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Editorial

Transformation towards Green Cities: Key Conditions to Accelerate Change

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1. Introduction

Cities worldwide are growing at unprecedented rates, compromising their surrounding landscapes, and consuming many scarce resources. In 2020, it is expected that 56% of the world's total population will be living in urban areas [1], and this number is expected to increase to approximately 68% in 2050 [2]. As a consequence, this will increase the compactness of cities [3] and will also decrease the availability of urban green space. Vegetation in cities disappears, for example, through new housing, including through the infill of 'empty' spaces; adjusting of infrastructure; paving of squares with stone or cement; and the construction of business parks. Moreover, many people are also tiling their gardens [4]. In recent years, many Dutch municipalities have cut back on municipal green space and its maintenance. At the same time, due to changes in climate, temperatures in cities are rising and weather extremes are becoming a common phenomenon. Most (western-oriented) cities are facing a worrying loss of green space, decreasing levels of biodiversity, the increasing alienation of inhabitants (including children) from daily experiences of nature, the natural environment, food, and, lastly also, repercussions on health and the quality of life [5,6]. To offer a liveable environment in 30 to 50 years, cities must face these challenges head-on and strive to create green urban areas that build on liveable and coherent sustainable circular subsystems. In the WUR long read [6], seven reasons were identified whereby the importance of investing in green city development has been distinguished: reducing risk of flooding; cooling the city in the summer; contributing to better health and increased well-being; contributing to social cohesion; supporting biodiversity; attracting companies and investors; and, to conclude, boosting the value of houses and offices. Some practical starting points for the greening of cities can be found in papers by the likes of de Roo [7] and Tucci and Battisti [8].

This introduction for the Special Issue directs its attention towards a theoretical framework that supports the transformation towards green cities and, moreover, how contributing papers have described possibilities for this transformation. The papers discuss emerging green practices that address themes such as liveability, food production, ecology, heat reduction, water retention, and combine the strengths of involved stakeholders as change agents. In the theoretical framework, we focus on which combination of the social, technical, and ecological changes can be detrimental to dealing with these transformations, and, at which level, namely, the macro, meso, or micro level. We describe the conditions necessary to accelerate a successful implementation of green urban transformations, as well as several pitfalls. We illustrate these conditions and pitfalls with some Dutch examples and discuss ways to speed up this green urban transformation.

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Citation: Stobbelaar, D.J.; van der Knaap, W.; Spijker, J. Transformation towards Green Cities: Key Conditions to Accelerate Change. *Sustainability* **2022**, *14*, 6410. https://doi.org/10.3390/su14116410

Received: 11 May 2022
Accepted: 13 May 2022
Published: 24 May 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

2. Theoretical Framework: Conditions for Green Urban Transformation

Building on research by Wolfram et al. [9] and Elmqvist et al. [10], we adopt the term sustainable urban transformation to describe the process that we wish to address within the framework. The term transition or transformation is used interchangeably in many papers that revolve around sustainable change. Hölscher et al. [11] (p. 1) explained this in their paper: "*Their differences may partially result from their etymological origins, but they largely stem from the different research communities concerned with either transition or transformation*". In this introduction, we have chosen to identify this change process as transformation. Within this transformation we further direct our attention towards the role of green urban space, being both an instigator of, and affecting a transformation towards sustainable cities. Sustainable urban transformation is a multiple system transformation whereby many separate subsystems are interrelated and change simultaneously in relation to each other (see also Figure 1). Examples of these subsystems are green urban infrastructure (GUI), housing, transport, and climate related issues. Changes in one subsystem, thus, have implications on other subsystems, as these subsystems ultimately compete for space and finance (see Appendix A). Such an interrelatedness arguably makes it challenging to change one subsystem, for instance improving the GUI. Although one (separate) subsystem already has a certain reluctance to change (in literature often called resilience (see, e.g., [12] or stability [13] of the system), changing such a multiple system is even more difficult and complex [10] (see also Section 3 for more details).

Similar to many other scholars in this field, we consider transformation to be a multi-level phenomenon [9,10,12,13], mostly represented within the macro level (landscape level), meso level (regime level), and micro level (niche level) (see Figure 1). On the macro level, policy on climate, ecology, housing, etc., is, alongside climate change, a driver for change on the longer term, and given the unexpected impacts on society, such as those brought about by the COVID pandemic [14]. On the micro level, changing behaviour of people [4] and their demands, alongside societal initiatives, such as self-management, puts pressure on the meso level, or, at least, demonstrates alternative options. The meso level is also changing, which can be understood as incremental change [13]. Johnson et al. [15] stated that drivers of change on the meso level can arise from different levels in the system, both being social and ecological, and combinations of that Juri [16] added the technical element, defining the meso level as a socio-technical-ecological system (STES). Decisions for changing the system are made in a multi-level governance system, which entails actors, often change agents on different levels, finding each other and proposing solutions that work throughout the different levels [10,15,17–22]. Gorrissen et al. [23] (p. 172) called this: "*new practices, technologies that seek to profoundly change established unsustainable routines and perceptions towards more sustainable ones*." They used this because the transformation takes place in complex multi-regime systems (going beyond the single socio-technical niche-regime framework).

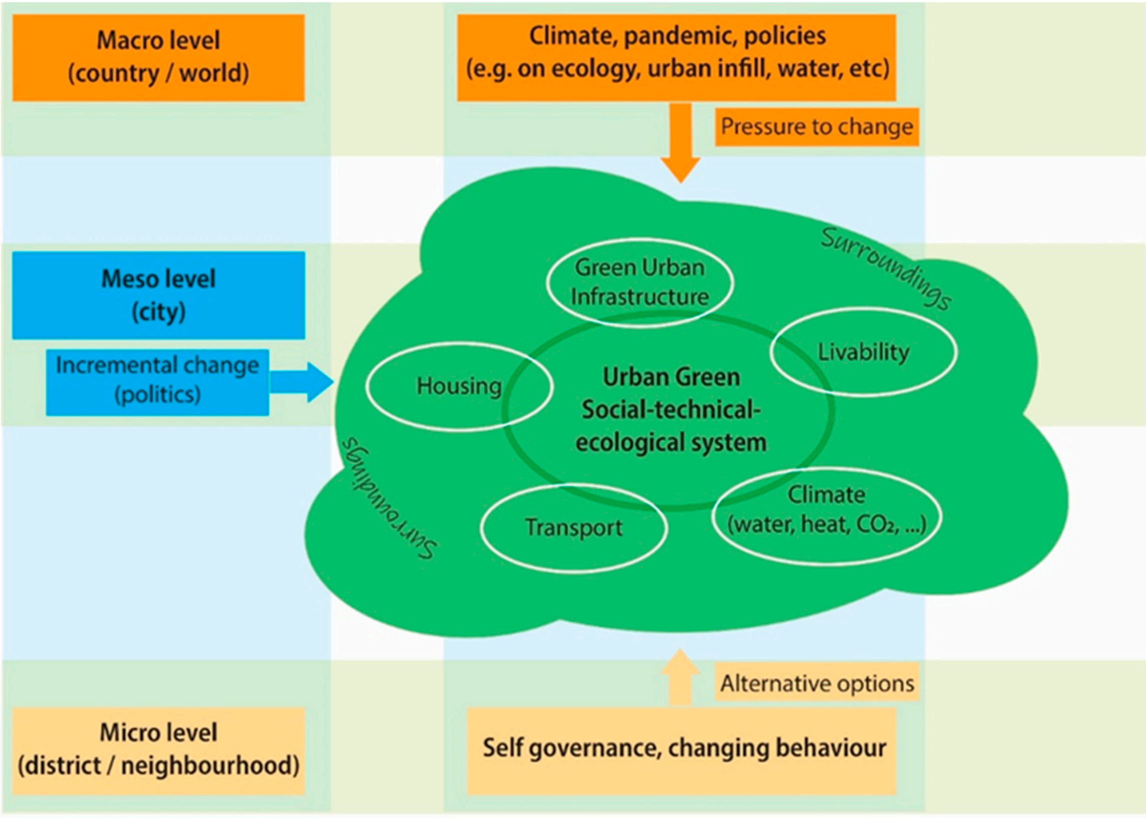

Figure 1. Multilevel and multisystem transformation of greening a city. Many different change agents are active on all levels, also in and between subsystems.

In short, we assume that, in theory, transformations this urban green STES can take place under the following conditions: firstly, the three layers must coincide based on pressure from the macro level that takes shape in the form of policy (nature, environment, climate, housing, etc.; see also [21]). Additional factors could include unexpected developments (such as the COVID pandemic, etc.), combined with pressure the micro level (people in the neighbourhoods demanding green spaces, experimenting with green streets [24]), as well as the incremental development on the meso level (politicians wanting to change [22,25] and seeing increasing problems in separate subsystems in a city (see Section 3 for more explanation)). Secondly, solutions for problems in separate subsystems on the meso level must coincide [22,26,27]; problems with climate issues, housing, liveability, green urban infrastructure, transport, etc., must be addressed by integrated solutions. In addition, policy, funding, planning, awareness, and communication should be aligned, in order to create a window of opportunity (see also [22]). Thirdly: change agents on the different levels and from different subsystems should find each other and should propose options that link the levels of the transformation model [18,28]. In Box 1, an interpretation making use of this theoretical framework from a 2021 Dutch newspaper clipping is presented as a short example of a possible radical transformation in Dutch green urban development.

Box 1. Example of greening cities; (*) based on a newspaper item [25] about expected radical changes in large Dutch cities.

Transformations Towards Green Cities Amsterdam and Utrecht (*)

In the next 20 years, the city of Utrecht will build 60,000 houses within the existing city boundaries (=38% extra) and simultaneously will create 70 hectares of green area [25,29]. Amsterdam is doing likewise. This can only be reached when the needed space for mobility is reduced by strictly limiting the presence of the car in the city. Car lanes can be transformed into cycle paths or green areas. Parking lots must disappear. The new neighborhoods are built almost car-free. "Removing the car is a sacrifice for some, but it brings a nice living environment" [25]. A success factor of these plans is integrality: combining housing, transport, urban green area, livability etc. This asks for a transition force driven from the regime itself, an *incremental change* on the entire meso level.

"Ten years ago, the municipality struggled to remove some stones from the pavement and now we embrace this" [25]. This change of thinking is prepared by the ongoing work of Steenbreek (and alike) which is now necessary for the management of the many new little green patches that will arise. In other words, *niche* Steenbreek has opened up opportunities for changing the meso level for green maintenance that traditionally focused on larger green (public) areas that were managed by the municipality. Networks of people living in neighborhoods and on city level are now being invited to organize the management (*change agents on different levels find each other*).

Such plans are financially demanding. Maintaining more urban green areas is expensive, especially when this space is not used for housing, and less parking lots bring in less parking fees. By using parts of green areas for water retention, one can for example reduce costs tied to sewage systems. The large cities asks the central government for help; it is their wish to build more houses in the cities, that is one of the drivers for this transformation [25]. In addition to this, the central government, also asks for more water retention, urban nature, etc. Such combined policies form pressures from the higher (macro) level on the meso level to change. Networks of people from central government, provinces, waterboards, city level, and (individual) citizens should be created to organize this change.

New development Utrecht/Merwede district [30].

3. Road to a Better Future: What to Influence on the Multi-Level System

In the following section, we describe the means through which several separated urban subsystems manage to become stuck in their development on the meso level (Section 3.1). We elaborate on three examples that explain in more detail why change in single subsystems can be challenging (Section 3.2). The main issues can be linked, primarily, to a shortage of space for the demands made by separate subsystems and the negative effects. This is especially visible in a country such as the Netherlands within which many competing spatial claims exist. In this overview we specifically focus on green infrastructure, transport, climate, liveability, and housing. We consider these five subsystems as relevant because of their claim on urban space and, on the other hand, their need for urban green development [6]. It illustrates a demanding integration of issues on the meso level. In the original model presented by Geels [13], the meso level is constructed by specific elements, such as culture, actions, (industrial) networks, policy, and technology, and it influences specific subsystems. However, spatial and financial aspects also play a role on this level [31]. All these elements are relevant in explaining why the single subsystems do not easily change. We present several examples of interaction between the five mentioned subsystems on the meso level with their possible (internal) barriers in Appendix A and possible solutions in Appendix B. These tables merely serve as indications, mostly based on practical insights.

3.1. Locked-in between Subsystems

We first focus on the five specific urban subsystems and elaborate on a few examples from Appendix A, with separate locked-in situations that limit each other from attaining a more integrated development, which is essential for green urban transformation (Figure 1).

Vulnerable green infrastructure: driven by (inter)national policy, cities are working to develop an ecological structure. However, due to the shortage of green spaces, pollution (water, air, noise, light), and poor management, biotope quality is often not sufficient for upholding biodiversity. In addition to poor biotope quality, poor connectivity between urban natural spaces is an important driver of decreased levels of biodiversity [32]. This also applies for the connectivity between public and private urban green spaces, which could potentially be one flourishing ecosystem, but which are fragmented, unconnected elements at the moment [33].

Fragmented transport: cars are designed for high-speed transport, but in cities, this is not possible. In many instances, bicycles are faster than cars. Furthermore, cars are polluting the air with particulate matter (PM10/2.5), NOx, etc., and produce noise. In combination with the housing demand within city boundaries (see, e.g., [34]), more space is needed for transport while less space is available [35].

Isolated climate issues: because of climate change (more frequent and larger downpours) and increasing soil sealing, sewer systems do not have capacity enough to manage downpours [36,37]. Furthermore, it is worthwhile to mention that the soil subsidence in the Netherlands influences the sewer system, and this subsidence also has an impact on houses that are sinking. In addition to this, the impact of extreme heat is an important climate related phenomenon in cities, causing drought problems.

Decreasing liveability: the city is becoming much more crowded, partly because of more compact building. Spaces to breathe (both literally and figuratively) are becoming scarce and social binding is decreasing [38]. The quality of urban environments have come under pressure, partly because of heat island effects and specific wind streams, but moreover also extra mobility, caused by more residents. This also can negatively influence health and social contacts, especially at the neighbourhood level [39].

Shortage of housing: within the Netherlands, more houses are needed to be built within city boundaries, and so little space is available for green urban development. In the Netherlands, 950,000 houses per year are planned to be built (on an existing amount of 8 million), mainly in urban areas [40]. The amount available and the increase in demand for building(s) are putting extra pressure on other projects, including green development.

If there are so many problems within the city's (separate) subsystems, one must ask themselves why is it then still so difficult to change? Alternatively stated, in more theoretical terms: why does the (multiple) system have such fragmented connectivity [12] and stability [13]? Or, more ethically defined, why are cities locked into a management of unsustainability [23]? Carton et al. [41] already pointed out that the inertia of the city finds its origin in a lack of space, separated finances, contradicting regulations, and differences in discourse. These can be typified as internal barriers that exist within each subsystem. Green space can serve as a strong connection between the subsystems. However, why are we not making much more use of green spaces as methods to support a more integrated system? Reasons for this could be found in external barriers, such as: path dependencies; far-reaching institutionalization; power relations; privatization or public interest; siloed organizations, both public and private; lack of coherent, overarching, sustainability and climate approach; those who are making the costs are different from those obtaining benefits from the suggested change; and whether the interventions and measures are being evaluated (see also [42]).

3.2. Barriers and Limitations for Solutions: Three Examples

To illustrate the complexity mentioned in the previous section, we now further explore the phenomenon by emphasising mechanisms on the different levels and between subsystems, with a few examples. The first example entails parking norms per household. These are often set by traffic engineers alone, with little or no consultation with other experts. Furthermore, it is fixed in rules and policy that each house must have a specific space for parking facilities, all to be placed on the macro level. On the meso level, there are different active agents. Residents themselves, on the micro level, also wish for more space for a second car. For city management, parking lots may be regarded as profitable as offering revenue through money for licences and parking fees. For project developers, parking spaces with houses or apartments is a selling issue and they are not very enthusiastic about experiments to lower the amount of parking space (except for a few frontrunners and cross-thinkers on the micro level). Therefore, reducing the prevalence of this parking norm in favour of more green alternatives is a very difficult (and tiresome) prospect. Sometimes one is successful, but mostly only in very local, sustainably oriented projects or neighbourhoods. A micro level example is Amsterdam's late-1990s GWL-project [43] where cars were banned from the area in favour of more green space. Another example can be found on the eastern part of Purmerend [44], where there are plans to develop a new neighbourhood with lots of green space and less space for cars. Of course, adequate facilities for public transport, walking, biking and sharing cars are a prerequisite for the success of this transformation.

Another example relates to the norms that are developed for water drainage and storage. Although more intense and higher peak rainfall levels appear, these regulations for how much rainwater should be stored are becoming stricter (leading to technical measures to enlarge the capacity of the sewer system), and by doing so cement even more the locked-in situation. These policies can be implemented on the macro level. Water stress maps must make clear where rainwater is moving to, mostly to the lowest points, in order to deliver customization of measures at the street level. On the meso level, water boards and municipal departments deal with sewers that normally store this overload of water at surface level or within the sewers, using technical means. The sewers are also used because it is easier to use already available public grounds instead of dealing with other parties and stakeholders. With storage and drainage often being underground, they are not directly visible for residents, making it challenging to discuss its risk for their living environment. On the contrary, managers do not think about dealing with it any differently. To be able to store water in and around buildings or green spaces requires a learning trajectory. For example, with the construction of swales, some progress has been made on the micro level (see for an example Box 2, relating to the Ruwenbos project in Enschede). However, for storage at a peak rainfall of 50–100 mm per downfall, a more integrated approach is required, such as less paved areas in gardens or parking lots, more space for water in green areas, etc., which is also often less expensive in comparison to storage in sewer systems. A combination of green and grey solutions is needed in order to deal with the impact on health [45,46].

A third example concerns heat stress. This can lead to a higher mortality and reduced well-being, especially for the elderly. Taking the heat waves of the first decade of the 20th century into consideration, attention and interest have heightened (changes induced from the macro level). This can be noticed in the increase in air-conditioning systems sales on the meso level, however, only within the housing subsystem. The weather forecast nowadays also contains warnings for extreme temperatures, and the RIVM (the National Dutch Health Institute) can activate a national heat plan if deemed necessary. These can be regarded as signals for the elderly and care institutes to take protection measures. The role of green solutions and green spaces in preventing the warming of houses and buildings or protecting people from heat has not yet much applied. Why not? First of all, the development of green solutions requires significant growing time to reach sufficient levels of shadow impact; while air-conditioning offers instantaneous results. Or it could be that you should use somebody else's' property to develop green solutions (such as with the water storage issue), especially when dealing with private and public interests. Furthermore, green solutions have disadvantages, such as falling leaves, slippery paths, an unsafe (social) spot, or places for insects. Next to this, technical solutions on the meso level can be steered more easily. With green solutions, this is much more difficult and does not have direct impacts. These measures could, however, be more effective on the long run for cooling down a city. Health care is often not involved in designing public space, while it has much more impact.

Box 2. Example of a swale implementation as green city transformation (own picture).

The Swale as Example of Green City Transformation

In the beginning of the 1990s the first system of swales was created in the Netherlands in Ruwenbos, a district in the city of Enschede. Nowadays more than 500 districts with swale systems can be found all over the Netherlands. One of the reasons it started in Enschede is due to fact that Enschede is situated on the flank of higher grounds, causing flooding in the lower parts of the slopes during precipitation events (pressure from the macrolevel - environment). The city council of Enschede was open for new solutions (incremental change on meso level) and gave 'carte blanche' to a group of urban planners, traffic engineers, hydraulic engineers and architects to design together an ecological sound neighborhood [47]; change agents from different subsystems and different levels find each other). This led to a design in which housing, traffic lanes, green urban infrastructure were aligned to make the swales a success: "From the three-meter narrow streets to the greenery, the roofs of the houses, the gardens on the north, the drainpipes and the gutters: absolutely everything in Ruwenbos was designed at the time to be able to drain rainwater as effectively as possible towards the three swales." [47].

The main issue revolved around solving the water quantity problems, but this design also added ecological quality and livability. Surveys show that the inhabitants are happy with the design, with children playing in the water (solutions for problems on meso level coincide). After Enschede, many other cities followed (copied this niche), often under pressure from increasing downpours (climate change) and responding policy (e.g., [48] pressure from the macro level). Studies showed that construction costs are lower than traditional water management options, although maintenance can be a bit more expensive (Boogaard et al. 2006), which can be an incentive for change on the meso level.

Nowadays most swales are situated in so called "bloemkoolwijken" (also known as cauliflower districts built in the 1970s, swales later added), renewal districts (from the 1990s) and villa districts (all ages), all with enough public space for swales [49]. According to research, livability is often improved [50], and if properly managed, it can also be an addition to biodiversity in the green urban space, which is also cheaper in maintenance [51].

In this way, the swale, as an ancient and rediscovered technique, could change the existing ecological and social conditions, forming a new Urban STES, first on niche level, but 25 years later completely embraced by the mainstream of municipality engineers on the meso level.

4. Accelerating Changes towards Green Cities

In the previous section, we exemplified why a transformation towards green cities is challenging. Based on our theoretical framework and literature, we will now stipulate a few measures that can be implemented to speed up transformations towards sustainable green cities. This acceleration needs an interwoven approach to deal with locked-in situations and are also comprehensively described and illustrated by Gorissen et al. [24] and Elmqvist et al. [10]. Reports by Natuur en Milieu [52], Barboza et al. [53], Groene_Stad_Challenge [54], and NL Green label [55] showed the growing importance of green spaces for ecosystem development, health, and well-being. However, especially in newly built housing areas, the amount of pavement in private gardens is increasing significantly showing the need to change course in the direction of greening the city. We have identified eight additional aspects we wish to highlight:

- Many scholars emphasize that real change takes effect when ideas about how we must to do things also change, which means that changes on the macro level must take place [26,56]. In reviews, people often highlight their preferences towards green urban spaces, over car dominated asphalt spaces, such as those that now dominate urban landscapes [52,57]. Additionally, although people are not voluntarily giving up their own private use of cars and other asphalt-bound uses, city councils can definitely use this change in perception to underpin the need of transformations towards green cities.
- Certainly, supporting transitions to green cities requires paying attention to the moral aspects of green in cities. When people see that it is immoral to not care for nature and furthermore also for some (poorer) people to not benefit from GUI (health, wellbeing, meeting people [58,59]), changes in behaviour are possible and policy changes towards greening the city are much more accepted.
- Use and make visible the advantages of integral development. Using Appendix B, it must be easy for coalitions of the willing to show that integrated solutions are cheaper, use less space, and are much more interesting.
- Make greater use of good practices (as used by [23]), showing how transformation works through the levels of the theoretical framework (Figure 1), as already is shown in the examples in former sections. It is relevant to know what has been achieved, but also how this has been achieved. The previously presented theoretical framework helps to describe the transition processes of these good examples, which means that we can obtain more insights on the road towards integrated green solutions.
- In addition to what has been achieved in this field, the design and imagining of possible futures, in a plan-making phase, can also help to accelerate transformations [16,60–62], as it shows how the city can be and, thus, attracts people to see the advantages of greening the city. In such a way, Tamminga et al. [63] illustrated an index of standard green elements that can be used in several ways for greening the city. This index is helpful given that inhabitants or other actors can easily project these elements in their surroundings, helping them to understand how the future can possibly be. Additionally, the concept of Nature-Based Solutions (NBS) should be mentioned here, as Boros and Mahmoud [64] stated that nature-based solutions are a design intervention. NBS, such as nature inclusive building, bring solutions to societal problems and enhance nature at the same time. Investment cycles, earlier described as a barrier for change, can be connected to green city visions, greening the city at the pace of the city administration. For instance, at the moment that the sewer system must be renewed, rainwater sewerage can be uncoupled, the streets depaved, green elements added, etc.

- Improving the quality of the building and renovation process using nature-based solutions [65]. The technical targets set are often clear and delineated, but softer goals, such as climate adaptive standards, gradually disappear during the plan-making and implementation process because existing sectoral standards, such as for parking, or financial arguments take precedence (see also [62]). Such non-institutionalized standards, especially related to green solutions, should become basic elements as well, with an interwoven system approach.
- As previously mentioned, space is an extremely scarce resource in cities. So, mechanisms that could add ecological elements that (1) do not cost extra space and (2) solve societal problems should create a new promising social–technical–ecological system (STES). One of these solutions is nature inclusive building, whereby nature is integrated into buildings by means of green roofs and walls, integrated birds' nests, etc.
- One other, more theoretical, frame of reference to look for transformations towards green cities is to find social tipping interventions that can activate contagious processes of rapidly spreading technologies, behaviours, social norms, and structural reorganization that, within their functional domains, can be referred to as social tipping elements [26]. Based on the previous section, we believe that the social tipping elements in greening the city are: transport, climate (water), liveability, housing, and green structure (ecology). For instance, an extreme flooding event caused by extreme rainfall can act as a cue for action [4] to change routines in all mentioned subsystems. That means that cities should be prepared to act on these possible triggers.

5. The Papers in This Special Issue

The papers in this Special Issue direct their attention towards specific aspects of sustainable future(s) and means to deal with its resiliency in the context of pathways that could lead to more unsustainable lock-in situations. In the following section, we will highlight some aspects of the papers and how such can be linked to our theoretical frame. One of the aspects in two of the papers is related to food and food production. Such especially highlights the meso and macro level. A third paper describes justice aspects that are linked to these levels and what our norms and values are in relation to financial options and health. Three papers discuss the role and impact of change agents on the micro and meso level interaction. Additionally, there are three papers that focus more on the personal, micro level; what can we encounter when dealing with greening our own environment. Overall, the papers give an impression of the many opportunities that exist to modify the locked-in subsystems into more organic operating sustainable systems.

Van Dooren, Leseman, and Van der Meulen [66] argued that the transition of the food system is intertwined with the quest for green, liveable cities, solutions for the one subsystem coincide with other subsystems. Green urban infrastructure can also function for food production. Regional food networks are supported by new governmental policy (meso level), city policy 'the Nijmegen approach' (meso level) and by local initiatives (micro level). Research by Farhangi, Turvani, Van der Valk, and Carsjens [19] discussed the high-tech urban agriculture (HTUA) cultivation of plants inside and on top of buildings can possibly increase green spaces in urban areas and that the uptake of such technological innovations in urban planning processes is problematic, especially when trying to cross the three levels (Figure 1). This study highlighted a lack of connection between planning actors and technology developers, influenced by agency of artefacts, such as visualizations of the future projects.

The paper by De Vries, Buijs, and Snep [58] accentuates justice aspects regarding green space in cities linked to financial status. They also stated that urbanisation and densification will likely result in less greenspace in urban residential areas, especially in deprived neighbourhoods. This is a threat to the ambitions of healthy and liveable cities as green spaces have positive effects on human health and well-being (coinciding subsystems). In this sense, De Vries et al. [58] described a locked-in situation on the meso level of deprived areas with little green, that will not easily change to the better.

In the paper by Stobbelaar, Van der Knaap, and Spijker [4], a theoretical model of greening gardens is described. It shows that on a micro level a combination of subsystems (garden functions in this case) is needed to ensure a transition towards greening gardens. Moreover, it also shows that changes on the micro level are influenced by the social network and its changes agents through the levels. Additionally, the functioning of the ecological network around the private garden is of importance, in other words, people more easily green their garden if it can be part of a larger STES. Novasadová and Van der Knaap [18] described that the role of change agents to boost a change for a green environment is linked both to biophilic activities, as well as indirectly with non-biophilic agents; their mutual cooperation is essential to support this green environment development on all levels. Stobbelaar [24] discussed linking the levels in the multilevel system that is needed to initiate greening cities. If the micro and meso level coincide, green urban measures are more easily implemented, forming a new green urban STES. Such is shown in the case of Enschede, in contrast with the case of Haarlem. In both cases, the combination of GUI and other subsystems, such as water retention, liveability, etc., was helpful in starting the transition.

Tamminga, Cortesão, and Bakx [63] presented a conceptual framework for using "convivial green streets" (CG) as a resource for climate adaptation. When applied consistently, CG can become an emerging green practice with a positive impact on urban adaptation to climate change: CG may provide localized climate amelioration in ways that support social engagement outdoors (coinciding subsystems). CG are an informal-sector phenomenon resulting from assemblages of features and patterns enacted by a variety of local actors, mostly residents, merchants, and/or employees who share a street's frontage. As an informal-sector phenomenon, in CG, local actors work as gardeners "*who cultivate plants to a degree sufficient to elicit some sensory appreciation on the part of passers-by and, now and then, to prompt social engagement between cultivators, neighbours, and passers-by*". This kind of increasing development can be linked to a role for change agents on the micro level. Another aspect of this personal, micro level is offered by Colding, Giusti, Haga, Wallhagen, and Barthel [38]. They argued that nature reconnection requires urban ecosystems, with a capacity to enable environmental learning in the cognitive, affective, and psychomotor domains, i.e., learning that occurs in the head, heart, and hands of individuals using a theoretical framework for human–nature connection. It has a focus on a more personal impact in which also presumptive sentiments towards nature are not always positive. Patuano [67] reviewed the concept of [urban] biophobia. Natural areas are now known to be important resources for the health and wellbeing of urban dwellers, through which, for example, the opportunities they provide cognitive and emotional restoration (subsystems coincide). This review presents the current state of knowledge on urban biophobia, as well as evidence of instances in which built and mixed urban environments were found to be more restorative than natural ones for the urban population, in order to assess any connection within the two. Therefore, Patuano described that there are not only social-institutional barriers to greening the city, but also a psychological barrier that makes cities locked in dramatic greening operations.

6. Conclusions

In this Special Issue on "Green Urban Solutions", integrated approaches to green urban development from different angles are specified. In order to keep, and make the cities liveable and climate-adaptive, it is important that solutions that are currently used as pilots and on a small scale are upscaled. There is a long way to go for this important challenge, and at the same time, we have little time left, given the pace of urbanisation, climate change, and loss of biodiversity. The final say has certainly not been said and written on this subject. Therefore, we cordially invite other authors to add new papers and viewpoints to this Special Issue, particularly research that is able to highlight how to deal with one of the locked-in subsystems as presented in Appendices A and B. However, other themes could also discuss, for instance, the amount of wild nature in cities, and particularly, that too much wild nature in a city will not be tolerated by the majority of people. Another issue concerns pressure that can be derived from the Paris Climate Agreement 2015, to become carbon neutral in 2050, which leads to the question of whether the city can become a carbon sink. One of the ways is to start building with wood and other natural materials, such as reed mace. Moreover, trees, shrubs, and swamps could be part of the carbon sink. Alternatively, one could think about how to measure the real increase in green urban space; is it more than policy babble (e.g., [68])? Another issue is if we can or should predict tipping points as positive points of change or should we just position specific aspects and hope for the best.

In this introduction we briefly described the large body of knowledge about the positive effects of Green Urban Space; we have also described why it is so difficult to use the full potential of it for the benefit of all. We think that this contribution has added some knowledge to the not so extensively explored field of how cities—as complex social–ecological–technical systems—can be transformed towards green cities.

Funding: This research received no external funding.

Acknowledgments: We wish to thank Diego Valbuena Vargas, for checking on the structure, and Nicholas Been, for reviewing the English language. Additionally, we would like to thank Monique Jansen for creating Figure 1.

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

Appendix A

Urban subsystems keeping each other locked in; indicative examples (how can the development of a row item/subsystem be hindered by a column item).

Challenges	Green Structure	Transport	Climate	Liveability	Housing
Green Structure	X	Intensification of car transport and extra routes	Drought, extreme flooding and precipitation, and high-temperatures affecting biodiversity	Other functions require space; design of neighbourhoods influence; mowing roadsides; cultural differences in experience and usage (e.g., food forest)	Infringement, intensification of persons/m^2; underground cables and pipes; Investment cycles, infrastructural inertia, power structures (Otto et al. 2020); people having less time for other activities (like gardening).
Transport	Green structure policy (ecological barriers) increases pressure	X	Climate policy (such as CO_2 related) increases pressure	Liveability policy (related to nitrogen, particulate matter, noise) increases pressure; design of specific neighbourhoods, not logical for transport and accessibility	Car transport and parking complications given a rise in private cars
Climate	Overcrowding in parks for shade or sun; too much shade or much volume creating dark (unsafe) spots	Emission of gas and particles impacting air, soil, water; diversity of mobility forms requiring each own space	X	Large consumerism, especially non-sustainable. Terrace heating; many large events; nature friendly water banks turned into living space for private use;	Extra and bigger housing requires space which is also needed for climate measures
Liveability	Not enough GUI and variation. Use of area, shade or feeling of social safety; growing impact ticks and mosquitoes	Noise, particulate matter, etc.	Heat in the city; wind turbines and solar parks requiring space and destroying landscape; high water tables or drying out gardens	X	Too many houses/people in a city; many apartments, no gardens
Housing	impact shade on houses	vibrations; noise; air quality	house typology (house with a through lounge becoming a 'well-baked' lounge)	not too many persons/km^2 to lend support to societal activities taking place	X

Appendix B

Options for urban subsystems helping each other to change into a green sustainable direction. (the column items strengthen the development of the row item).

Solutions	Green Structure	Transport	Climate	Liveability	Housing
Green Structure	X	Other types of transport (walking, bicycle, public transport). Less transport due to other working conditions.	Nature based climate solutions require more GUI; green water squares (not only hard surfaces); creating cooling and shadow places	Allotment-like garden developments; green social meeting spots; linkages between public and private green spaces	Nature based building, incl. circular building; rooftop gardens and parks; vertical greening of buildings.
Transport	More city nature means less transport to nature areas outside the city; also, by foot or bus	X	Modal split with more use of public transport, bicycles and walking. Less cars when shared use; greening fuel and infrastructure, including electric charging stations, self-charging cars, or use road surfaces for energy	Less cars mean less pollution; more electric cars mean less direct pollution; City transport: shared logistics; attractive (cycle) roues; canals for waste transport; bulk transport until city limits and fine mesh for distribution using electric transport	More houses in the city means less transport is needed regionally and create possibilities for slower means of transportation; less parking spots (only for some large events, such as removals)
Climate	GUI is the main solution for climate/water retention; also cooling of the city using local (solitary) trees	Less car transport and increased electric mobility is beneficial for the climate	X	Greening the city helps climate mitigation (storage of carbon) and also climate adaptation (water retention, reducing heat)	Houses as a carbon sink (e.g., wood building); energy neutral or even energy generating houses; using circular materials
Liveability	Green infrastructure adds to liveability	Less noise; nice bike lanes, walking in greened neighbourhoods	Climate constructions (e.g., water retention) can add to liveability, Parks and tress for shade; rooftop gardens in combination with solar panels generate more energy, while trees in the neighbourhood decreases energy yield	X	Housing in green areas is good for citizen health; can promote social contacts; diversity in building styles and neighbourhoods; integration of use of equipment and services
Housing	More attractive and greener living and makes houses more valuable	More houses, better public transport, more efficient; more bicycle lanes combining with other modes of transport.	Water retention is stopping houses from sagging; give more shadow, decrease warming. Rooftop gardens can promote isolation.	More attractive neighbourhood. Opening for social contacts	X

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