actor 2	51–60 years	construction engineer	Expert in quality control of construction work	M
External actor 3	31–40 years	lawyer	Expert in preparation of legal documents (e.g., contracts, appeals against rejection of applications for public subsidies)	F

Concerning the case study description, in March 2010, the studied residential building was owned by a group of 13 owners who owned 15 residential units (some owners owned more than one unit) of various sizes (studios, one-room, two-room, and three-room apartments), with a total floor area of 953 m^2 for the entire building. Ten years later (in June 2020), the building was owned by a group of 15 slightly different owners (please see below) who owned 17 housing units of various size (studios, one-room, two-room, and three-room apartments as well as two duplex apartments built during the regeneration), with a total floor area of 1130 m^2. The groups of owners from the beginning of the studied period in March 2010 to its end in June 2020 were relatively stable, and changes in the ownership structure occurred in the case of only two housing units due to a situation in which one elderly couple passed away—this apartment was inherited by descendants—and the sale of another housing unit. The owner of this apartment was not satisfied with the course of the renovations and sold his property. The apartment ownership structure in the building was diverse. We found both families with small children and also owners living outside the studied site who rented their apartments. Among the owners, both economically active and inactive people could be found.

4. Results

4.1. Avenues and Blind Alleys in the Regeneration Planning

In the initial planning phase of the regeneration, the problem concerning sources of financing had to be solved. Several financial calculations were made by the owners, and it was found that if the funds saved in the collective bank account were used and a bank loan was taken (up to the maximum amount without mortgaging individual apartments), then the money would only be enough to conduct basic repairs, construction of the outer insulation, and necessary repairs to the old roof. To carry out this first regeneration option, it was necessary to obtain 75% support from all involved owners. The second option envisaged the construction of an elevator while anticipating that additional funds would be obtained through the sale of the attic space for the construction of new attic apartments. The second option was conditioned by a necessary change in the ownership shares and therefore required 100% consent of all owners. As the owners frequently stressed during the interviews, after long and complicated negotiations, it was agreed that further requirements from all owners would be incorporated into the common agreement (such as building a soundproof and heat-insulating partition to prevent noise pollution from the lift operation and compensation for any damage caused by the renovations). In the end, an agreement was negotiated, and all owners supported the second regeneration option. This agreement allowed for the usage of funds from the sale of the attic space, which was subsequently invested in the building of a new elevator and a new roof. The next portion of funding was procured through the Green Savings Programme [76] and the final part from a bank loan (to be repaid by 2026).

The owners reported during the interviews that despite considering the use of almost all possible sources of funding, the money gathered was limited. Consequently, decisions had to be made as to which of the proposed environmentally friendly solutions would be implemented and which of them would be too costly and thus had to be left out from further considerations.

Among the most intensively discussed regeneration issues among the owners was the question of how to transform the energy use of the building. Advancements in heating and cooling in the building were the most frequently raised requirement to be added to the regeneration project. Owners usually highlighted that the heating system before the regeneration was far from ideal due to poor thermal comfort. Some households reported using highly inefficient mobile direct heaters to heat their apartments during winters. Similarly, during summers, mobile air conditioning units were frequently used.

From the perspective of energy savings, it is remarkable that the owners carefully considered the possibilities of using alternative energy sources together with the energy sources used so far. For example, during the owners' association meetings, a large number of owners repeatedly demanded the formulation of individual heating options as they strongly criticized the position of the Brno Heating Plant Company as a monopoly supplier of heat that charges too much. As shown during the interview with a member of the committee, there was not a real possibility of switching to cheaper gas heating, as such an energy switch would not get a permit from the relevant public authorities (due to air protection in the city center). Other heating options considered were electric heating (perceived by the owners as too expensive) and the usage of a heat pump that required drilling boreholes. As reported by the member of the committee, this heating option was connected to unacceptable uncertainty, as drilling boreholes would be too demanding, and the installation company was able to guarantee trouble-free operation of the heat pump for just ten years but not beyond. As a long-term heating solution was required by the owners, this option was abandoned.

In the end, the owners decided to continue to have the building heated by the Brno Heating Plant Company. The decision was surely influenced by the fact that the Brno Heating Plant Company, as a traditional heat supplier, recently made large investments, co-funded via EU funds, to upgrade the heating equipment and distribution network [83].

It was visible during the interviews that the owners calling for disconnection from the traditional heating plant identified themselves as voices seeking energy independence, and, even more interestingly, this call for energy independence was also supported by the new owners who had bought newly constructed apartments in the building. It was these new owners who devised the idea to have an independent heat source (gas) at least in these new apartments. As a secondary argument, they stated that the building costs would be lower if this part of the building was heated independently. Some of the owners also intended to switch from electrical heating to gas during the regeneration as gas heating was more cost-effective at that time. As was already mentioned above, gas as a heating option would not get the permission of authorities, so this option was also abandoned.

Another plan to introduce renewable energy to the building occurred in the case of one of the newly built apartments whose owner considered the usage of rooftop solar collectors for the generation of hot water. As demonstrated in the latter stage, this plan was also abandoned, as it would have resulted in a reduction in the size of one of the bedrooms.

4.2. Real-Life Regeneration and Conflict Situations

Within the studied building, the following energy savings measures were finally implemented:

- Insulation of external walls, roof, and ceilings of the building;
- Replacement of old wooden castle windows with new ones;
- Repair of the heat exchanger station and balancing of the heating system; and
- Installation of thermovalves and heat consumption meters (with remote reading) on all radiators in individual apartments.

In the area of energy savings, many fundamental decisions had to be made during the regeneration. The most important decisions were whether to insulate the building with a thicker layer of insulation material and use a grant from the Green Savings Programme for funding or whether to insulate the building with a thinner layer of insulation material and avoid the administratively demanding subsidy program. As reported during a committee meeting, the option not to use the subsidy was recommended to the owners by a construction expert, arguing that in the case of errors in administrative reporting and project implementation, there was a risk the subsidy from the Green Savings Programme would not be granted. However, going against the recommendation, the owners decided to use the subsidy program and implement more thorough insulation of the building.

The committee was instructed by the owners to hire a specialized company to deal with the application for the subsidy program. As shown later, the construction expert's warning proved accurate: After applying, the administration of the subsidy program was suspended. Funds from the subsidy program were finally obtained only two years after the submission of the application, which made usage of the subsidy complicated.

The implementation of the measures also provoked certain conflict situations between the owners. First, there was a complication regarding window replacement, which was caused by the fact that one owner had two years prior replaced an old wooden window with new plastic windows and demanded reimbursement from the common repair fund. Similarly, the replacement of windows with plastic ones was refused for aesthetic reasons by another owner who had had old wooden castle windows refurbished at his own expense; this owner also demanded reimbursement from the repair fund. The owners' committee proposed and agreed in an owners' meeting that the owners who had replaced or refurbished windows would be reimbursed from the repair fund as if they had installed plastic windows as part of the insulation action but for a quantity discount—it means the owner who had paid for the costly refurbishment of wooden windows was paid only about half of the amount spent. The committee also tried to meet the other requirements of the owners; for example, one owner had aluminum windows with a hidden frame installed so as not to reduce the brightness in one room due to the installation of a plastic window with a wide frame. However, responsiveness to the individual needs of individual owners brought complications from the Green Savings Programme as the relevant technical documentation had to be submitted for each type of window (e.g., properties in terms of heat transmission).

Some conflicts also arose around the fact that the implementation of energy-saving measures influenced some of the life habits of the owners, which may look marginal but may be of great symbolic value. For example, a lady in retirement criticized the replacement of the windows because she used the space between the wings of the old wooden windows for overwintering flowers, which is not possible with new plastic windows. However, most owners greatly appreciated the thermal comfort increase as well as the decrease in heating costs for their apartments. Some owners also appreciated the improved thermal comfort during the summer months, as the insulation materials also prevent heat from penetrating during summer heatwaves. In connection with protection against summer heatwaves, the possibility of installing window blinds was discussed, but for financial reasons, it was decided that they would not be installed throughout the building; funds were only dispersed for this to the owners of the attic housing units, where the problem of overheating is the largest.

Furthermore, the owners discussed the following measures to improve the heating of the building during the study period: (1) disconnection from the Brno heating plant and use a heat pump, (2) insulation of the building's outer envelope and replacement of the old windows, (3) installation of remote heat readings and thermovalves in residential units to motivate residents to save energy, (4) replacement of older central heating distribution systems within the building and old cast iron heaters in residential units with new ones, (5) replacement of the exchanger station due to the transition from a steam to hot water heating system. Of these five measures, only three were implemented, with the two most

expensive (insulation of the building's outer envelope and window replacement and the replacement of the exchanger station) implemented thanks to subsidies from the public sector (Green Savings Programme, large investments by the city of Brno in transitions from steam to hot water heating systems). The other two costly measures were not implemented (use of a heat pump and replacement of the older central heating systems within the building and old cast iron heaters in residential units with new ones) due to a lack of funds.

4.3. Regeneration of Building Surroundings with Attention to Environmentally Friendly Solutions

For the surroundings of the building, the main challenge in the regeneration was how to use the land in a suitable and environmentally friendly way for the building's inhabitants. The main topics discussed during the owners' meetings included waste management and, above all, composting options. The building first acquired two city-subsidized classic composters (Figure 5A). In the years 2012–2020, the city of Brno provided property owners with almost 7000 composters for free or at a significant discount [84]. After a year in operation, the composters turned out to be a target for numerous groups of rats that searched for food and reproduced here. Due to their spread, it was necessary to repeatedly pay a company specialized in dealing not only with the studied building but also this issue in the neighboring buildings, which provoked great criticism not only among the owners of the building but also among owners of the surrounding properties. Therefore, these plastic composters were disposed of with the consent of most owners. A small number of owners who promoted environmentally friendly solutions agreed with the owners' committee to buy, at their own expense, a special sheet metal rotary composter (Figure 5B) that is resistant to rat penetration.

Figure 5. Subsidized urban plastic building composters (**A**) were replaced due to the reproduction of rats by a two-chamber sheet metal insulated composter used by a minority of owners (**B**). Author: Petr Klusáček.

In this context, it should be noted that Brno is a city in which environmental activists have a strong position and are strongly involved in urban development issues [85].

The topic of greenery was also loudly articulated within the community of owners. Before the implementation of the main phase of the regeneration, the possibility of a green roof on the building was considered, but it was not implemented due to enormous additional costs. In terms of rainwater collection, the installation of an underground rainwater catchment tank was considered, but again, installation was found to be too costly in addition to technically complicated as the yard is used to run (heat, electricity, gas, telephones, and internet) networks.

As part of the regeneration, balconies were rebuilt to enable the growth of flowers and, generally, some greenery. Naturally, not all owners use the balconies in this way, and, especially in the case of short-term rented apartments, the possibility for greenery

is not utilized. If we focus on greenery on the surrounding land, fast-growing willow and evergreen ivy were selected as site-suitable species (Figure 6). There is an informal agreement between the owners of the building that these adjacent lands are used by the owners of the first-floor apartments, who do not have balconies for gardening. The owners had been using these lands in the previous ten years mainly for growing vines, fig trees (Figure 7), tomatoes, and roses.

Figure 6. Greenery formed by ivy and willows combined with a place for a garbage dump. Author: Petr Klusáček.

Figure 7. The fig tree and roses east of the building as part of the adaptation to global climate change. Author: Petr Klusáček.

In terms of composting and greenery, it should be emphasized that the adjacent land is relatively small, which leads to issues arising from the combination of leisure activities and waste management. Most frequently, it is people enjoying the leisure activities with their children (trampoline, swings, sandbox) who are bothered by the smell emitted from composting (Figure 8). On the other hand, joint leisure activities among the owners (barbecues, joint celebrations) are important in terms of building mutual relationships among the community living in the apartment building. It is vital for further development of the building's community that voluntary activities among the owners who care about the surroundings are successfully developed. Contrariwise, the owners who live outside

the locality and rent their apartments do not support the leisure activities or the joint use of space as they perceive these as a disturbance.

Figure 8. Combination of leisure activities (swing for children) and composting and garbage cans, which are separated by fast-growing greenery (ivy and willows). Author: Petr Klusáček.

5. Discussion of Results and Conclusions

Our research focused on a case study that illustrates the regeneration process and the implementation of environmentally friendly solutions (Figure 1) conducted in a residential building located in the city center of the second-largest city in the Czech Republic—Brno.

The analysis of the apartment renovation and regeneration process confirmed that the level of support for individual solutions is different as are the driving forces and barriers acting in the selection process. The primary motivation of the building inhabitants for adaptation can be described as economic (energy/money savings), together with an effort to improve living comfort and property valorization. Environmental and other motivations are background issues. There is no large difference between the situation in post-socialist countries and elsewhere in the European Union [86]. On the contrary, the research of Camarasa et al. [28] shows that economic aspects play a more important role in post-socialist countries.

As part of the regeneration process, the owners discussed various environmentally friendly solutions and where to find funding for their implementation. Due to the underfunded condition of the building, investments were primarily focused on basic improvements (window replacement, elevator construction, replacement of common electrical lines and water, gas, and waste risers). A set of environmental solutions (Figure 9) was realized. Measures with the lowest financial barriers, the fastest financial return, and majority support among the building residents were implemented; for example, one fully implemented measure was the thermal insulation. In the Czech Republic, this is the most common energy savings solution with a full return on investment taking approximately four years [87]. However, some considered solutions (heat pump, green roof, replacement of internal central heating and radiators in apartments, rainwater harvesting) failed to materialize, as the implementation of these plans encountered economic and technical limits [29]. Similar trajectories in decision-making processes were found in UK households [88]. This fate is obvious for expensive technical solutions with long-term return (or no visible economic value at all) such as rooftops solar collectors [89] for the generation of hot water, green roof [90], and rainwater harvesting solutions [91]. Other difficulties that ruled out full project implementation were the current technical possibilities, the reluctance of owners to borrow more money, and, undoubtedly, the risks connected with the selection of alternative options that were not sufficiently supported by expert advisors. So, the activity and knowledge of actors played an important role in the adoption of different solu-

tions [52]. It is also important to emphasize that some important environmentally friendly solutions such as graywater management [92] or photovoltaic [38] were not discussed at all, although the city has one of the best solar locations in the Czech Republic [93].

Centralization ⟷ Decentralization

Environmentally friendly solutions	Centralized (collective) solutions influenced by urban, state, and EU policies implemented, non-implemented *(main reason)*	Centralized solutions at the building level implemented, non-implemented *(main reason)*	Decentralized (individual) solutions for one owner or groups of owners implemented, non-implemented *(main reason)*
Source of energy for heating and hot water	**Building exchanger station replacement** *(municipal project for transition from steam to hot water urban heating system)*	**Disconnection from Brno heating plants and use of new building-wide gas heating** *(urban regulation for air pollution)* **Disconnection from Brno heating plants and investment in a building-level heat pump** *(high financial demands, little confidence in long-term operation of heat pump system)*	**Modernization of individual hot water heating systems using gas or electricity in individual apartments** *(need to comply with stricter regulatory standards in the field of fire protection)* **Separate gas heating of three new attic apartments** *(urban regulations for air pollution, the obligation to share the heating costs of common spaces)* **Rooftops solar collectors for generation of hot water** *(equipment expense according to apartment size)*
Energy savings (energy management during winter and summer seasons)	**Insulation of the building's outer envelope and window replacement** *(cofinancing from state-run Green Savings Programme)*	**Installation of remote heat readings and thermovalves in residential units** *(fairness of energy costing)* **Replacement of old central heating distribution within the building and old cast iron heaters in residential units** *(high financial demands, fear of construction within apartments)*	**Refurbishment of wooden castle windows and installation of aluminum window with a hidden frame** *(aesthetic reasons, owners' willingness to invest money in more expensive solutions)* **Window blinds in apartments under roof** *(protection against summer heat waves, willingness of some owners to invest money in additional solutions)*
Waste management	**New place for urban waste bins** *(traditional connection to and use of Brno municipal waste collection and disposal system, modernized with EU money—creation of Brno waste incineration plant and urban waste sorting system with containers next to building)*	**Plastic building composters** *(provided free of charge by city and liquidated after a year in operation thanks to huge infestation of rats causing sharp complaints from some owners and neighboring inhabitants)*	**Two-chamber sheet metal insulated composters** *(protection against rats, willingness of some owners to invest time and money into additional solutions)*
Greenery and other activities	**Possibility to use playgrounds and greenery in city parks regenerated through use of EU funds** *(in proximity to studied building is Brno's largest park, Lužánky, which was regenerated through public investment in greenery, exercise equipment, children's playgrounds, public grills, and other facilities)*	**Green roof** *(high financial demands)* **Water harvesting system** *(complicated technical solution - lack of space for underground rainwater tank and high financial demands)*	**Small regeneration activities with a focus on leisure activities** *(willingness of some owners to invest time and money in additional solutions)* **Planting of new greenery** *(willingness of some owners to invest time and money in additional solutions)*

Figure 9. Overview of centralized and decentralized solutions discussed and factors affecting implementation in the studied area during the 2010–2020 period.

The role of public support is crucial for the acceptance of energy savings solutions [86], and, paradoxically, subsidies also have (under certain circumstances) the potential to create problematic and conflictual situations. Experience with the Green Savings Programme in our study shows that in the case of non-compliance with very complicated and bureaucratic conditions, the risk of subsidy rejection increases. It has to be stated that the enormous amount of required documentation accompanied by complicated bureaucratic processes of application approval requires the involvement of various external specialists and companies. We have identified this issue as one of the barriers to the greater use of public subsidies [94].

From the perspective of centralized or decentralized solutions (Figure 9), there are obvious differences in the acceptance of particular solutions. While centralized solutions (associated with the public sector and subsidies) were all accepted, only economically efficient measures were implemented when the entire apartment building or individuals/groups of owners were involved. Therefore, the economics (return on investment) can be described following Camarasa et al. [28] as the fundamental barrier to the acceptance/rejection of a given solution. Other barriers were legislation (municipal regulations), the technical disposition of the building, and, to a lesser extent, confidence in the effect of environmental measures. The economic advantage of centralized solutions is the result of the generous subsidy provided through public money (EU, national, city funds), and the majority of owners lack the motivation to invest their time and financial resources in individualized solutions when they have the opportunity to use the modernized, cen-

tralized systems (e.g., Brno heating plants, urban waste collection and sorting system, regenerated city parks, and playgrounds). Decentralized solutions were dependent on the willingness of some owners to invest their own time and money in "above standard" individual environmentally friendly solutions.

Due to the facts described above, the final form of the building regeneration cannot be described as exemplary/ideal, as not all measures were implemented. It is an image of reality that mainly reflects economic aspects. It would be appropriate for other energy-efficient technologies to be implemented in the coming years because, as Dubois and Allacker [21] point out, "giving subsidies for half-way energy renovations in these old houses is not an efficient way to spend public money".

The following policy considerations emerged from this detailed case study of a multi-occupancy residential dwelling in Brno: (i) the core motivation for revitalization is to save money, improve living comfort, and property valorization; therefore, return on investment is the fundamental barrier to the acceptance/rejection of environmentally friendly solutions; (ii) it is useful to develop more scenarios/options concerning financial matters of the project; (iii) only measures with the lowest financial and technical barriers and the fastest financial return have a chance for successful implementation; (iv) mutual communication between concerned parties from the very first planning stages of the project is crucial; (v) it is not that easy to get support from public sources due to administrative matters; (vi) detailed planning of the project and involvement of construction supervision is necessary; (vii) installation of facilities for the generation of renewable energy is financially demanding, and such investments have to be assessed from perspectives beyond financial return; and (viii) the involvement of professional project management will likely increase the project initial budget but generate long-run savings in the end.

Author Contributions: Conceptualization, P.K.; methodology, P.K., J.N. and S.M.; data analysis, P.K. and P.D..; writing—original draft preparation, P.K., J.N.; writing—review and editing, P.K., S.M., J.N. and P.D.; visualization, P.D. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by the Internal Grant Agency (IGA) of the Faculty of Regional Development and International Studies of Mendel University in Brno (FRRMS_IGA_2019/014).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

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

Appendix A

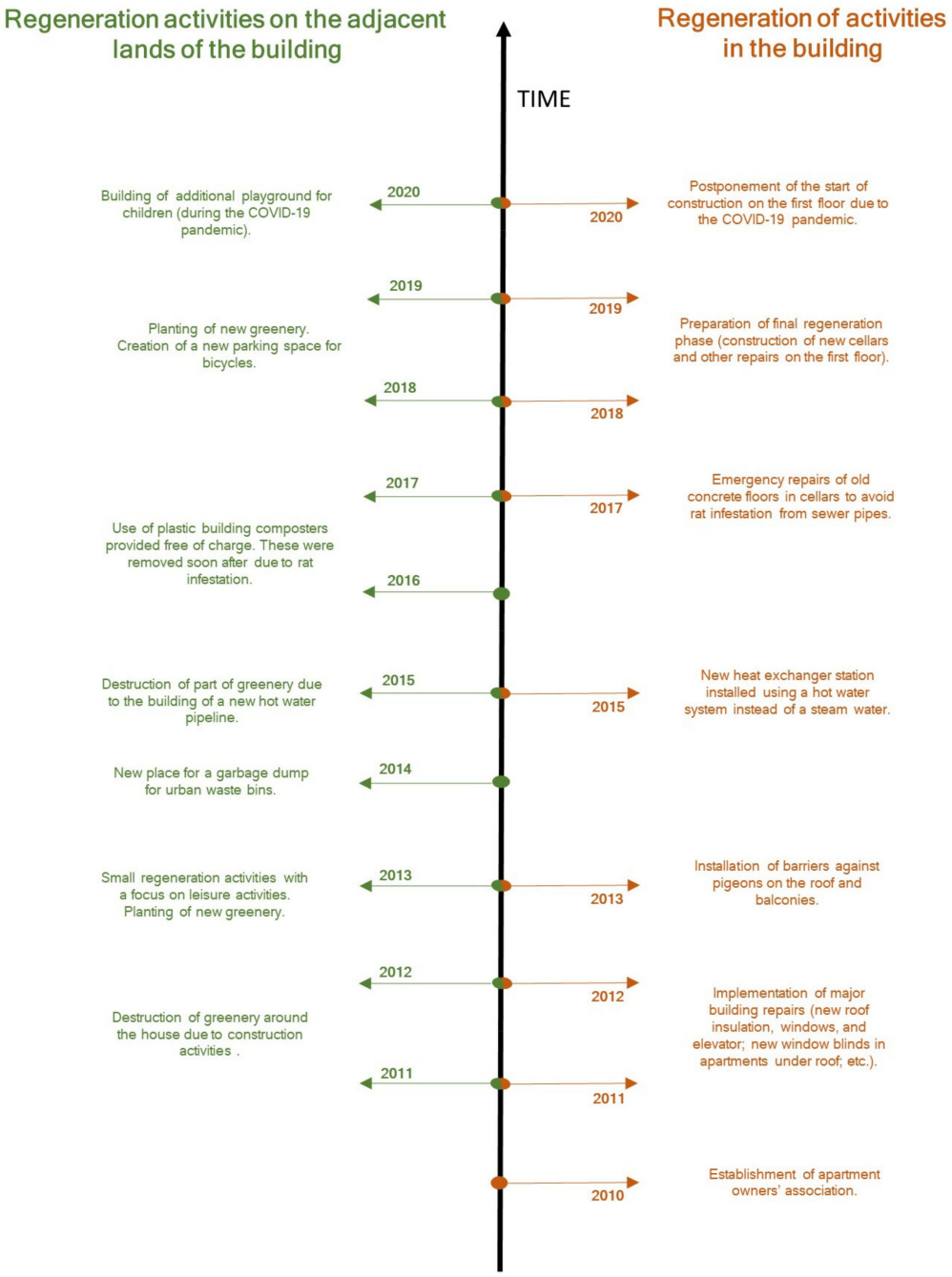

Figure A1. Timeline of regeneration activities.

References

1. Bardzinska-Bonenberg, T.; Baczkowska, M. Beauty of historic urban centres-Evolution in conservation theory. *Arch. Civ. Eng. Environ.* **2019**, *12*, 7–17. [CrossRef]
2. Cox, K.R. Development policy, Western Europe and the question of specificity. *Eur. Urban Reg. Stud.* **2020**, *27*, 4–17. [CrossRef]
3. Spurling, N. Parking futures: The relationship between parking space, everyday life and travel demand in the UK. *Land Use Policy* **2020**, 91. [CrossRef]
4. McGreevy, M.P. Complexity as the telos of postmodern planning and design: Designing better cities from the bottom-up. *Plan. Theory* **2018**, *17*, 355–374. [CrossRef]
5. Tiwary, A.; Vilhar, U.; Zhiyanski, M.; Stojanovski, V.; Dinca, L. Management of nature-based goods and services provisioning from the urban common: A pan-European perspective. *Urban Ecosyst.* **2020**, *23*, 645–657. [CrossRef]

6. Rogatka, K.; Starczewski, T.; Kowalski, M. Urban resilience in spatial planning of polish cities-True or false? Transformational perspective. *Land Use Policy* **2021**, 101. [CrossRef]
7. Tuvikene, T.; Sgibnev, W.; Zupan, D.; Jovanovic, D.; Neugebauer, C.S. Post-socialist infrastructuring. *Area* **2020**, *52*, 575–582. [CrossRef]
8. Troch, P. Of Private and Social in Socialist Cities: The Individualizing Turn in Housing in a Medium-Sized City in Socialist Yugoslavia. *J. Urban Hist.* **2021**, *47*, 50–67. [CrossRef]
9. Roubal, P. The Battle of Zizkov: Urban Planners' Transition from Heritage Protection to Neoliberal Discursive Planning. *J. Urban Hist.* **2020**, 47. [CrossRef]
10. Kubes, J.; Kovacs, Z. The kaleidoscope of gentrification in post-socialist cities. *Urban Stud.* **2020**, *57*, 2591–2611. [CrossRef]
11. Vasilevska, L.; Zivkovic, J.; Vasilevska, M.; Lalovic, K. Revealing the relationship between city size and spatial transformation of large housing estates in post-socialist Serbia. *J. Hous. Built Environ.* **2020**, *35*, 1099–1121. [CrossRef]
12. Sykora, L.; Bouzarovski, S. Multiple Transformations: Conceptualising the Post-communist Urban Transition. *Urban Stud.* **2012**, *49*, 43–60. [CrossRef]
13. Haase, A.; Wolff, M.; Spackova, P.; Radzimski, A. Reurbanisation in Postsocialist Europe-A Comparative View of Eastern Germany, Poland, and the Czech Republic. *Comp. Popul. Stud.* **2017**, *42*, 353–389. [CrossRef]
14. Rall, E.L.; Haase, D. Creative intervention in a dynamic city: A sustainability assessment of an interim use strategy for brownfields in Leipzig, Germany. *Landsc. Urban Plan.* **2011**, *100*, 189–201. [CrossRef]
15. Neducin, D.; Skoric, M.; Krkljes, M. Post-socialist Development and Rehabilitation of Large Housing Estates in Central and Eastern Europe: A Review. *Teh. Vjesn. Tech. Gaz.* **2019**, *26*, 1853–1860. [CrossRef]
16. Szafranska, E.; de Lille, L.C.; Kazimierczak, J. Urban shrinkage and housing in a post-socialist city: Relationship between the demographic evolution and housing development in od, Poland. *J. Hous. Built Environ.* **2019**, *34*, 441–464. [CrossRef]
17. Kubes, J. Gentrification and physical upgrading of inner-city neighbourhoods in the city of Ceske Budejovice. *Geogr. Cassoviensis* **2017**, *11*, 137–152.
18. Volarik, T.; Wawerka, R.; Dermekova, S. Smart housing estate: Implementation of ICT user friendly application to raise inhabitant's sustainability awareness. In Proceedings of the 15th International Multidisciplinary Scientific Geoconference (SGEM), Albena, Bulgaria, 18–24 June 2015; pp. 793–799.
19. Nikolic, J. New challenging approach for analysis and upgrading of massive building structure: Case study of new Belgrade post-was mega blocks. *Sustain. Build. Refurb. Next Gener.* **2013**, 135–138.
20. Haase, A.; Wolff, M.; Rink, D. From Shrinkage to Regrowth: The Nexus Between Urban Dynamics, Land Use Change and Ecosystem Service Provision. In *Urban Transformations. Sustainable Urban Development Through Resource Efficiency, Quality of Life and Resilience*; Kabisch, S., Koch, F., Gawel, E., Haase, A., Knapp, S., Krellenberg, K., Nivala, J., Zehnsdorf, A., Eds.; Springer: Cham, Switzerland, 2018.
21. Dubois, M.; Allacker, K. Energy savings from housing: Ineffective renovation subsidies vs efficient demolition and reconstruction incentives. *Energy Policy* **2015**, *86*, 697–704. [CrossRef]
22. Morelli, M.; Harrestrup, M.; Svendsen, S. Method for a component-based economic optimisation in design of whole building renovation versus demolishing and rebuilding. *Energy Policy* **2014**, *65*, 305–314. [CrossRef]
23. Sagan, I.; Grabkowska, M. Urban Regeneration in Gdansk, Poland: Local Regimes and Tensions Between Top-Down Strategies and Endogenous Renewal. *Eur. Plan. Stud.* **2012**, *20*, 1135–1154. [CrossRef]
24. Zhang, G.C.; He, B.J. Towards green roof implementation: Drivers, motivations, barriers and recommendations. *Urban For. Urban Green.* **2021**, 58. [CrossRef]
25. Carter, T.; Keeler, A. Life-cycle cost-benefit analysis of extensive vegetated roof systems. *J. Environ. Manag.* **2008**, *87*, 350–363. [CrossRef] [PubMed]
26. Hardin, G. The tragedy of the commons. *Science* **1968**, *162*, 1243–1248. [PubMed]
27. Bouzarovski, S.; Frankowski, J.; Herrero, S.T. Low-Carbon Gentrification: When Climate Change Encounters Residential Displacement. *Int. J. Urban Reg. Res.* **2018**, *42*, 845–863. [CrossRef]
28. Camarasa, C.; Kalahasthi, L.K.; Rosado, L. Drivers and barriers to energy-efficient technologies (EETs) in EU residential buildings. *Energy Built Environ.* **2021**, *2*, 290–301. [CrossRef]
29. Cristino, T.M.; Lotufo, F.A.; Delinchant, B.; Wurtz, F.; Neto, A.F. A comprehensive review of obstacles and drivers to building energy-saving technologies and their association with research themes, types of buildings, and geographic regions. *Renew. Sustain. Energy Rev.* **2021**, 135. [CrossRef]
30. Stec, A.; Mazur, A. An Analysis of Eco-Technology Allowing Water and Energy Saving in an Environmentally Friendly House-A Case Study from Poland. *Buildings* **2019**, *9*, 180. [CrossRef]
31. Pai, S.; Ai, N.; Zheng, J.J. Decentralized community composting feasibility analysis for residential food waste: A Chicago case study. *Sustain. Cities Soc.* **2019**, 50. [CrossRef]
32. Serrano, S.; Urge-Vorsatz, D.; Barreneche, C.; Palacios, A.; Cabeza, L.F. Heating and cooling energy trends and drivers in Europe. *Energy* **2017**, *119*, 425–434. [CrossRef]
33. Gomez, Y.D.; Teixeira, L.G. Residential rainwater harvesting: Effects of incentive policies and water consumption over economic feasibility. *Resour. Conserv. Recycl.* **2017**, *127*, 56–67. [CrossRef]

34. Majerska-Palubicka, B. How to Design Buildings, Housing Estates and Towns So That Their Impact On the Environment Will Be Acceptable? In Proceedings of the World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium (WMCAUS), Prague, Czech Republic, 12–16 June 2017.
35. Grygierek, K.; Ferdyn-Grygierek, J.; Guminska, A.; Baran, L.; Barwa, M.; Czerw, K.; Gowik, P.; Makselan, K.; Potyka, K.; Psikuta, A. Energy and Environmental Analysis of Single-Family Houses Located in Poland. *Energies* **2020**, *13*, 2740. [CrossRef]
36. Andreou, A.; Barrett, J.; Taylor, P.G.; Brockway, P.E.; Wadud, Z. Decomposing the drivers of residential space cooling energy consumption in EU-28 countries using a panel data approach. *Energy Built Environ.* **2020**, *1*, 432–442. [CrossRef]
37. Urge-Vorsatz, D.; Cabeza, L.F.; Serrano, S.; Barreneche, C.; Petrichenko, K. Heating and cooling energy trends and drivers in buildings. *Renew. Sustain. Energy Rev.* **2015**, *41*, 85–98. [CrossRef]
38. Akinyele, D.O.; Rayudu, R.K.; Nair, N.K.C. Grid-independent Renewable Energy Solutions for Residential Use: The Case of an Off-grid House in Wellington, New Zealand. In Proceedings of the IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC), Brisbane Convention Exhibition Ctr, Brisbane, Australia, 15–18 November 2015.
39. Koci, J.; Fort, J.; Cerny, R. Energy efficiency of latent heat storage systems in residential buildings: Coupled effects of wall assembly and climatic conditions. *Renew. Sustain. Energy Rev.* **2020**, 132. [CrossRef]
40. Lu, D.B.; Warsinger, D.M. Energy savings of retrofitting residential buildings with variable air volume systems across different climates. *J. Build. Eng.* **2020**, 30. [CrossRef]
41. Cockroft, J.; Cowie, A.; Samuel, A.; Strachan, P. Potential energy savings achievable by zoned control of individual rooms in UK housing compared to standard central heating controls. *Energy Build.* **2017**, *136*, 1–11. [CrossRef]
42. Singh, V.K.; Henriques, C.O.; Martins, A.G. Assessment of energy-efficient appliances: A review of the technologies and policies in India's residential sector. *Wiley Interdiscip. Rev. Energy Environ.* **2019**, 8. [CrossRef]
43. Duzi, B.; Frantal, B.; Rojo, M.S. The geography of urban agriculture: New trends and challenges. *Morav. Geogr. Rep.* **2017**, *25*, 130–138. [CrossRef]
44. Keng, Z.X.; Chong, S.; Ng, C.G.; Ridzuan, N.I.; Hanson, S.; Pan, G.T.; Lau, P.L.; Supramaniam, C.V.; Singh, A.; Chin, C.F.; et al. Community-scale composting for food waste: A life-cycle assessment-supported case study. *J. Clean. Prod.* **2020**, 261. [CrossRef]
45. Kucbel, M.; Raclayska, H.; Ruzickova, J.; Svedova, B.; Sassmanova, V.; Drozdova, J.; Raclaysky, K.; Juchelkova, D. Properties of composts from household food waste produced in automatic composters. *J. Environ. Manag.* **2019**, *236*, 657–666. [CrossRef] [PubMed]
46. Teotonio, I.; Silva, C.M.; Cruz, C.O. Eco-solutions for urban environments regeneration: The economic value of green roofs. *J. Clean. Prod.* **2018**, *199*, 121–135. [CrossRef]
47. Uren, H.V.; Dzidic, P.L.; Bishop, B.J. Exploring social and cultural norms to promote ecologically sensitive residential garden design. *Landsc. Urban Plan.* **2015**, *137*, 76–84. [CrossRef]
48. Egerer, M.; Kowarik, I. Confronting the Modern Gordian Knot of Urban Beekeeping. *Trends Ecol. Evol.* **2020**, *35*, 956–959. [CrossRef]
49. Silva, A.S.; Ghisi, E. Uncertainty analysis of daily potable water demand on the performance evaluation of rainwater harvesting systems in residential buildings. *J. Environ. Manag.* **2016**, *180*, 82–93. [CrossRef] [PubMed]
50. Wurthmann, K. Assessing storage requirements, water and energy savings, and costs associated with a residential rainwater harvesting system deployed across two counties in Southeast Florida. *J. Environ. Manag.* **2019**, 252. [CrossRef] [PubMed]
51. Teston, A.; Geraldi, M.S.; Colasio, B.M.; Ghisi, E. Rainwater Harvesting in Buildings in Brazil: A Literature Review. *Water* **2018**, *10*, 471. [CrossRef]
52. Camarasa, C.; Heiberger, R.; Hennes, L.; Jakob, M.; Ostermeyer, Y.; Rosado, L. Key Decision-Makers and Persuaders in the Selection of Energy-Efficient Technologies in EU Residential Buildings. *Buildings* **2020**, *10*, 70. [CrossRef]
53. Radzimski, A.; Weinsziehr, T.; Bartke, S.; Hageman, N.; Klusáček, P.; Martinát, S.; Grossmann, K. Teaching Energy Poverty. Lessons Learnt From an International Research and Teaching Initiative on Energy Vulnerability in Five Cities. In *Energie und Soziale Ungleichheit*; Grossmann, K., Schaffrin, A., Smigiel, C., Eds.; Springer: Berlin/Heidelberg, Germany, 2017; pp. 699–721.
54. Ali, L.; Haase, A.; Heiland, S. Gentrification through Green Regeneration? Analyzing the Interaction between Inner-City Green Space Development and Neighborhood Change in the Context of Regrowth: The Case of Lene-Voigt-Park in Leipzig, Eastern Germany. *Land* **2020**, *9*, 24. [CrossRef]
55. Hafner, R.J.; Pahl, S.; Jones, R.V.; Fuertes, A. Energy use in social housing residents in the UK and recommendations for developing energy behaviour change interventions. *J. Clean. Prod.* **2020**, 251. [CrossRef]
56. Sapsford, R.; Abbott, P. Trust, confidence and social environment in post-communist societies. *Communist Post Communist Stud.* **2006**, *39*, 59–71. [CrossRef]
57. Jehlicka, P.; Kara, J. Ups and downs of Czech environmental awareness and policy: Identifying trends and influences. In *Protecting the Periphery: Environmental Policy in Peripheral Regions of the European Union*; Baker, S., Milton, K., Yearly, S., Eds.; Routledge: London, UK, 2019; pp. 153–170.
58. Protic, I.B.; Mitkovic, P.; Vasilevska, L. Toward Regeneration of Public Open Spaces within Large Housing Estates-A Case Study of Nis, Serbia. *Sustainability* **2020**, *12*, 256. [CrossRef]
59. Maly, J.; Dvorak, P.; Suska, P. Multiple transformations of post-socialist cities: Multiple outcomes? *Cities* **2020**, 107. [CrossRef]
60. Temelova, J.; Novak, J.; Ourednicek, M.; Puldova, P. Housing estates in the Czech Republic after socialism: Various trajectories and inner differentiation. *Urban Stud.* **2011**, *48*, 1811–1834. [CrossRef]

61. Temelova, J.; Slezakova, A. The changing environment and neighbourhood satisfaction in socialist high-rise panel housing estates: The time-comparative perceptions of elderly residents in Prague. *Cities* **2014**, *37*, 82–91. [CrossRef]
62. Kabisch, S.; Grossmann, K. Challenges for large housing estates in light of population decline and ageing: Results of a long-term survey in East Germany. *Habitat Int.* **2013**, *39*, 232–239. [CrossRef]
63. Kristianova, K. Post-Socialist Transformations of Green Open Spaces in Large Scale Socialist Housing Estates in Slovakia. World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium 2016, Wmcaus 2016. *Procedia Eng.* **2016**, *161*, 1863–1867. [CrossRef]
64. Galuszka, J. Examining patterns of policy change in a post-socialist city: The evolution of inner-city regeneration approaches in Lodz, Poland, after 1989. *Town Plan. Rev.* **2017**, *88*, 639–664. [CrossRef]
65. Bonnefoy, X.; Braubach, M.; Krapavickaite, D.; Ormandy, D.; Zurlyte, I. Housing conditions and self-reported health status: A study in panel block buildings in three cities of Eastern Europe. *J. Hous. Built Environ.* **2003**, *18*, 329–352. [CrossRef]
66. Clapham, D. Privatisation and the East European housing model. *Urban Stud.* **1995**, *32*, 679–694. [CrossRef]
67. Evans, G. Creative Cities, Creative Spaces and Urban Policy. *Urban Stud.* **2009**, *46*, 1003–1040. [CrossRef]
68. Scott, A.J. Beyond the Creative City: Cognitive-Cultural Capitalism and the New Urbanism. *Reg. Stud.* **2014**, *48*, 565–578. [CrossRef]
69. Kummitha, R.K.R.; Crutzen, N. How do we understand smart cities? An evolutionary perspective. *Cities* **2017**, *67*, 43–52. [CrossRef]
70. Klusacek, P.; Konecny, O.; Zgodova, A.; Navratil, J. Application of the smart city concept in process of urban recycling-Case study of Špitálka in Brno, Czech Republic. *Deturope Cent. Eur. J. Reg. Dev. Tour.* **2020**, *12*, 22–40.
71. Brilhante, O.; Klaas, J. Green City Concept and a Method to Measure Green City Performance over Time Applied to Fifty Cities Globally: Influence of GDP, Population Size and Energy Efficiency. *Sustainability* **2018**, *10*, 2031. [CrossRef]
72. Wellmann, T.; Schug, F.; Haase, D.; Pflugmacher, D.; van der Linden, S. Green growth? On the relation between population density, land use and vegetation cover fractions in a city using a 30-years Landsat time series. *Landsc. Urban Plan.* **2020**, 202. [CrossRef]
73. Neducin, D.; Krkljes, M.; Gajic, Z. Post-socialist context of culture-led urban regeneration-Case study of a street in Novi Sad, Serbia. *Cities* **2019**, *85*, 72–82. [CrossRef]
74. Milojevic, M.; Maruna, M.; Djordjevic, A. Transition of Collective Land in Modernistic Residential Settings in New Belgrade, Serbia. *Land* **2019**, *8*, 174. [CrossRef]
75. McCord, M.; Davis, P.; McCord, J.; Haran, M.; Davison, K. An exploratory investigation into the relationship between energy performance certificates and sales price: A polytomous universal model approach. *J. Financ. Manag. Prop. Constr.* **2020**, *25*, 247–271. [CrossRef]
76. State-Environmental-Fund. About the New Green Savings Programme. Available online: https://www.novazelenausporam.cz/about-the-new-green-savings-programme/ (accessed on 12 April 2021).
77. CSO. Population of Municipalities-1 January 2020. Available online: https://www.czso.cz/csu/czso/population-of-municipalities-1-january-2019 (accessed on 4 February 2021).
78. Smith, N. Toward a Theory of Gentrification A Back to the City Movement by Capital, not People. *J. Am. Plan. Assoc.* **1979**, *45*, 538–548. [CrossRef]
79. Frantal, B.; Greer-Wootten, B.; Klusacek, P.; Krejci, T.; Kunc, J.; Martinat, S. Exploring spatial patterns of urban brownfields regeneration: The case of Brno, Czech Republic. *Cities* **2015**, *44*, 9–18. [CrossRef]
80. Klusacek, P.; Alexandrescu, F.; Osman, R.; Maly, J.; Kunc, J.; Dvorak, P.; Frantal, B.; Havlicek, M.; Krejci, T.; Martinat, S.; et al. Good governance as a strategic choice in brownfield regeneration: Regional dynamics from the Czech Republic. *Land Use Policy* **2018**, *73*, 29–39. [CrossRef]
81. Alexandrescu, F.; Osman, R.; Klusacek, P.; Maly, J. Taming the genius loci? Contesting post-socialist creative industries in the case of Brno's former prison. *Cities* **2020**, 98. [CrossRef]
82. Bierzynski, A.; Grabkowska, M.; Haase, A.; Klusacek, P.; Maas, A.; Mair, J.; Martinat, S.; Sagan, I.; Steinfuhrer, A.; Vaishar, A.; et al. Lodz, Gdansk, Brno and Ostrava and their Inner Cities: Urban and Demographic Development during Post-socialism. In *Residential Change and Demographic Challenge*; Steinführer, A., Kabisch, S., Grossmann, K., Haase, A., Eds.; Routledge: London, UK, 2011; pp. 101–140.
83. Žáková, M. Teplárny fungují 90 let. „Hřejivé" výročí slaví v kondici. *Brněnský Metrop.* **2020**, *11*, 28–29.
84. Gregorová, Z. Do sběrných hnízd přibudou kontejnery na odpad z kuchyně. *Brněnský Metrop.* **2021**, *2*, 5.
85. Durnova, A. A Tale of "Fat Cats" and "Stupid Activists": Contested Values, Governance and Reflexivity in the Brno Railway Station Controversy. *J. Environ. Policy Plan.* **2018**, *20*, 735–751. [CrossRef]
86. Beillan, V.; Huber, A.; Battaglini, A.; Goater, A.; Mayer, I.; Trotignon, R. Barriers and Drivers to Energy-Efficient Renovation in the Residential Sector. Empirical Findings From five European Countries. Available online: https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/2011/5-saving-energy-in-buildings-the-time-to-act-is-now/barriers-and-drivers-to-energy-efficient-renovation-in-the-residential-sector-empirical-findings-from-five-european-countries/ (accessed on 12 April 2021).
87. Karasek, J.; Pavlica, J. Green Investment Scheme: Experience and results in the Czech Republic. *Energy Policy* **2016**, *90*, 121–130. [CrossRef]

88. Caird, S.; Roy, R.; Herring, H. Improving the energy performance of UK households: Results from surveys of consumer adoption and use of low- and zero-carbon technologies. *Energy Effic.* **2008**, *1*, 149–166. [CrossRef]
89. Todeschi, V.; Mutani, G.; Baima, L.; Nigra, M.; Robiglio, M. Smart Solutions for Sustainable Cities-The Re-Coding Experience for Harnessing the Potential of Urban Rooftops. *Appl. Sci.* **2020**, *10*, 7112. [CrossRef]
90. Liberalesso, T.; Junior, R.M.; Cruz, C.O.; Silva, C.M.; Manso, M. Users' Perceptions of Green Roofs and Green Walls: An Analysis of Youth Hostels in Lisbon, Portugal. *Sustainability* **2020**, *12*, 136. [CrossRef]
91. Ghisi, E.; Schondermark, P.N. Investment Feasibility Analysis of Rainwater Use in Residences. *Water Resour. Manag.* **2013**, *27*, 2555–2576. [CrossRef]
92. Leigh, N.G.; Lee, H.Y. Evaluation of Implementation Strategies of Onsite Water-Conserving Technologies in Three Urban Neighborhoods. *J. Water Resour. Plan. Manag.* **2020**, 146. [CrossRef]
93. Camargo, L.R.; Nitsch, F.; Gruber, K.; Dorner, W. Electricity self-sufficiency of single-family houses in Germany and the Czech Republic. *Appl. Energy* **2018**, *228*, 902–915. [CrossRef]
94. Graves, E. Rooms for Improvement: A Qualitative Metasynthesis of the Housing Choice Voucher Program. *Hous. Policy Debate* **2016**, *26*, 346–361. [CrossRef]