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How to overcome local policy conflicts that hinder climate actions? A green roof planning dispute between politicization and de-politicization

Rima Almalla[1] · Jani Vuolteenaho[2] · Jukka Käyhkö[1]

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Abstract
The integration of green infrastructure, such as green roofs (GR), in urban centres is considered crucial for climate change adaptation, and improving environmental quality. Previous research highlights the benefits of GR, including urban heat island mitigation, energy efficiency, biodiversity enhancement, and stormwater management. However, it also addresses the challenges, particularly in cold climates, where seasonal variations affect GR performance. Furthermore, barriers such as policy constraints, financial limitations, and cognitive challenges can hinder the mainstreaming of vegetated roofs. This study examines the political and policy dynamics surrounding GR implementation through a case study of a planning conflict in Turku, Finland. It employs a mixed-method approach, analyzing planning documents, municipal decision-making data, media reports, and stakeholder interviews. Findings reveal that the politicization of GR in Turku was driven by conflicting interests among stakeholders, including a local affordable housing developer. The introduction of the Blue-Green Factor (BGF) planning tool in 2021 facilitated the depoliticization of GR by providing a flexible framework for enhancing urban greenness and stormwater management. This case underscores the importance of adaptive policy frameworks in overcoming local conflicts and advancing urban sustainability goals. The study also contributes to the broader discourse on urban political ecology and critical planning studies, emphasizing the need for context-sensitive approaches to green infrastructure implementation.

Keywords Green roofs · Stormwater management · Climate change adaptation · Urban planning · Blue-green factor · Policy barriers · (De)politicization · Stakeholder engagement · Urban political ecology

1 Introduction

> The insertion of green infrastructure (green roof, green walls, etc) in urban centres plays an important role in the adaptation to climate change, increasing cities resilience and improve environmental quality. However, barriers can hinder green infrastructure dissemination, these barriers can be classified as: *federal and state policies; city policies; governance policies; financial resources and cognitive barriers*.
> (Liberalesso et al. [1], our emphasis)

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✉ Rima Almalla, rima.almalla@utu.fi | [1]Department of Geography and Geology, University of Turku, Turku, Finland. [2]Department of Geosciences and Geography, University of Helsinki, Helsinki, Finland.

Urban nature-based solutions—parks, allotments, green corridors, riverbank greens, derelict areas with wilding species, and more micro-scale urban ecological interventions—are a burgeoning policy and planning trend [2]. Rooftops that are partially or completely covered with vegetation are increasingly considered as a solution to address the adverse impacts of climate change and urbanization [3]. In cities under different climatic conditions, scholars have highlighted benefits stemming from the green roof (GR) concept: inter alia, vegetated roofs can potentially reduce urban heat island effects, facilitate energy usage for cooling, nurture urban wildlife habitat and biodiversity, and improve stormwater retention [4–9]. Recently, pro-GR researchers like Liberalesso et al. [1] have also reflected power-embedded and potentially conflictual political and policy processes linked with adopting nature-based solutions, including barriers that can impede the mainstreaming of GR in cities. Via a Finnish case of a GR-related planning conflict, the wider theoretical objective of this article is to bring the research on green roofing into dialogue with insights of urban political ecology and critical planning studies, the latter emphasizing that planning initiatives and goals (like green roofing) tend not only to convey stakeholders' varied interests and responses, but even reignite politicized resistance (e.g., [2, 10–13]).

Arguably due to its northern circumstances, Finland has lagged behind many other European states in the implementation of vegetated roofs via institutionalized policies. However, an increasing interest in the green roof concept has lately emerged in major Finnish cities, particularly since the mid-2010s [14–16]. To cast light on power relations in this recent but hardly all-embracing attitudinal change, this article's key analysis recounts a planning debate in the Finnish city of Turku. In the case of the so-called Turku Energia (TE) -quarter, a politically-steered initiative on the prescribed use of GR on a cluster of planned apartment blocks became sternly questioned in the City boardrooms, the local press, and social media forums in 2017–2018. The local GR-resistance was machinated and lobbied most vigorously by a developer and provider of affordable housing, leading to a politicization around the attempted site-specific GR initiative. After a 4-years halt in the planning process, however, when a new revised TE plan was equally equipped with GR, it did not anymore stir strong emotions among the politicians and other stakeholders. In part, this depoliticization of green roofing was due to an integrated Blue-Green Factor (BGF) adopted in Turku in 2021. BGF is a tool to assess the proportion and quality of water retention elements (blue) and vegetation elements (green) in a planned area. This article will delve more deeply to the Turku Energia green roof (TEGR) -conflict by giving voice to pro-GR, anti-GR and more consensus-seeking voices and justifications during and after this localized battle over the mainstreaming of green roofing.

As distinct from purely technically-oriented GR research that tends to conceive its study object as a neutral or apolitical sustainability solution [17], this article's aim and approach is to inspect the interplay between power, planning and environmental processes (e.g. [18, 19]). To this end, our study at one level draws from policy-oriented GR studies. As with Zhang and He's [20] notion that "inefficient government policies may hinder societal enthusiasm for GR construction", these studies have insightfully traced barriers to GR implementation or a (lacking) political acceptance for increased green roofing [1, 20]. Along the same vein, this study asks:

1. How are local ecological interventions embedded in policy frameworks and initiatives?
2. How have local-, national- and superregional-level policy processes and aspirations supported, or impeded, green roof planning and implementation in the studied urban context?

In answering these research questions, a more critical premise à la urban political ecology adopted in this study is to not dismiss, at face value, objections to green roofing (or controversies around it), as futile. Applicable to "travelling" GR policies, the planning theorist Healey [21] warned policymakers and researchers "to be careful about applying models or best practices that work well in one place but may be inappropriate elsewhere" (cited in Fainstein [18

2 Green roof benefits and drawbacks in literature

Zhang and He [20] identify altogether 12 types of potential GR benefits, ranging from enhanced energy efficiency and urban heat island mitigation to recreational and aesthetic enhancement. Paving the way to the article's analyses via summarizing scientific and technical research, this section discusses the advantages of green roofs and the drawbacks that can limit their adoption, focusing on those GR aspects that played a role in the (de)politicization of the Finnish case analyzed below.

2.1 Stormwater management

Especially in urban areas under threat of flooding, GRs can play a valuable role in the retention of urban stormwater runoff [22]. GR compensate for the high proportion of sealed surfaces, which is because of the ability of the vegetation and soil layers to store a large amount of water, and their evapotranspiration capacity [23–26]. Studies on the hydrological performance of GRs have demonstrated that the rate of rainwater retention in the green roofs ranges from 55 to 88% [27]. However, in cold regions there are seasonal variations in GR-based stormwater retention, particularly due to a reduced infiltration capacity associated with soil frost and snow cover [28, 29].

In its Land Use Strategy, the City of Turku aims at developing its centre towards the seaside harbour area, where stormwater management is a key priority due to the flat, low-lying topography. The TE quarter analyzed below is located within this wider target area. Moreover, in finetuning the city's Green Factor (BGF), recently inaugurated in municipal planning to suit local circumstances and needs, stormwater management was the principal priority.

2.2 Other potential GR advantages and drawbacks

Research has shown that GR structures convey potential advantages in sound absorption and noise insulation [13, 27, 30, 31]. Other studies suggest that vegetated roofs are a sustainable solution to improve air quality [13], or in enhancing biodiversity and reducing habitat losses [30]. Green roofs can also play an important role in urban farming [25, 32]. Further, publicly accessible green structures on rooftops are prone to promote social and recreational activities e.g., via roof cafés, patios or roof gardening.

Further, green roofs' role in regulating micro- and local climate by providing thermal comfort and reducing surface temperatures have been demonstrated in many studies globally [33, 34]. Green roofs can directly or indirectly affect the temperature of the buildings (internal) and its surrounding (external) environment [35]. In climates with warm or moderate winters, green roofs can help to reduce heat loss from buildings by acting as an insulating membrane thus decreasing energy demand [4, 36, 37]. However, the GR-associated energy savings in Nordic conditions are more negligible, as during times of snow cover, snow is acting as an insulator and reducing the relative energy saving benefits achieved by green roofs [38, 39].

Also more broadly, a range of technical GR challenges are geographically variable (hot or cold, arid or humid climatic conditions) and building-specific (old or new building, protected or unprotected) [20]. Many GR types require regular maintenance. Lack of maintenance planning and guidelines still often hinder GR adoption [27]. In Turku and elsewhere in Finland, a perception of the cold climate's unsuitability for vegetated roofs has actually been one of the hindrances to GR adoption [7, 40].

Notably, all these GR benefits and challenges related to technical aspects, thermal effects, noise reduction, air quality, biodiversity and social liveability were present as arguments in the local GR dispute reflected below. In contrast to the prominent role on GR in local stormwater management and BGF calculation sheets, however, these "other" GR advantages were referred to more as general points (rather than as exact facts or calculations) in the dispute.

2.3 Economic potential and concerns

Often, economic benefits provided by GRs are difficult to measure, or do not have a market price. For instance, the influence of green roofing on energy consumption by cooling is difficult to assess as it is highly dependent on the building type, height, the type of vegetation used, and geographical location [7]. Similarly, more research is required on the effects of various GR types on roof longevity (and associated maintenance costs or savings) in different climatic circumstances [41]. The difficulty in measuring GR benefits also concerns the accessibility to green rooftop spaces, as their health, well-being and comfort-enhancing effects for residents can substantially increase the value of the property [7, 20].

GR cost–benefit analyses sometimes emphasize construction costs without considering the wide spectrum of their potential but difficult-to-measure advantages, all of which can in favourable circumstances add to the market value of a building [20, 27]. Nurmi et al. [7] and Feng and Hewage [42] classified the economic benefits of GRs into private (especially energy saving) and public benefits (especially stormwater reduction and air quality). Feng and Hewage [42] found that the public benefits of vegetated roofs are over three times larger than the private benefits, and hence saw that city authorities should play a key role in promoting green roofs.

Concerns related to the higher costs and financial risks of GR as compared to standard roof designs are widespread in many societies, including Finland [43, 44]. To investigate whether the benefits of green roofs outweigh their costs, Nurmi et al. [7] conducted an interview-based GR cost–benefit analysis for light-weight, self-sustaining vegetated roofs in Helsinki, Finland. In densely-built areas, green roofing had multiple types of public benefits, and thus proved a good investment. However, the private benefits were not sufficiently high to justify GR installation by private-sector developers. Nurmi et al. [7] concluded that the GR implementation rate was expected to stay low in the Finnish capital without corrective policy instruments such as administrative orders or incentives.

3 The mainstreaming of GR in policy context and as a domain of politics

In cities and societies where the public sector does not actively promote or regulate GR, the popularity of vegetated roofs is more dependent on market trends and developers' prioritizations. A strengthening worldwide trend, however, is that cross-scalar policy networks and project-based collaborations are developing tools for environmental governance [45], such as the iWater project discussed further below. At different scales, various policy instruments are used to promote nature-based urban solutions, including green roofing [1, 2, 20, 46–48]. These include legal provisions (acts, bylaws), building codes, strategies, financial support and incentive subsidies, as well as specific planning tools such as calculated Green (and Blue) Factors. In McCormick et al.'s [2, 49]). Likewise, tenders for developers, planning competitions, and citizen consultations may be arranged in a way that facilitates GR-based solutions. Policy-wise promotion of GR may also take place via contractual covenants in land and real estate transactions or leaseholds, charging stormwater fees from property owners, or devising binding plans that prescribe a developer to implement GR. Contrarily, efficient GR promotion, planning and management can suffer from the absence of appropriate policy frameworks and instruments [2, 20].

Equally crucially for this article, policy theorists have analyzed governmental processes in which design innovations like GR are involved, observing that these regularly feature cycles of openings and closures, politicization and depoliticization [50, 51]. Further, while thinking in more epochal terms, critical urban ecology and planning scholars are offering invaluable insights into depoliticized tendencies in decision-making and steering development in the current neoliberalized urban governance. Giddens [52] prognosed that in the expertise-dominated "post-traditional" society, all forms of local knowledge will become the applications of knowledge from elsewhere. In the late 20th and early twenty-first centuries, so the argument has gone in an extensive body of scholarship on "post-politics" or "post-democracy", regimes such as municipal governments have been increasingly offloading or outsourcing their decision-making power to technocratic systems, thereby depoliticizing governance and potentially delimiting democratic oversight on urban ecological interventions alike [53, 54]. As green roofing and other nature-based solutions have emerged as a component of urban ecological governance, aimed at climate change adaptation, and enhancing urban biodiversity , its depoliticization as a purely technical intervention may result in sidelining critical questions about who benefits, who decides, and whose priorities are served in urban sustainability efforts based on GR.

3.1 European path-setters

Nation-scale and local-scale GI and GR forerunners exist both in Europe and other continents, as with North America (e.g., Portland) and Asia (e.g. Singapore). Out of the path-setters in the branch, Germany has a particularly long record in scientific research, large-scale implementations and policy guidelines for planning and constructing GRs [27, 55]. Some German cities commenced supporting GR construction as early as the 1970s [30]. Importantly for this article, the idea for an integrated blue-green policy approach was also initiated in Germany. This took place in Berlin in the late-1980s, reflecting policy-makers' aspiration to transform "the city from grey to green" [56]. For this purpose, the Biotope Area Factor (BAF) tool, the inaugural Green Factor (a numeric calculation that provides a ratio of green area as a proportion of the total plot area), was taken into use in 1994.

In the Nordics, Denmark and Sweden represent countries with a reputation as leaders in the promotion of GR as a sustainability solution. In Copenhagen (pop. 660,000), GR has been obligatory since 2010 for new municipal buildings with roof slopes of less than 30° [27, 57]. In 2003, the second city to follow Berlin's model was Malmö in Sweden [56]. Increasingly since then, the integrated Green Factor tools have appeared under varying names in different policy contexts to ensure sufficient green infrastructure elements in the built area. These include various city- or country specific versions of BAF, GAF (Green Area Factor), and BGF (as with Turku).

3.2 Emergence of green roof policies in Finland

In comparison to Germany, Denmark and Sweden, GR promotion and regulation are relatively new phenomena in the Finnish urban context. In part due to international and EU-related pressures, and related to the country's climate change adaptation strategy, however, the early 2010s witnessed signs of increasing political will to integrate the GR concept into official planning policies and other regulations [58, 59]. In 2012, the national Government issued a Resolution on the Finnish Strategy for the Conservation and Sustainable Use of Biodiversity for the Years 2012–2020, which briefly mentioned GRs. Also, the Water Management Act was updated in 2014 [58]. It allowed the municipalities to regulate stormwater according to their own requirements, e.g., to formulate general stormwater management goals, or deliver property-specific obligations and stormwater fees. Importantly, this Act emphasized the use of green elements to manage storm waters.

Consequently, green roofing policies have started to emerge across major Finnish cities. A forerunning city in advancing GR has been the country's capital. In May 2013, the City of Helsinki decided to develop a green roof strategy, aiming at being profiled as a pioneer in GR implementation [3]. The city's strategic guideline for GR was approved by the City Council in 2016. Its goals included improving the stormwater management, regulating micro-climate and promoting urban diversity. A further milestone was when Helsinki commenced piloting its GAF [60]. Since then, Helsinki has increasingly applied GR stipulations in zoning target areas via this coefficient-based (integrated) approach.[1] In the upcoming years, other major cities such as Tampere, Turku and Oulu, as well as Helsinki's neighbouring municipalities Espoo and Vantaa have followed the suit.

The mentioned Finnish cities have lately developed their GR policies largely independently in collaboration with frameworks and institutions at different levels of governance, both nationally and internationally. The City of Turku's GR-related policy initiatives, for instance, have gone hand in hand with its involvement in the Global Climate Action through the Turku Climate Plan 2029 (since June 2018), and its aim to become a carbon neutral city by the end of 2029 [61]. Adding nature-based elements such as GR in the urban environment is seen as a means of fulfilling these strategic goals. A case in point is Turku's BGF. Like with the GAF of Helsinki, it is an upshot of the City's involvement in the EU-funded Integrated Stormwater Management (iWater, 2015–2018), where planning tools were developed to enhance stormwater management concept and sustainable urban planning and resilience in the Baltic Sea region.

Based on parameters finetuned for Turku, it is an urban planning tool intended to ensure the ecological efficiency of a built-up area. BGF regulates green efficiency of urban areas by setting the ratio of vegetation and ecologically functional surfaces to the built-up area. For housing areas, for instance, the BGF threshold value of 0.8 is used. Consisting of a relatively intricate calculation process, it estimates the amount and quality of vegetation and permeable surfaces within a plot, and actually prioritizes stormwater management (capacity to retain and delay stormwater runoff) via technical infrastructure elements (e.g., stormwater retention tanks, permeable surfaces) and nature-based solution alternatives (including green roofs).

4 The Turku Energia green roof dispute

4.1 Research area and data

The following investigation focuses on Turku, a provincial capital with over 200,000 inhabitants on the South-Western coast of Finland. The climate of the region is characterized by cool to cold winters and warm summers (Table 1). Turku has a seasonal cover of frost and snow and relatively short growing season (less than 150 days, compared to e.g., over 200 days in Copenhagen) introducing the question of the impact of a cold climate on GR functionality. Equally noteworthy, climate change can be traced in the local climate statistics. From the 1960s, Turku has experienced temperature increase especially during winter. Snow cover has become thinner, and its duration has shortened [62]. In addition, climate change predictions state that precipitation will increase, and heavy rain events will become more frequent [63]. All this is pressurizing stormwater management in the city's riverside lands, currently undergoing post-industrial redevelopment.

[1] In part resonating with this study's analysis of Turku, however, Helsinki has simultaneously imposed dozens of detailed plan-based GR prescriptions for specific buildings [72].

Table 1 Selected climatological statistics of Turku [64]

Period 1991–2020	Value
Annual mean T, °C	+ 5.8
Mean of monthly min T, °C (Jan)	-4.5
Mean of monthly max T, °C (Jul)	+ 17.5
Absolute min T, °C (Jan 2013)	-28.2
Absolute max T, °C (Jul 2018)	+ 33.0
Annual precipitation, mm	684
Snow cover, months	3

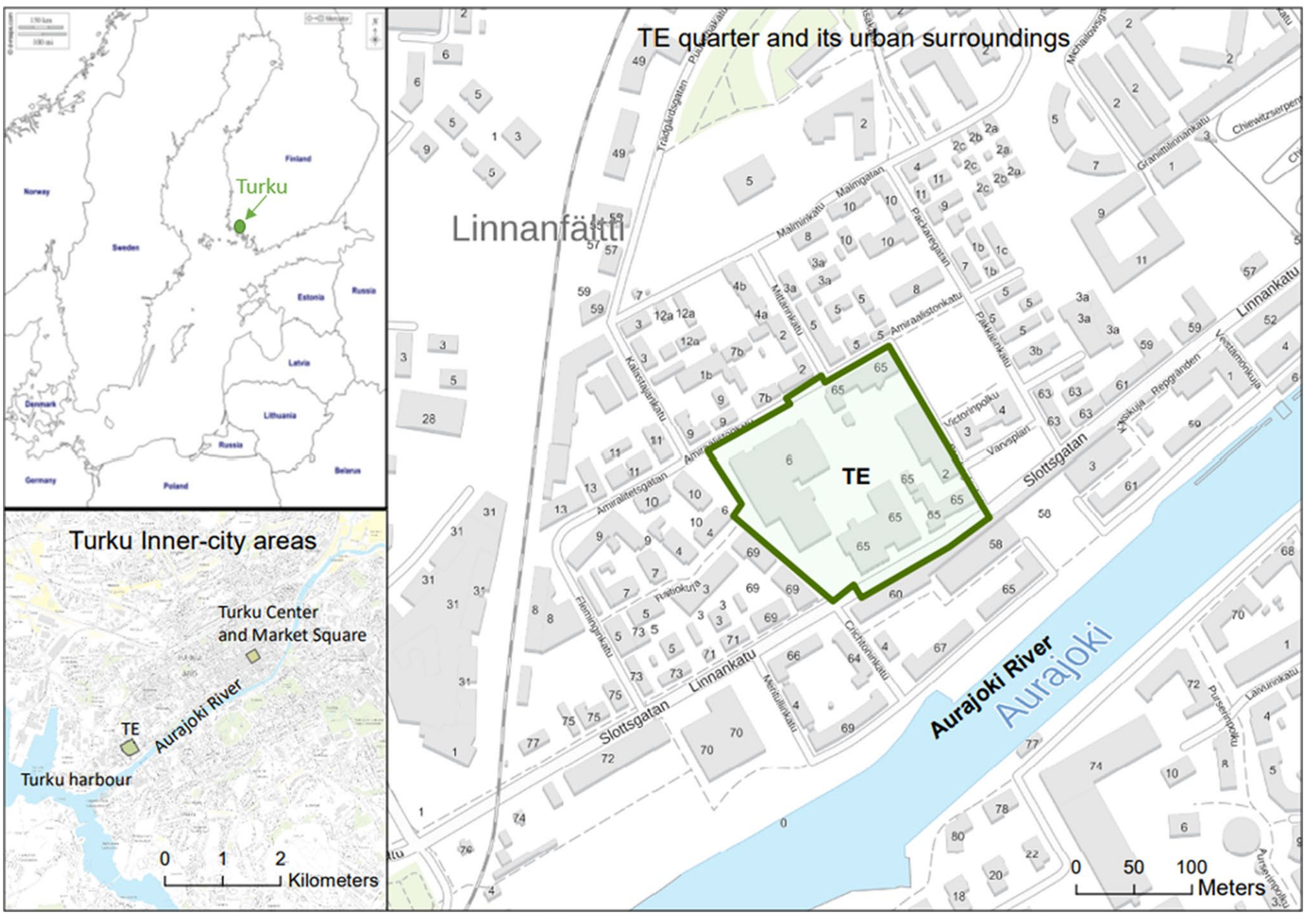

Fig. 1 The study site, Turku Energia quarter (street address: Linnankatu 65), located in an inner-city riverside zone that has undergone deindustrialization. The base map is retrieved from National Land Survey of Finland: https://asiointi.maanmittauslaitos.fi/karttapaikka/?lang=fi [65]

Locating within this zone, our case study site, the Turku Energia (TE) quarter, is a former industrial plot of 3.4 hectares (Fig. 1). The quarter has been used by the municipal energy company Turku Energia for several decades for producing energy by combustion. The plot is neighboured by several other (completed, ongoing or projected) regeneration projects, all linked with the City's strategic aim to expand its centre westwards, towards the sea. In this entire area, stormwater management is a key priority due to the flat, low-lying topography. In the two versions of revised detailed plans for the TE quarter from 2018 and 2022, it is being transformed into a mixed-use plot with new residential and office buildings, and new uses for its old, protected building stock. Due to the increased density within the quarter, green roofs were suggested as a key solution to manage the TE quarter's urban stormwater runoff.

In analyzing a planning conflict associated with the TE quarter's zoning, we utilize a mixed-method case study approach combining qualitative and quantitative methods. Following Flyvbjerg [66], the aim is to conduct a problem-driven rather than method-driven analysis of the planning process and conflicting interpretations related to the use of GR in TE quarter's revised plans. From the data perspective, we collected the available planning documents related to the TE quarter redevelopment, as well as data related to municipal decision-making. The latter data unravelled the conflicting views on using green roofs in the TE quarter that were a subject of heated debate among the representatives of different political parties. To gain a picture of the arguments and counterarguments along the political spectrum, we also conducted a questionnaire survey with Turku council members (18 respondents). Furthermore, reports in the local media were used to highlight the dispute. Finally, we conducted interviews with six local stakeholders with GR expertise (Table 2) to provide in-depth analysis of the reasons why the GR concept was either strongly advocated or objected to in the case of TE quarter. A detailed description of the data is provided in Appendix 1.

4.2 From a planning competition to two consecutively revised detailed plans

In 2015, two units of Turku's City administration (Real Estate and Urban Environment divisions) and two city-owned public utilities (Turku Energia –company, the plot's tenure-holder; and TVT, a major local developer and provider of social housing) took a joint initiative to arrange a planning competition to envision redevelopment ideas for the TE area's future. Combining renovations of preserved energy-production plant and tram depot with new infill residential buildings, it was estimated that once completed, the plot would house 450–600 residents.

Planning competition (2015–2016): In the competition instructions for the TE quarter, stipulations regarding stormwater management in the area were detailed in line with the building code, and greenness was mentioned as a broad ideal in evaluating the entries. However, at this phase, there were not any mention of GR in the official instructions for the four architectural teams invited to attend the competition. On the contrary, with an eye to TVT, it was specifically mentioned that the entries should include units of affordable rentals to be instantiated in line with the nation-wide funding principles of ARA (The Housing Finance and Development Centre of Finland).

Thus, GR was a non-existing design element for the quarter in the competition instructions and even in the final evaluation protocol. However, out of the four candidates that were qualified to submit their entries, two entries had opted for GR in their proposals of the area's overview. One of these was the winning entry "Rasteri" by Sigge Architects Ltd, in which all eight residential buildings within the area were "cosmetically" visualized with vegetated roofs (Fig. 2). Interestingly, the evaluation report expressed concerns over Rasteri's potential costliness stemming from its plentiful balconies, excessive number of offices, transport and public spaces, but did not mention GR as an expense-adding factor.

The initial detailed plan: Drawing from the planning competition, the area's municipality-led planning went ahead. At this phase, GR achieved a more prominent role, and the politicization of the TE's green roofing took place. The municipal elections held in April 2017, influenced the march of events. In October 2017, the newly-nominated Urban Planning and Environment Committee with councilors representing the City Council's parties, chaired by the election-winning Green Party's N.N. (one of our interviewees), added a revision (with 7 votes for and 5 against) to the detailed plan proposal drafted by city-planners. This revised plan stipulated that at least half of the roof area on the new buildings must be implemented as green roofs. Clearly cognizant of GR research, the multi-party Committee stated that "there are several benefits to green roofs: They are beautiful, significantly reduce runoff water, protect roof structures and extend roof life, insulate heat in summer and cool in winter, reduce noise, improve urban air quality and act as a carbon sink." On the other hand, the Committee report admitted that "barriers such as the construction and maintenance costs of residential buildings must be taken into account" in implementing GR on the plot.

Instantly, however, tensions escalated. In particular, the TVT expressed its adamant objection to the requirement of GR on its three projected TE apartment blocks. In its notification, TVT argued that "there does not exist wide experience on using GR in industrial housing production" in Finland, and that "it is evident green roofs are more expensive to implement and require continuous maintenance and monitoring". Given the institutional framework of the ARA-subsidized production of affordable housing in Finland (in which expense thresholds guarantee cheap loans), TVT underscored that meeting the GR stipulation would be "very challenging" for it.

This led to a months-long political dramatization over the issue whether green roofs on TE's upcoming residential blocks should be mandatory or appear only as a recommendation in the detailed plan. In the City boardrooms, the local press, and social media forums, politicians and other stakeholders took stance on the issue. Representing the right-wing Coalition Party, the mayor Minna Arve was in favor of recommending rather than commanding GR. In her diplomatic address to the City Board in January 2018, she mentioned both GR benefits and risks, and drew on recent GR policy changes in Helsinki:

Table 2 Information on the interviewed experts

Interviewee	Title & institution	Expertise of relevance
N.N	City councillor (Green Party), Urban Planning and Environment Committee (chair in 2017–2021; City of Turku)	Expertise in green infrastructure and environmental policies. Strong political and public involvement in the TE dispute
M.M	City councillor (Coalition Party), Urban Planning and Environment Committee (vice-chair in 2017–2021; City of Turku)	Long-term, expertise in city planning and environmental policies. Strong political and public involvement in the TE dispute
L.L	City planning architect (City of Turku)	Expertise in greening urban architecture, its prospects and challenges, including projects in Turku's densifying areas. Turku's representative in the iWater-project
K.K	City planning architect (City of Turku)	Expertise in greening urban architecture, its prospects and challenges; a long-term involvement in redevelopment plans for the TE quarter
J.J	Development Manager (municipal property company TVT Rental Housing)	Expertise in rental housing provision, construction engineering, and real estate business
H.H	Journalist (Turun Sanomat newspaper)	Expertise through reporting widely on local urban development, policy and decision-making in the region's most widely read newspaper

Fig. 2 Aerial visualization of the Turku Energia quarter in the winning entry "Rasteri" by the Sigge Architects. (Excerpt retrieved from City of Turku: https://www.turku.fi/uutinen/2016-03-15_sigge-arkkitehdit-oy-voitti-turku-energian-tontin-suunnittelukilpailun) [67]

"As GR implementation may become excessively costly for affordably-priced targets such as TVT Housing Ltd's developments, one needs to be cautious about it. In comparison to many other European countries, a very moderate number of GR has been thus far built in Finland. In 2016, Helsinki decided to construct GR on new schools, daycare centers and its own housing productions in cases where GR is a solid solution based on an overall evaluation."

In the decisive, quarrelsome Council meeting in later January, however, Arve's proposal was not endorsed. Instead, a trade-off solution according to which GR would be mandatory on five new market-price buildings, whereas for the three apartment blocks to-be-developed by the TVT, GR was a recommendation only.

The reformulated detailed plan: Subsequently, appeals to Administrative Court, and eventually Supreme Administrative Court, temporarily halted the area's redevelopment. In October 2020, the Supreme Administrative Court overruled the TE detail plan, which meant that a further round in preparing the TE plan by municipal city planners took place (Fig. 3).

As distinct from the 2018 version, the newer 2022 TE detailed plan does not contain any GR-related map designations. Its description part, instead, specifies subplot-specific recommendations for promoting green efficiency and especially stormwater retention. As Table 3 shows, for the subplots 2–3 (including five new apartment blocks, with 3550 m^2 total roof surface), for instance, the recommendation is to built a 350 m^2 roof garden, and cover the rest of the roof area with a *Sedum* (liverwort) GR. Instead, in the subplots *4–6,* "tentatively intended for the TVT Housing Ltd", "it is feasible meet the coefficient 0.8 without GR."

This suffices to demonstrate that there are not very drastic differences in how GR is instructed to be used on the area's rooftops between the 2018 and 2022 versions of the TE detailed plan. For the TVT apartment blocks, GR is not seen as the only option in either of the plans. For the market-price apartment blocks, GR is either stipulated (the 2018 version), or stated as "the recommendation" or "apparently… the only way" to achieve sufficient green efficiency and stormwater retention capacity (the 2022 version). Regarding the articulation of ecological interventions, the main difference is simply in the more exact BGF-based vocabulary and framework. Apparently, an intricate quantified ecological and storm water retention assessment has entered municipal planning, but how exactly the calculations were performed, and the mainly GR-based recommendations given, are not disclosed in any detail in the planning document itself.

The Turku City Council ratified the new revised detailed for the TE quarter in September 2022. In this short hearing, none of the councilors questioned or "politicized" the GR recommendations for the target area.

4.3 Causes for politicization and depoliticization

In essence, the first round of formulating and deciding on the TE redevelopment plan was a disorderly process of mutual misunderstandings, especially as regards green roofs. In this section, we seek to dig deeper into the causes for the TEGR case's politicization, and its subsequent depoliticization.

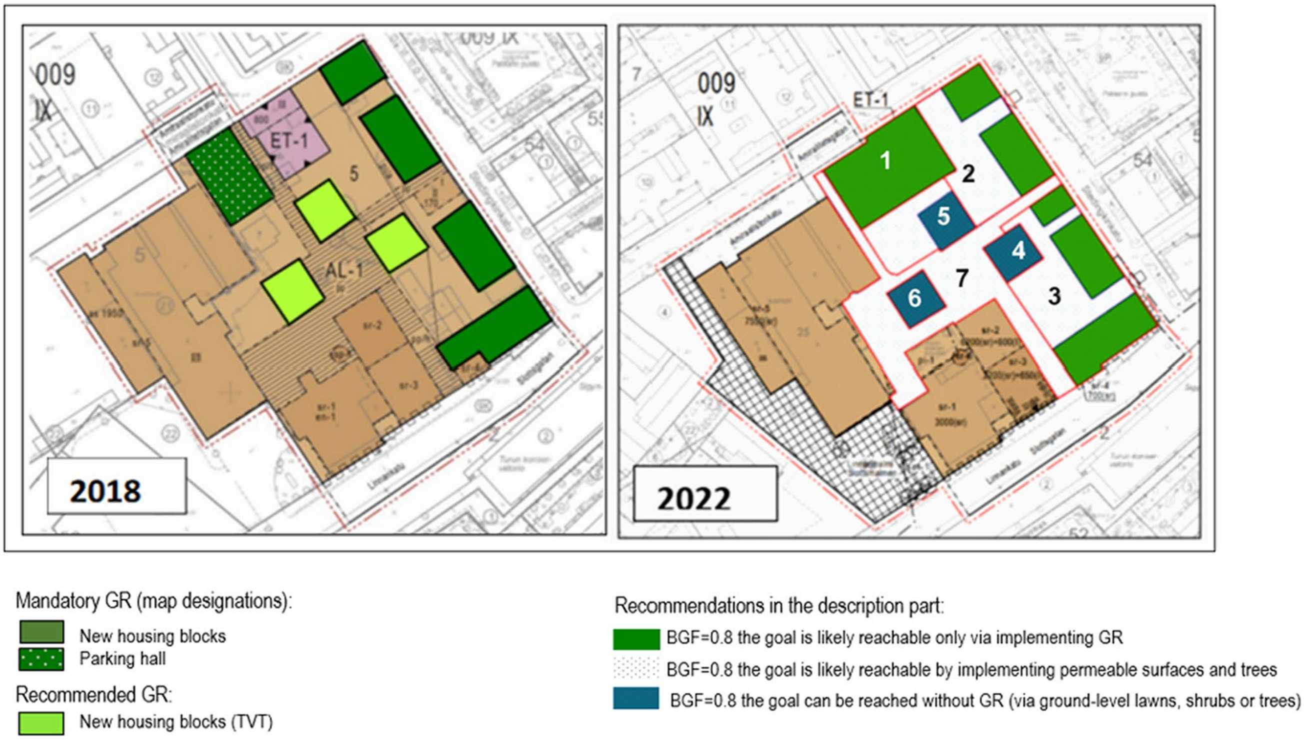

Fig. 3 In the 2018 and 2022 versions of the Turku Energia revised detailed plan, green roof regulations are given either as recommendations or mandatory prescriptions. Via map designations, the 2018 plan recommends GR for three apartment blocks (reserved for TVT's ARA-subsidized housing) and prescribes GR for other buildings. The description part of the 2022 plan utilizes the BGF. It details ways by which adequate green efficiency can reached in subareas 1, 2–3 (market-priced apartment blocks), 4–6 (residential blocks reserved for TVT) and 7

Table 3 Suggested ways to reach the BGF threshold level in the 2022 version of the Turku Energia revised detailed plan

Subplot	Description	Recommendation to reach the BGF threshold level (0.8)
Subplot 1	Preserved electricity station and a new parking facility	Use *Sedum* cover of ~ 1150 m^2
Subplot 2–3	Five new apartment blocks on the decked parts of the plot	350 m^2 roof garden 3200 m^2 with *Sedum* green roof
Subplot 4–6	Three new apartment blocks on the undecked parts of the plot, amidst the TE plot, "tentatively intended for TVT Housing Ltd"	Other green solutions than GR
Subplot 7	Cycling and walking areas through the block	Use semi-permeable surface materials and plant ~ 15 trees

Antagonistic views on GR: As we have seen, the municipality-owned social housing provider TVT was extremely dissatisfied with the Environmental and Committee's GR-favorable turn in TE quarter's planning after the 2017 council elections. According to our interviewees, the key launching factor for the politicization of the case was actually the Green party's preceding election victory. To redeem its environmentalist promises to the electorate, the party adopted itself a leading role in advancing sustainability and greenness on several fronts of urban (re)development, including pro-GR ambitions. As the then chairperson of Turku's Urban Planning and Environment Committee, the Green Party's N.N., explained, the Greens saw that pioneering GR showcases are needed in Turku. In an interview conducted in 2021, she suggested that the stance that vegetated roofs are "not workable in Finland… is sneaking into certain parties", and that "we cannot just wait that some developers would implement things out of good will". She also opined that "the (Finnish) construction industry in a broad sense" tends to be skeptical about the GR concept. As she put it:

"Pattern-setting models for green roofs are needed in Turku. The TE plan was properly justified in terms of making green roofs mandatory. There exist many prejudices against green roofs, and breaching these requires more experiences and pioneering."

While the Greens' endorsement of green roofs is somewhat self-explanatory, why then the TVT's stance was adamantly GR-negative? The TVT's interviewed Development Manager J.J. reminded us that the company one of the initiators of TE quarter's redevelopment. Against this backdrop, J.J. complained that "few asked about our opinion or what we are thinking about" when the City's planning machinery drove forward with the pro-GR plan. During the interview, it became very apparent that J.J. was highly knowledgeable about different kinds of advantages typically associated with GR. Actually, he brought an array of argued GR merits into discussion, but which he then consistently torpedoed from the perspective of his employer. J.J. argued that implementing and maintaining GRs is costly, and especially for builders-and-property owners like TVT who need to keep expenses low. He then highlighted the serious technical maintenance and moisture damage risks in adopting GRs in Turku where winter temperatures fluctuate above and below zero, asking "who will maintain them… and who has the proper expertise, and can one rely on this?". Neither the aesthetic benefits of rooftop vegetation on 8-storey buildings nor the concept of GR as a tool of climate change adaptation convinced him. At one point, J.J. also hinted at TVT's social duty as a provider of affordable housing, saying that TVT tenants prioritize "laundry rooms", "parking lots" and "nice window views" above a GR. Seemingly preoccupied with ARA's cost-cutting imperatives for his company's operations, J.J. consistently objected to the TE plan as a local showcase for GRs.

Broader GR perceptions and knowledge sources: Apart from the above extreme views contra or pro GR, the majority of our informants held more balanced views on their benefits and challenges. Both in the interviews and the Council survey, the clearly most widely recognized GR benefit in the council survey was that of vegetated roofs acting to reduce stormwater runoff. In the words of the interviewed journalist H.H.: "Land there is so low-lying that for sure these areas are most problematic for managing the runoff… You know, [storm]waters have been taken under active deliberation in this City". Furthermore, certain GR risk or challenge types featured prominently in the policy-makers' perceptions, both in the survey and expert interviews. Many emphasized that GR is not only more expensive to build than non-vegetated standard roofs, but also that the lack of experience in building them in Finland can convey technical risks and unexpected maintenance costs.[2] In the survey, many right-wing councilors mentioned potential moisture damages as a cause of worry. The interviews revealed a further attitudinal gap. In the phrase of the right-wing Coalition party councilor M.M., "the old coalition" tends to perceive GR structures as an economically costly and risky solution. By contrast, informants on the pro-GR side saw the technical problems as solvable, even if acknowledging that more experience in GR constructing and maintaining is needed.

Given the intensity of the TEGR debate and the above-mentioned political division lines, it is pertinent to ask: what were the main sources of GR knowledge among the Turku policy-makers? Interestingly, the interviewed experts also emphasized differentiation in GR knowledge acquisition across different political parties. A noteworthy point stressed by M.M. was that "all politicians cannot familiarize themselves with all matters, instead some of them in the lead read up on a certain field and influence others' decision making based on that knowledge." In the light of other interviews, too, pre-vote briefings and discussions within party-specific council groups played a crucial role in the councilors' GR-related opinions and voting behavior. As the City Architect K.K. put it: "I think that in each party there is a knowledgeable devotee who was able to formulate the party's stance."

Causes for depoliticization and post-debate insights: If there was a thing on which the experts agreed in our interviews, this was their shared perception of biased communication and the lack of co-operation between the actors during the politicized phase of the TEGR case. Whatever its merits in principle, the adopted site-specific, prescription-based strategy by the Greens did not excel in advancing mutual communication among policymakers, or deliberativeness in urban planning. Rather, the promotion of GR via the showcase of TE proved counterproductive in that it caused a strong counter-reaction from the TVT and many politicians under its sphere of influence. Even though the policymakers' were generally aware of many facts on the GR concept, preset opinions loomed large as an overall result. As the Green Party's N.N. admitted in retrospect:

"Now I have a feeling that political stakes should not be risked for quarrelling on specific plans, and whether or not a green roof is implemented on a certain building. It was incredibly wrenching…"

[2] In the interviewed City Architect L.L.'s words, GRs are "quite complex in technical terms… Experience in executing them is scarce, and they are shunned and feared exactly for this reason.".

Reflecting on the issue from a broader decision-making perspective, another non-Green party -Council member wrote in an open survey question:

> "The GR issue is much wider than the case at hand. The city should not embark on this kind of solution based on a proposition by one political group. Instead, it should agree upon general principles concerning green roofs."

The latter quote captures what has taken place in the municipal planning system's approach to green roofing and other GI elements in recent years. In the meantime, the City of Turku has developed its urban greenness coefficient, the BGF, and put it in use in 2021. Concerning both the TE and other (re)development plans, this has made the site-specific "top-down" mandatory GR prescriptions, such as with the first analyzed TE plan, as increasingly redundant.

Most of the experts interviewed for this study agreed that the key advantage of the BGF stems from its flexibility as a planning tool to enhance urban greenness in ways that are suitable for local and plot-specific circumstances (see also [56]). In the city architect K.K.'s words, "there now increasingly prevails a will to draft plans in which alternatives and leeway is given to developers." As M.M., with a long experience as a politician specialized in urban development and redevelopment matters, explained, with the BGF tool:

> "You don't need to focus the discussion on roofs alone, but you can scan different alternatives… I have known about green roofs quite long insofar as locations slightly outside of Finland are concerned. So, the concept is in a way familiar. I must admit, however, that the idea of bringing green roofs to the Finnish circumstances, has been alien… I have had to pretty much think over and adapt to a thought that they might function here as well."

5 Conclusion: How to overcome local policy conflicts that hinder climate actions?

The urban ecological intervention investigated in this article has been a planning process enacted in a transitory phase between politicization and depoliticization. What broader lessons can be drawn from the power-embedded complexities of the Turku Energia quarter's green roof -focused planning issue? Or to return to the question posed in the article title: How to overcome local policy conflicts that hinder climate actions in the light of the city-specific and plot-specific insights opened above? Two distinctive approaches to achieve goals of urban sustainability and climate change adaptation occurred: the site-specific, prescription-based tactic towards the mainstreaming of green roofing adopted by the Green party at the height of its power in municipal politics, and the city-wide integrated approach in which a Turku-finetuned Green Factor was taken into use to advance green efficiency and stormwater management through urban planning. Whatever its merits in principle, the principled environmentalist enthusiasm in the former approach proved inefficient in that it launched an adamant principled objection campaign by one of stakeholders behind the quarter's redevelopment initiative, the TVT Rental Housing. At least in the present conjuncture, it appears that the Green Factor -approach is proving by far more successful in achieving greening goals in Turku as well. The approach leaves the developers with options for implementing nature-based solutions in their own wished ways, while the local governments are able to strategically steer target levels for green infrastructure, and emphasize specific elements of it (e.g. by weighting GR in the spreadsheet calculations). This finding resonates with preceding studies such as Perera et al.'s [56] meta- global review of urban blue-green planning tools.

Interpreted through the lens of urban political ecology and critical planning studies, the second takeaway is related to the fact that multiple stakeholders with differing aspirations tend to partake in urban redevelopment and planning projects. Characteristically, not all stakeholders prioritize urban greenness. In our case study, one of the root causes for the furor over the TE's "forced" green roofing attempt was that the TVT was excluded from the politically-nominated committee, which commenced the prescription-based approach to cover the TE roofs with vegetation. In this situation, the municipality-owned company became embittered as its institutionally stipulated expense-cutting raison d'être was at odds with the plan. The interviewed TVT representative himself did not underscore that the rationale of the company is to build and offer affordable housing for lower-income tenants. However, it is pertinent point out that the river zone plots in Turku are located in an area of soaring property prices. In this zone, "socially mixed" housing developments have become increasingly exceptional in the 2000s. Seen from this angle, the TVT's reluctance to endorse green roofing was voicing a criticism against the area's foreseeable gentrification through urban greening. As the scholars of "green" or "eco- " gentrification in Finland and beyond have observed, ecological innovations and improvements are not without social implications, as they characteristically mean a heightened price tag for housing in the target areas [68, 69]. At the same time, it needs to be recalled that TVT eventually had its say on the TE quarter's plan, showing that its "non-environmentalist" approach to planning was not fully suppressed. It remained a powerful actor in the planning process. If anything, the TVT's persistent position in TE redevelopment project demonstrates that urban spaces are shaped by intricate social, economic, political and environmental power relations.

Finally, what are the pros and cons of the depoliticized turn in planning via nature-based solutions, brought along in Turku by its Blue-Green Factor? In our data, the politicians and planners were largely satisfied and hopeful with this "agile" planning novelty. In general, this attitude likely echoed criticisms on the rigidity of the municipal planning system in Finland [70], and in particular, the "incredibly wrenching" experience of a dichotomous quarrelling about the advantages and drawbacks of the green roof concept at height of the TE debate's politicization. This attitude resonates with notions on the advantages of depoliticization, namely that as a governmental entity mandates technocratic or expert systems to manage the minutiae of operational policies in fields like urban planning, it decouples the decision-makers from whimsicalities brought by short-term election cycles, and allows them to concentrate on strategic interests and goal-setting [19, 71]. However, local disputes and differing opinions on GR or any other planning novelty are not to be considered merely as problematic. On the contrary, as justifiably argued by agonistic-participatory planning theorists, disputes are a crucial element in the functioning of democracy [11, 21]. Furthermore, the depoliticization in planning and implementing green solutions carries a risk of excessive reliance on the accuracy of numeric parameters and calculations in policy tools such as Green Factors [18]. Without deliberative mechanisms and democratic accountability, overly technocratic green planning may also end up inadvertently pushing ahead gentrification in the better-off areas for higher-income residents, while eroding urban social cohesion at the expense of ecological sustainability [68]. Overall, it is still too early to say what kinds of longer-term effects the increasingly depoliticized and efficient green planning will have in cities.

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Declarations

Ethics approval and consent to participate In Finland, research with human participants must comply with the guidelines of the Finnish National Board on Research Integrity TENK The ethical principles of research with human participants and ethical review in the human sciences in Finland" Finnish National Board on Research Integrity TENK guidelines 2019". The University of Turku has undertaken to comply with TENK's guidelines. The guidelines do not cover medical research as defined by law (Medical Research Act 488/1999) or other research designs where ethical review is a separate obligation laid down by law. Hereby, in accordance with Ethics Committee for Human Sciences at the University of Turku, this study did not require an ethics approval as it involved non-sensitive, anonymous survey data that did not collect any personal information. The Ethics Committee for Human Sciences at the University of Turku does not mandate approval for this type of research under the (Finnish National Board on Research Integrity guidelines). All participants in this study provided informed consent prior to their participation.

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