



TOOLS FOR SUSTAINABLE AND RESILIENT RIVERFRONTS: THE ROLE OF BUILDING CERTIFICATES AND DESIGN MANUALS IN HAFENCITY, 3LAND, AND NECKARBOGEN¹

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Abstract

Introduction

Urban riverfront megaprojects in Germany recently rely on two instruments to steer quality and sustainability: building certificates that translate policy targets into measurable performance, and design manuals that codify morphological and material standards. This paper compares how these tools are deployed in three high-profile cases from the German context: HafenCity (Hamburg), 3Land (Basel – Huningue - Weil am Rhein), and Neckarbogen (Heilbronn).

Methodology

The research performs document analysis and comparison of documents such as the HafenCity Ecolabel, DGNB certificate schemes, the certification process manual for 3Land, and the Design manual developed for Neckarbogen. The document analysis will be accompanied by a spatial analysis of the redevelopment areas.

Findings

Certificates are responsible for legitimizing higher construction costs. They also help to quantify climate resilience, energy, and social equity. Manuals translate the abstract criteria into site-specific design codes.

Discussion and conclusion

Findings show that certificates and manuals operate as a mutually reinforcing quality matrix for such redevelopments and play a key role in achieving sustainability and resilience goals. The insights from this research can inform both policymakers and practitioners when designing the next generation of climate-adaptive, sustainable, and resilient urban riverfronts.

The paper offers three contributions: Firstly, an overview of how certificates and design manuals operationalize sustainability and resilience in waterfront districts; secondly, evidence-based recommendations for public authorities on how to sequence regulatory instruments and reduce stakeholder friction; and finally, lessons for transboundary projects (such as the 3land project) on how to successfully harmonize different national certification cultures and practices.

Keywords: *building certification, design manuals, resilience, sustainability, urban waterfronts*

¹ This paper is derived from the doctoral dissertation of Sanja Avramoska at TU Darmstadt, which investigates the translation of visions into binding engineering solutions and contracts across HafenCity (Hamburg), Neckarbogen (Heilbronn), and 3Land (Basel–Weil am Rhein–Huningue)

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Introduction

Riverfront redevelopments of former industrial and port areas incorporate multiple infrastructural systems at once: flood management infrastructures, blue-green, high-quality public spaces, mobility infrastructures, and sustainable and resilient vertical superstructures. This complexity of infrastructures in riverfronts is often implemented by hybrid governance instruments which include publicly led corporates and public-private partnerships. As these developments are situated in central urban areas, the expectations and pressure for achieving social and environmental sustainability and resilience are always high. Certification systems for sustainable neighborhoods started to emerge around two decades ago. Local governments implement building certificates and labels, which are joined by design manuals, to steer more sustainable outcomes.

This paper compares how these instruments are operationalized in three key riverfront redevelopments from the German context: HafenCity (Hamburg), 3Land (Basel–Weil–Huningue), and Neckarbogen (Heilbronn). These three cases are situated in three different contexts, differ in scale, governance models, and planning process, but are comparable as they are all placed in an urban context, are recent port redevelopments (From the last 3 decades), and all rely on certificates and labels as instruments that ensure building qualities.

The paper employs not only comparative analysis on three specific cases, but it also foregrounds the engineering of standards, and it aims to answer the following research question: How do local governments enforce urban sustainability and resilience certification systems in Germany, and how are these systems shaped to respond to the specific context in riverfront redevelopments?

1. Literature Review and Conceptual-Theoretical Framework

Most of the existing scientific literature maps or critiques the main neighborhood and district certification schemes. Comparative analyses find that certification systems sometimes focus on procedures and features over measured performance, have fewer mandatory targets than needed, and, with that risk, “certifying without being sustainable” if credits can be traded off. Other indicator-level comparisons focus on the use of sustainable materials and show divergence across design guidelines and neighbourhood sustainability assessment tools (Wangel et al., 2016; Yoon and Park, 2015). Research that reviews post-certification performance on buildings shows inconsistent post-occupancy evaluation methods and reporting, and calls for a standardized and cohesive post-occupancy evaluation approach (Evans et al., 2025; Hersh, 2012). Research that reviews post certification performance on buildings shows inconsistent post occupancy evaluation methods and reporting, and calls for standardized and cohesive post-occupancy evaluation approach (Afroz et al., 2020; Zhao et al., 2024). Respectively to the topics, methodologies used in these research are: comparative content analysis of scheme criteria, (Wangel et al., 2016; Yoon and Park, 2015), case-study research on specific redevelopments often with mixed-methods for data collection (Hersh, 2012) and post-occupancy evaluation and performance reviews (Afroz et al., 2020; Zhao et al., 2024).

There are many comparisons of certification systems and labeling, but very few studies examine how sustainability targets (which are expressed firstly in redevelopment visions) become enforceable through concrete instruments and what the governance network that operationalizes

them. This paper traces exactly that translation pathway. Furthermore, waterfront research argues for resilience governance, but the link between flood-risk engineering and certification targets is rarely mapped. This research is based on a network perspective that views riverfronts as systems-of-systems and aims to map the links and networks from vision to inscription into certificates, labels, or manuals. To frame the concepts, certificates and manuals are seen as inscriptions that shape metrics and thresholds which regulate typologies, materials, and details for architecture. When the authorities adopted instruments such as certification systems, they created a new translation moment (in ANT³ terms) and a new Obligatory Passage Point (OPP)⁴ (Latour, 2005) for investors, architects and developers.

2. Methodology

The methods combine document analysis (certification criteria, design manuals, land-sale contracts, planning ordinances) and institutional analysis (who owns, verifies, and enforces the certifications). Each certification instrument is reviewed across nine dimensions: scope, legal/contractual force, administrator, verification, core metrics, resilience, enforcement levers, and interaction with other tools, and the certification systems are compared through these two perspectives. The analysis is limited as it focuses only on the structure and design of the certification systems, their implementation strategy, and the governance structures that enable them, rather than long-term performance monitoring. One of the cases – 3Land is treated as an evolving practice as it is still not obligatory and widely implemented in the redevelopment.

3. Case Contexts and Instrument Genealogies

3.1. HafenCity (Hamburg)

The instrument set for HafenCity was evaluated from a local and voluntary system to a hybrid local-state mandatory system. The Hafen City Eco Label (v 1.0) launched in 2007 (Figure 3c). The label was not mandatory and awarded “silver” and “gold” category labels based on the performance of the building. In 2010, “HafenCity Eco-Label Gold” became mandatory, which changed procedures for land-sale contracts and building permitting. In 2017, City Eco Label (v 3.0) (Figure 3b) (GFÖB & HCH, 2010) was launched, which introduced the “platinum” category and stricter sustainability criteria. Finally, in 2023, the local Eco-Label joined the German national DGNB⁵ standards (Figure 3d) and evolved into the DGNB Special Award: Ecolabel for HafenCity, Billebogen, Grasbrook, and Science City districts (DGNB, 2023). The label became contractually mandatory on HafenCity Hamburg GmbH (HCH)⁶ - developed plots and became a rare example of making certification binding through development contracts. To operationalize the label other instruments were employed: plot-specific guidelines, land-sale contracts, flood-resilience norms, and mobility targets.

³ Actor–Network Theory (ANT); maps how human and non-human actors (rules, plans, infrastructures) align through translations to stabilize a project.

⁴ a required node/process all relevant actors must pass through or align around.

⁵ German Sustainable Building Council; runs the DGNB certification systems for buildings and urban districts.

⁶ HafenCity Hamburg GmbH: city-owned developer/landowner for HafenCity that ties plot sales to sustainability requirements.

HCH acts as land developer and a manager, which is translating local authorities' policy into contracts with obligations. Independent experts and certification bodies verify compliance at building permit and handover stages.

Figure 1: Public space in-between blocks of Neckarbogen, with seating/play elements. Source: author, 2023



Figure 2: Les Jetées residential tower, Huningue. Source: author, 2024



Figure 3: HafenCity district, residential buildings. Source: author, 2023



3.2. 3Land (Basel – Weil am Rhein – Huningue)

The instrument set for the 3Land (Figure 2) project consists of several layers. Firstly, a couple of trinational planning agreements (Canton of Basel-Stadt et al., 2022; Kanton Basel-Stadt et al., 2011) establish the governance and quality procedures in the area. Furthermore, the IBA Basel 2020#_ftn1 Label was used as a quasi-certification for cross-border projects to signal quality and access to funding. The redevelopment is tri-national (France – Germany – Switzerland), so national, municipal design codes, manuals for riverbanks, bridges, and public realm affect each part of the district differently. Building-certificate regimes by country are another layer of requirements for ensuring quality and sustainability. Finally, in 2019, a trinational Criteria Catalog (TEB, 2019) (Figure 3a) was published which as a non-binding guideline for the buildings in the 3Land area. “Nachhaltiges 3Land durable” certificate is awarded to each project that would follow these criteria, the first one being the residential quarter Les Jetées in France (Figure 2). To embed the Criteria Catalog institutionally, the Trinational Eurodistrict Basel (TEB)⁷ provides a platform for coordination. Each municipality/canton/commune retains their own statutory powers and the cross-border projects use harmonized criteria via memoranums, competition briefs, and design-review procedures.

⁷ Trinational Eurodistrict Basel; cross-border public body (CH–FR–DE) that frames cooperation for projects like 3Land.

3.3. Neckarbogen (Heilbronn)

The instrument set for Neckarbogen district (Figure 1) was a product of an integrated planning process, which produced an Integrated Framework Plan and a Design Manual (Figure 3e) that sets requirements for façades, materials, building heights, ground-floor use, public-space typologies, rainwater handling, and biodiversity for each plot. This district was the first one to ever pre-awarded DGNB (Urban District) certification in the first construction phase. To achieve the sustainability targets and BUGA 2019 milestones, instruments such as contractual obligations via investor selection and development contracts were utilized. The City of Heilbronn and BUGA 2019⁸ GmbH used the manual and the competition results to organise the phasing of the project, and DGNB provided third-party verification at the area level. Plot developers were obligated by contracts to meet both DGNB credits and the Design Manual's prescriptions.

Figure 1: Key instruments reviewed across the three case studies (cover thumbnails): (a) 3Land – Criteria Catalogue (2019); (b) Ecolabel HafenCity guide (version 3.0/2017); (c) Sustainable Building in HafenCity (brochure, 2010); (d) DGNB System – Criteria catalog (2020); (e) Design Manual – Modellquartier Neckarbogen, Heilbronn (2015). Covers shown for identification; full citations in the References



4. Analytical framework

To be able to compare the sustainability certificates, each is treated as an engineering specification that carries performance metrics, design codes, and label-enforcing protocols. Therefore, the following information is encoded: operational and embodied carbon, energy demand and supply, materials and circularity, mobility modal split, biodiversity and soil treatment, indoor environmental quality, social mix and affordability.

5. Findings

Certificates translate policy into quantified indicators. They provide cross-project comparability, enable auditable claims in land-sale contracts and marketing. In flood-prone waterfronts, certificates and their accompanying technical rules embed: minimum finished-floor elevations above design storm level, dry access and emergency routes, critical services above flood lines, backup power, and nature-based solutions. They also require the use of cool materials, shading, and ventilation corridors. Manuals consolidate rules on façade articulation, materials, heights, ground-floor permeability, courtyard typologies, rain-infrastructure, and street sections. In Neckarbogen, the

⁸ Bundesgartenschau - Federal Garden Show is a large-scale horticultural exhibition in Germany, held every two years in different cities.

manual's open-space typologies (parks, waterfront promenades) and SUDS prescriptions support DGNB water and ecology credits. In HafenCity, elevated urban terraces and flood-safe waterfronts shape the entire district identity. The pairing of certificates and manuals, such as Neckarbogen's example, creates redundant controls: the certificate ensures outcomes are measured and verified; the manual ensures they are visibly and spatially embedded.

6. Comparative analysis

Table 1: General comparison. Source: Author, based on the analysed documents

	HafenCity	3Land	Neckarbogen
Certificate/ label	HafenCity Eco-Label v1.0; HafenCity Eco-Label v3.0; DGNB Special Award Eco Label	IBA Basel 2020 label; 3Land Durable certificate	DGNB Urban District Pre-certificate; BUGA Label
Manual/ code	Plot and public-realm manuals; 2002 Flood protection ordinance	Trinational criteria catalog	Design Manual
Administrator	HafenCity Hamburg GmbH; BSU ⁹	TEB platform; Municipalities Canton; Commune	City of Heilbronn; BUGA 2019 GmbH
Legal/ contractual force	Embedded in land-sale contracts; building permits	Label via IBA; statutory force via local permits	Binding via investor contracts
Verification	Independent experts; HCH acceptance tests; certificate audits	IBA evaluation panels; local permitting bodies	DGNB auditors; municipal review

Governments enforce the sustainability and resilience criteria through different mechanisms (Table 1). In HafenCity's case, sustainability targets are made contractually mandatory through HCH land-sale agreements, which tie them to acceptance. The verification of compliance with the standards includes expert audits and HCH acceptance tests. The 3Land project provides a voluntary trinational criteria framework and awards the projects that comply with it. For now, any legal

⁹ Behörde für Stadtentwicklung und Wohnen - Hamburg's Ministry/Authority for Urban Development and Housing (since 2015)

requirement comes only when local authorities embed specific requirements in their own plans and permit procedures. Neckarbogen uses the Design Manual and investor contracts to make its targets binding. The DGNB certificate is applied as a project-level requirement with third-party auditing.

HafenCity Eco-Label (now DGNB Eco-Label Special Award) is mandatory on HCH-sold plots; 3Land Durable is a certificate given to voluntary compliance with sustainability criteria; Neckarbogen DGNB requirements are binding via investor contracts. As shown in the cases observed, early pilot projects in each of the cases often set criteria voluntarily to signal quality and set precedents that later became contractual norms. Finally, BUGA and IBA labels are recognition mechanisms that catalyze implementation but do not create statutory obligations; obligations arise when cities embed criteria in contracts, design manuals, and permits.

Table 2: Sustainability metrics comparison. Source: Author, based on the analysed documents

	Energy and Carbon	Flood and Water	Mobility
HafenCity Ecolabel (v1-v3)	<p>Measurable: Primary energy demand; Transmission heat loss; Renewable energy share ; 2-year energy monitoring</p> <p>Non-measurable: low CO₂-limit-based district heating; Early planning integration of energy goals</p>	<p>Measurable: Compliance with the reference value for water demand ; Design % of the roof area as either a green roof, solar-active surfaces, and/or roof terrace</p> <p>Non-measurable: Proof of heavy metal-free roof/façade runoff</p>	<p>Measurable: maximum parking spaces per apartment; max distance from entrances</p> <p>Non-measurable: integration of HafenCity's subway, bus, walkable city</p>
DGNB System – Criteria Catalogue for New Buildings (Version 2023 / Operational 2020)	<p>Measurable: Annual greenhouse gas emissions of the building; Proportion of renewable energy generated on-site; Solar utilization rate; Agenda 2030 bonus: TRY-based thermal comfort simulation/calculation</p> <p>Non-measurable: Documentation and evaluation of the user survey conducted to increase energy efficiency</p>	<p>Measurable: Water Use Index (WEI+); Fixture flow classified by flow rates; % non-potable water for irrigation; Sponge City bonus: ≤10% deviation from natural water balance (infiltration, evap, runoff)</p> <p>Non-measurable: Integration with district water infrastructure</p>	<p>Measurable: Modal split % (share of trips by walking, cycling, and public transport.); Proximity to public transport stops</p> <p>Non-measurable: Mobility management plans and operational concepts are evaluated qualitatively</p>

DGNB Special Award Ecolabel (2023–2024)	<p>Measurable: Climate neutrality target (net-zero 2045); CO₂ balance requirement; Integrated with EU taxonomy</p> <p>Non-measurable: Climate adaptation strategies; Integration with funding programs</p>	<p>Measurable: Irrigation concept for outdoor areas</p> <p>Non-measurable: Sustainability and adaptation; Resilience to heavy rainfall and flooding</p>	<p>Non-measurable: Integration with city-wide transport systems; Electromobility readiness</p>
3Land Kriterienkatalog	<p>Measurable: Building energy demand limits; Share of renewable energy in supply systems</p> <p>Non-measurable: Sustainable construction principles; Minimize reliance on external energy sources</p>	<p>Non-measurable: Rhine as ecological free space must be preserved;</p>	<p>Non-measurable: Priority on walking, cycling, PT); Dense pedestrian network and cyclist user-friendly infrastructure; Prioritisation of car reduction</p>
Neckarbogen Design Manual	<p>Measurable: DGNB Platinum criteria:CO₂ reduction below the legal standard expected in the future; Primary energy demand benchmarks (EnEV-based); Energy efficiency measured in operational phase</p> <p>Non-measurable: Energy concept as binding part of Baukommission review; Preference for regional building materials</p>	<p>Measurable: Water retention requirements in courtyards/streets (DGNB-linked)</p> <p>Non-measurable: Integration of Altneckar as open space and blue-green corridor; Lakes (Stadtsee, Freizeitsee) as floodable urban landscape</p>	<p>Measurable: Bicycle parking facilities mandatory at every building; Car-sharing stations as planning obligation</p> <p>Non-measurable: Mobility concept part of Baukommission approval; Encouragement of public transport use and walkability</p>
3Land Free Space and Nature Protection Strategy (2020)	<p>Non-measurable: Climate adaptation and mitigation through urban greening; Support for climate adaptation through green-blue infrastructure</p>	<p>Non-measurable: Improve Rhine accessibility and continuity of waterfront; Protection of natural river landscapes</p>	<p>Non-measurable: Creation of cross-border green mobility corridors and bridge; “soft mobility” and trinational accessibility of public spaces.</p>

BUGA Label / City Exhibition requirements from the integrated framework plan	<p>Measurable: primary energy demand, CO₂ emissions, renewable energy share; targets for reduced heating demand, connection to district heating, monitoring</p> <p>Non-measurable: Showcase “Smart City” housing with efficient energy systems; Integration of energy, mobility, water, and climate as “holistic” systems</p>	<p>Measurable: Surface of development land allocated to water areas (Stadtsee, Freizeitsee); Rainwater management integrated into DGNB certification criteria</p> <p>Non-measurable: Sustainable water management” as a guiding principle (BUGA 2019 link); Re-integration of the Neckar River</p>	<p>Measurable: Pedestrian- and bicycle-friendly layout explicitly stated: dense cycle and footpath network, direct connections to main station and city center</p> <p>Non-measurable: Mobility change modelled through city exhibition; “City of short distances” principle</p>
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Table 3: Sustainability metrics comparison. Source: Author, based on the analysed documents

	Materials and Circularity	Biodiversity and Microclimate	Social and Governance
HafenCity Ecolabel (v1-v3)	<p>Measurable: certified wood; Falling below the reference values for global warming (CO₂, eutrophication, acidification)</p> <p>Non-measurable: Ban on toxic substances</p>	<p>Measurable: at least 80% of roof area greened or accessible;</p> <p>Non-measurable: Design for pleasant outdoor microclimate in roof design and public spaces</p>	<p>Measurable: % barrier-free accessible spaces; Indoor air quality; Thermal comfort; Acoustic comfort</p> <p>Non-measurable: Public ground floor or mound flooruse</p>
DGNB System (NB 2023 / Op. 2020)	<p>Measurable: % secondary/recycled raw materials; Verification of compliance with ILO conventions, OECD guidelines, and LkSG</p> <p>Non-measurable: Qualitative evaluation of ethical procurement practices and anti-corruption measures</p>	<p>Measurable: Ratio sealed vs. green surface; Agenda 2030 bonus: local evapotranspiration rates</p> <p>Non-measurable: Integration of greenery into urban design</p>	<p>Measurable: User satisfaction surveys; Interior comfort</p> <p>Non-measurable: Continuous improvement processes are evaluated for building operations and governance</p>

<p>DGNB Special Award Ecolabel (2023–2024)</p>	<p>Measurable: Use of secondary raw materials in certified products Non-measurable: Responsible sourcing aligned with EU taxonomy</p>	<p>Measurable: Outdoor biodiversity promotion quantified Non-measurable: Climate adaptation bonus</p>	<p>Measurable: Proof of EU Taxonomy and QNG compliance Non-measurable: Certification mandatory in HCH land allocation contracts</p>
<p>3Land Kriterienkatalog</p>	<p>Non-measurable: Encourage circularity and ecological materials</p>	<p>Measurable: creation of green space); greening coverage of technical structures Non-measurable: Promote cross-border ecological connectivity</p>	<p>Measurable: Certification score) Non-measurable: Mandatory expert review process once certification sought</p>
<p>Neckarbogen Design Manual</p>	<p>Measurable: DGNB LCA benchmarks for embodied carbon in materials Non-measurable: Recommendation for traditional/regional materials in façade</p>	<p>Measurable: Planting catalogues and greening rules per plot (species mix, tree quotas) Non-measurable: Improve urban climate through green courtyards, roof gardens</p>	<p>Measurable: DGNB social quality indicators (accessibility, participation, mix of uses) Non-measurable: Investor selection by Baukommission with quality review</p>
<p>3Land Free Space and Nature Protection Strategy (2020)</p>	<p>Non-measurable: Reuse of industrial/brownfield land suggestion</p>	<p>Non-measurable: Define biodiversity priority zones; strengthen ecological corridors</p>	<p>Non-measurable: Governance tool for trilateral cooperation; Inclusion of public interests</p>

BUGA Label / City Exhibition requirements from the integrated framework plan	Measurable: DGNB certification requires life-cycle assessment	Measurable: Land allocation principle: 1/3 green landscape areas	Measurable: 51% rental vs. 49% owner-occupied housing quota; 3,500 residents + 1,000 jobs target for quarter
	Non-measurable: Encouragement of innovative building typologies and materials	Non-measurable: Community gardens, vertical/hanging gardens as climate adaptation showcase; re-integration of Neckar as ecological corridor	Non-measurable: Civic participation via exhibitions and events;

As shown in Tables 2 and 3, the metrics for each certificate and manual are shaped by context. Only some of the metrics in the documents are mapped in these tables. HafenCity's core is accessibility, use of certified materials, and indoor comfort targets. Neckarbogen positions itself as a model district; it leverages DGNB criteria, but also a design manual that sets these criteria into a context and focuses on innovation in the district and the 1/3 building, 1/3 water, 1/3 green rule. 3Land puts its focus on the cross-border corridor continuity and harmonization across the countries into a single code.

Looking at the metrics one by one, energy and carbon criteria follow broadly similar logic across all three: Measurable targets for energy demand, CO₂ reduction, lower water demand, and innovation in building. The flood and water dimension focuses on targets for reduced water demand, integration with the district water infrastructures, improvement of the continuity of waterfronts and their accessibility, and their use as flood infrastructures. The mobility targets focus mainly on improving soft mobility, increasing public transport use, and lowering private car use. For the materials and circular dimensions, life cycle assessment is required; the use of secondary materials and the use of wood is encouraged. Biodiversity measures converge on habitat enhancement, corridors, and green roofs. façade greening (explicitly supported by Neckarbogen). Mixed social structures, opportunities for different social groups, and proximity to public amenities recur in all three cases, which support the social dimension of sustainability.

7. Discussion and Evaluation

Each case is treated as a chain of translations¹⁰. The first translation represents the process from policy to certificate, where public goals are turned into specific indicators and thresholds. The second translation is from certificates to contracts and manuals. The criteria here are embedded in land-sale contracts and design manuals that lead investors, architects, and developers through the design to implementation process. The third translation is from the delivery of a project to its verification. In this translation, audit reports, acceptance tests, and design reviews help stabilize the

¹⁰ the process by which actors re-define problems and align others around an obligatory passage point, typically through four "moments": problematization, intersement, enrolment, and mobilization. The products of a translation can be inscriptions (e.g., plans, contracts, standards).

networks into a built form. The fourth translation is from the revision of the projects certified for scaling of the requirements. As demonstrated in the cases analysed, lessons learned from initial certified projects often lead to stricter or more specific rules.

In the analysed case studies, how and when standards and requirements are inscribed in the process differ. The nature of the analysed documents is different as well. EcoLabel HafenCity and DGNB are certification systems that specify quantitative indicators and are mandatory. Both certification systems go through four translations: policy-certificate-verification-scaling. The 3 Land strategy is a soft, guiding framework that is mostly an active actor in the first and second translation: The Criteria Catalog is a directional rather than mandatory handbook, relevant in the first translation – from policy to criteria. Design Manual in Neckarbogen is a quality guideline that is a mix of fixed and flexible rules, active from the first to the third translation (Table 4).

Table 4: Comparison of certification systems across the four translations. Source: Author, based on the analysed documents

Instrument	1. Policy - Certificate	2. Certificate - Contracts / Manuals	3. Delivery - Verification	4. Revision - Scaling
HafenCity EcoLabel	Developed from public goals into EcoLabel v1–v3	Mandatory in land-sale contracts	Independent auditors check compliance	Evolved across 3 versions
3Land Criteria Catalog	Goals, criteria, and indicators derived from Spatial concept and planning agreements	Used in competitions and planning guidance, but not mandatory	No systematic verification	No formal scaling
3Land Free Space and Nature Strategy	Political agreement	Functions as argumentation tool	No formal verification	Lessons inspire cooperation
DGNB (Neckarbogen)	DGNB district criteria	DGNB certification tied into framework plan	DGNB audit/scorecard verifies built projects	Lessons from Neckarbogen inform later DGNB system refinements
Neckarbogen Design Manual	Public quality goals are translated into guidelines	Integrated into purchase agreements	Baukommission reviews and approves individual projects	Feedback from BUGA 2019 tightens later rules

Some recommendations can also be derived from the analysed cases. Resilience should be made non-negotiable and visible by fixing target elevations and emergency access. Where possible, certificates and manual compliance should be made binding through land-sale contracts. There should be sequencing of the certification process, and redevelopments should be started by the pilot phase, as shown by the City Exhibition in Neckarbogen, the first buildings in HafenCity that received the EcoLabel certificate, and the Les Jetées neighbourhood in the 3Land area. Not over-prescribing and leaving flexibility for innovative and alternative solutions (if they match performance specifications) is an asset. Finally, important indicators like carbon, circularity, and urban heat indicators should be measured, and a transparent post-occupancy evaluation should be done. I argue that for the transboundary districts, a practical approach is to build a side-by-side mapping and translation of other criteria. First, equivalent credits should be mapped. Furthermore, non-overlaps should be mapped, and a minimum common set should be decided. Authority of auditors should be decided, and the criteria should be implemented into competition briefs, development agreements, and design-review checklists. Finally, early pilot projects can serve as learning instruments for further scaling of the requirements.

Conclusion

Certificates and design manuals are complementary tools that can help in delivering resilient, sustainable, and high-quality riverfront districts. However, results show that enforcement frameworks are more important in delivering sustainability and resilience into districts than labels and certificates. This is shown in the contractual embedding in HafenCity and Neckarbogen. Labels often do not create a statutory obligation. Visible in the case of IBA and BUGA labels (exhibitions that raise profile but do not set hard performance metrics), they can help in better visibility of projects and better coordination, but obligations arise only when criteria are cited in contracts and permits. Voluntary pilots are an important tool to prefigure norms into mandatory criteria. In all three cases, pilot projects adopted the rules to signal better quality. Finally, context shapes the metrics and the processes of governance and verification of the certificates/labels.

Conflict of Interest Statement

The author declares no conflict of interest.

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