



Environmental Regulation, Administrative Friction, and Real Estate Development Efficiency: Evidence from New York City, London, and Singapore

Jennifer Park

JP Investment Holdings, Inc.

Abstract

Environmental regulation is often treated as a scalar constraint on real estate development: stricter rules are assumed to produce slower or more expensive development. This article argues instead that the sustainability–development trade-off depends on regulatory architecture. Using a structured, focused comparison of New York City, London, and Singapore, it separates three channels—environmentally relevant process regulation, substantive performance requirements, and market-based valuation or incentives—and adds regulatory uncertainty as a distinct developer-finance cost. The evidence base combines peer-reviewed research with statutes, adopted planning guidance, agency processing data, and government monitoring reports current through September 14, 2026. The comparison shows that strong environmental requirements can coexist with relatively predictable development when obligations are measurable, established early, and reviewed through coordinated administrative systems. New York combines stringent building-emissions requirements with lengthy discretionary pre-certification for some projects; London layers standardized carbon metrics onto a discretionary planning system; and Singapore combines mandatory standards and Green Mark with centralized administration, digital review, and targeted incentives. The evidence does not support a causal ranking of the three cities, nor does it show that administrative speed is equivalent to environmental performance. Its contribution is instead to distinguish regulatory stringency from administrative friction and to show why delay, uncertainty, and fragmented review can be economically consequential independently of substantive environmental standards. The policy objective is therefore not simply more or less regulation, but high environmental performance with disciplined, proportionate, and predictable administration.

Keywords: Environmental Regulation; Administrative Friction; Regulatory Uncertainty; Real Estate Development; Permitting; Green Buildings; Comparative Case Study; New York City; London; Singapore.

JEL Classifications: Q58; R33; R52

INTRODUCTION

Global cities face two demands that increasingly collide. They must add housing, commercial space, and infrastructure while also reducing the carbon intensity of a building stock that will remain in place for decades. Buildings are especially important because they create both long-lived emissions and long-lived capital commitments. A design or retrofit decision made today can influence energy use for decades, but the development process is also highly sensitive to time. Financing carry, consultant fees, construction-cost inflation, land-holding costs, and market-cycle risk accumulate while a project waits for approval. Environmental regulation can therefore improve long-term sustainability while simultaneously increasing short-run development cost or delay.

The conventional debate often treats this conflict as binary. A cost-centered view emphasizes that zoning restrictions, environmental review, energy codes, and carbon mandates can raise the price of producing real estate or restrict supply. A competing view, associated with the Porter Hypothesis, argues that well-designed environmental standards can induce innovation and resource efficiency that partially offset compliance costs (Porter & van der Linde, 1995). Real estate evidence also shows that environmentally certified and energy-efficient buildings can command rent or asset-value premiums (Eichholtz et al., 2010, 2013; Fuerst & McAllister, 2011). Yet a developer faces another dimension that neither first-cost analysis nor green-premium evidence fully captures: time and uncertainty. Approval delay creates financing carry and market-cycle exposure, while uncertainty

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over the duration or outcome of review can change the optimal timing of development itself. The relevant question is therefore not whether environmental regulation has a cost. It is which regulatory designs convert cost into environmental and economic value and which create avoidable friction.

This paper uses New York City as the anchor case and compares it with London and Singapore. The three cities are large global real estate markets, but their institutional structures differ sharply. New York relies heavily on discretionary land-use actions, City Environmental Quality Review (CEQR), and a penalty-backed building-emissions regime under Local Law 97. London embeds net-zero operational-carbon and whole-life-carbon requirements within a discretionary planning system involving borough authorities and, for referable projects, the Greater London Authority. Singapore combines mandatory environmental-sustainability standards with centralized land-use administration, BCA Green Mark, coordinated electronic submissions, and targeted development incentives.

The research question is: How do the design and administration of environmental regulation shape the trade-off between sustainable development and real estate development efficiency, and why do those effects differ across New York City, London, and Singapore? The unit of analysis is the city-level regulatory regime as it bears on major private development and large-building investment. For clarity, “environmentally relevant process regulation” includes environmental review and associated planning procedures only where they mediate or condition environmental and development approvals. The article does not treat all zoning or land-use regulation as environmental regulation, and it does not attribute all planning delay to environmental policy.

The article makes three contributions. First, it separates regulatory stringency from administrative architecture by distinguishing process, performance, and incentive/value channels. Second, it integrates urban-regulation research with real-estate investment logic by treating regulatory uncertainty—not only expected delay—as an economically relevant variable that affects when capital is committed. Third, it uses a common comparative protocol across the three cities to identify institutional mechanisms that may moderate the sustainability–efficiency trade-off. The contribution is integrative and theory-building rather than a claim of causal identification.

LITERATURE REVIEW AND ANALYTICAL FRAMEWORK

Regulation as a Cost: The Regulatory-Tax and Delay Literature

One major strand of urban economics treats land-use regulation as a constraint on supply. Glaeser et al. (2005) argue that Manhattan housing prices substantially exceeded physical construction costs and identify land-use restrictions as a major explanation for the gap. Glaeser

and Gyourko (2018) later describe the difference between market prices and production costs as an implicit regulatory tax when supply is constrained by regulation. Gyourko and Molloy (2015) review a broader literature linking land-use regulation to the quantity, location, and price responsiveness of housing supply.

The timing of approval is analytically distinct from the substantive content of regulation. Ball (2011) finds that actual planning delay for major housing projects in southern England was substantially greater than conventional official performance measures suggested. Ball et al. (2009) similarly document significant delay and institutional variation in the English planning system. In New York City, the Citizens Budget Commission (2022) reports that private discretionary land-use applications in its 2014–2017 sample took a median of approximately two and one-half years from formal filing to completion of ULURP, with pre-certification and environmental review accounting for most of the timeline. CBC estimates that a two-year discretionary approval process can add roughly 11 to 16 percent to development cost depending on project size and financing. Real-estate option theory provides a complementary mechanism: uncertainty can change the timing of development because the ability to wait has economic value (Titman, 1985). Regulatory uncertainty therefore matters not only because it lengthens expected review, but because it can change when capital is committed.

These studies do not prove that environmental regulation alone causes high real estate prices. Zoning, preservation, public review, infrastructure constraints, litigation risk, and political discretion are often intertwined. Nor does this paper treat estimates of a general “regulatory tax” as estimates of environmental regulation. Instead, the land-use literature is used to identify the mechanisms through which supply constraints, delay, and uncertainty affect development economics; city-specific statutes, agency guidance, and environmental-review data are then used to identify where environmental policy enters those mechanisms. This distinction is important because a city can streamline process without weakening substantive environmental performance standards.

Regulation as Innovation and Value Creation: The Porter Hypothesis

Porter and van der Linde (1995) challenge the assumption that environmental regulation and competitiveness are necessarily in conflict. Their argument is not that regulation is costless, but that well-designed standards can induce innovation offsets by forcing firms to identify resource-saving technologies and practices they might otherwise overlook. Subsequent assessment of the Porter Hypothesis is more qualified. Ambec et al. (2013) conclude that the empirical evidence is mixed and that the strongest case is for regulation-induced innovation rather than a general claim

that private compliance costs are fully offset. Applied to real estate, the hypothesis therefore supports a conditional proposition: predictable performance requirements may induce better envelopes, efficient mechanical systems, electrification, renewable energy, or lower embodied carbon, but whether those investments create private value depends on technology, energy prices, financing, market demand, and the design of the regulation itself.

There is empirical evidence for a value-creation channel in real estate. Eichholtz et al. (2010) find that environmentally certified U.S. office buildings command higher rents and effective rents, while Eichholtz et al. (2013) show that energy efficiency and environmental performance are capitalized into rents and asset values. Fuerst and McAllister (2011) also report rental and sale-price premiums for eco-certified offices. In London, Chegut et al. (2014) find that green certification is associated with property-market value effects, while also showing that the size and distribution of those effects can change as green supply expands. In Singapore, Heinzle et al. (2013) find that prospective condominium investors exhibit willingness to pay for stronger BCA Green Mark ratings. These findings do not imply that every environmental mandate pays for itself, but they make life-cycle value, market adaptation, and the durability of any “green premium” necessary parts of cost analysis.

Three Regulatory Channels

The two literatures can be reconciled by separating environmental-development regulation into three analytically distinct channels. The first is process regulation: environmental review, studies, consultations, referrals, sequencing, and agency coordination that determine how long and how predictably an affected project moves toward permission. The second is performance regulation: substantive limits or standards governing emissions, energy efficiency, design, materials, or operational performance. The third is market-based valuation and incentives: certifications, density bonuses, offset mechanisms, financial incentives, operating savings, or market premiums that can convert environmental performance into economic value. The categories are not mutually exclusive, but they prevent procedural delay from being conflated with substantive environmental stringency.

This framework is especially useful because the three cities do not simply represent high, medium, and low environmental ambition. All three now maintain substantial climate requirements. They differ more in the institutional form through which those requirements are imposed. New York has relatively high process friction for discretionary projects and a penalty-backed performance regime for large buildings. London has a discretionary planning system but increasingly standardized carbon assessment requirements. Singapore has mandatory environmental rules, but pairs them with centralized administration and selected

incentives. The comparison therefore examines whether differences in administrative design help explain variation in the development-efficiency trade-off without assuming that regulatory stringency and process friction are the same variable.

Development Efficiency as a Developer-Finance Problem

For a developer or real-estate investor, the private burden of regulation can be organized as a heuristic decomposition rather than a single regulatory-cost variable. Let the project-level burden B be represented conceptually as:

$$B = C_{\text{process}} + C_{\text{performance}} + C_{\text{uncertainty}} - V_{\text{incentives}} - V_{\text{operating}} - V_{\text{market}}$$

Here, C_{process} includes studies, consultant expense, financing carry, taxes, and construction-cost inflation associated with approval; $C_{\text{performance}}$ captures incremental capital and operating requirements created by energy, carbon, material, or building standards; and $C_{\text{uncertainty}}$ captures the option value and risk created by uncertain approval timing, scope changes, or resubmission. $V_{\text{incentives}}$ includes direct subsidies, tax benefits, or density value; $V_{\text{operating}}$ captures life-cycle energy and operating savings; and V_{market} captures rent, price, liquidity, or obsolescence effects. This expression is not an estimable accounting identity in the present study. It is a conceptual device used to identify channels that should not be collapsed into a single “cost of regulation” measure.

The separate uncertainty term is especially relevant to real estate because the timing of irreversible development is itself an investment decision. Titman (1985) shows that uncertainty can create option value in undeveloped land. In practical underwriting terms, a known requirement can be built into a land residual, development budget, and financing plan; an open-ended review creates a wider distribution of carry costs, interest-rate exposure, construction-cost escalation, and market-cycle outcomes. This framework therefore treats predictability as an economic variable in its own right.

Analytical Expectations

The framework yields three analytical expectations rather than statistically testable hypotheses. First, holding substantive environmental requirements broadly comparable, greater sequencing, resubmission, and uncertainty should increase development burden because time and the variance of time affect financing carry and the timing of irreversible investment. Second, measurable performance standards known early in design should shift more of the burden into budgetable capital cost and less into open-ended process risk. Third, market-value and incentive channels may partially offset performance costs, but they should not be assumed to eliminate them. The case studies assess whether the observed institutional arrangements are consistent with these expectations.

RESEARCH DESIGN AND CASE SELECTION

The study employs a structured, focused comparison in the sense of George and Bennett (2005): each case is examined with the same set of questions so that within-case evidence can be compared across different institutional settings. The unit of analysis is not an individual project but the city-level regulatory architecture affecting major development and large-building investment. Each city is examined through five questions: (1) What environmental rules materially affect development or building investment? (2) How are those rules administered? (3) What evidence exists on approval time, sequencing, and predictability? (4) What evidence exists on development or compliance cost? and (5) What evidence exists on environmental outcomes, incentives, operating value, or market value?

Case selection combines a relatively close comparison with a deliberately contrasting case. New York City and London are global financial and property centers with privately owned land, discretionary planning traditions, high construction costs, and strong city-level climate requirements. Singapore is institutionally different: public control of land and state-led development institutions play a larger role (Haila, 2015), and technical approvals are more centralized and digitized.

The contrast is useful for mechanism identification, but it also limits direct inference. Singapore is not treated as a counterfactual for New York or London.

The analysis is not a causal econometric test. Project-level data are not harmonized across jurisdictions, and the cities differ in land tenure, legal appeal rights, fiscal systems, construction costs, housing institutions, and the composition of projects subject to review. Published review-time metrics are also not equivalent: some describe formal statutory periods, others end-to-end discretionary review, and others technical processing targets. The article therefore does not rank cities by a single speed measure and does not interpret cross-city differences as treatment effects.

Source selection follows a hierarchy designed to reduce factual, temporal, and advocacy bias. Peer-reviewed research is used for general mechanisms and market effects; statutes, regulations, and adopted planning guidance establish legal requirements; agency documents establish current implementation rules and processing targets; and government monitoring reports provide administrative or modeled outcomes. Agency self-reports are treated as implementation evidence rather than independent causal evaluations. Policy claims were re-checked against current official sources through September 14, 2026.

Table 1. Operationalization of Core Analytical Constructs

Construct	Operational meaning	Observable indicators used in the comparison
Process friction	Administrative burden associated with review and coordination rather than substantive performance targets	Elapsed review time; non-statutory stages; sequencing; resubmission; number of review interfaces; digital/concurrent review
Performance requirements	Substantive environmental obligations imposed on buildings or development	Emissions limits; energy/carbon thresholds; retrofit or design requirements; penalties; offset obligations
Regulatory uncertainty	Variation or open-endedness in timing, scope, and approval conditions	Unbounded pre-application periods; scope changes; repeated information requests; appeal/litigation exposure; uncertainty over final conditions
Incentive/value channel	Mechanisms that offset or capitalize environmental performance	Bonus GFA; grants/tax support; operating savings; rent/price premiums; willingness to pay; avoided penalties or obsolescence
Environmental outcome evidence	Observed or modeled evidence that requirements produce environmental performance	Modeled carbon savings; filing/compliance rates; certified-building energy savings; post-occupancy evidence where available

Note. The indicators are descriptive and are not combined into a quantitative index. They are used to make the comparison transparent and to avoid treating non-equivalent metrics as directly interchangeable.

The resulting comparison can be summarized conceptually as follows: New York combines high process friction with stringent performance regulation; London combines discretionary planning with increasingly standardized carbon requirements; and Singapore combines mandatory environmental standards with centralized administration and targeted development incentives. These differences structure the case studies that follow.

NEW YORK CITY: ENVIRONMENTAL PERFORMANCE MANDATES AND DISCRETIONARY REVIEW

Process Regulation: CEQR, Pre-Certification, and ULURP

New York City most clearly demonstrates the distinction between environmental review and building-performance regulation. CEQR is the City's process for implementing the

State Environmental Quality Review Act. It is triggered when a city agency undertakes, funds, or approves a discretionary action; routine ministerial actions such as ordinary building permits are not themselves subject to CEQR. Depending on the action and potential impact, the process may end with an Environmental Assessment Statement and negative declaration or proceed to a full Environmental Impact Statement with scoping, alternatives, mitigation, and public review (New York City Mayor's Office of Environmental Coordination [NYC MOEC], n.d.).

The formal ULURP stage is time-limited, but the pre-certification process that precedes it is not constrained by a comparable external clock. The Citizens Budget Commission (2022) examined 171 private discretionary applications filed between 2014 and 2017 and found a median of approximately two and one-half years from formal filing through completion of ULURP. Nearly two years of the median timeline occurred in pre-certification and environmental review. CBC estimates that a two-year discretionary approval process can increase development costs by 11 to 16 percent, even without a change in project scope.

The 2025 New York City Charter Revision Commission reached a similar institutional diagnosis. Its final report identifies environmental review as an important contributor to lengthy pre-certification and notes that major projects can spend multiple years and substantial sums on review before formal public review begins. This evidence is descriptive and institutional rather than a causal estimate of CEQR's marginal cost. CEQR evaluates land use, socioeconomic effects, historic resources, transportation, air quality, greenhouse gases, noise, construction, and other impacts that may require mitigation. The analytical issue is therefore not whether review has social value, but whether additional rounds of process produce environmental information or mitigation commensurate with the time and uncertainty they impose.

New York has begun experimenting with targeted exemptions and streamlining. In 2026, Housing Preservation and Development guidance noted a new SEQRA/CEQR exemption pathway for certain HPD-funded housing projects below specified unit thresholds. The reform is narrow, but it is analytically important because it reflects a move toward risk-proportionate environmental review rather than uniform procedural intensity. For the policy framework developed here, such thresholds are an example of reducing process regulation without necessarily weakening substantive environmental performance standards.

Performance Regulation: Local Law 97

Local Law 97 (LL97) represents a different regulatory channel. The law applies annual greenhouse-gas emissions limits to most buildings larger than 25,000 gross square feet, with different compliance pathways for some affordable and special-use buildings. The Department of Buildings states that the law was enacted in 2019 as part of the Climate

Mobilization Act and that emissions limits tighten over time (New York City Department of Buildings [NYC DOB], 2026a). For Article 320 buildings, excess annual emissions can trigger a civil penalty calculated at \$268 per metric ton above the applicable limit, while failure to file can trigger a separate floor-area-based monthly penalty (NYC DOB, 2026b). Beginning in 2026, covered owners report emissions using revised Energy Star Portfolio Manager property-type limits, making the implementation framework more standardized across building categories (NYC DOB, 2026a).

For development analysis, LL97 should not be treated as equivalent to CEQR. CEQR can determine how long a discretionary project remains in pre-development. LL97 primarily changes the capital planning and operating economics of covered assets. Owners may need envelope improvements, control upgrades, electrification, heat pumps, or other energy-efficiency measures. The law can therefore affect acquisition underwriting, retrofit reserves, debt capacity, and the relative value of efficient and inefficient stock.

The cost channel is real. Building decarbonization often requires substantial upfront investment and may be particularly difficult for older structures. Yet the green-building literature shows that the economic comparison should be made over the asset life cycle, not only at first cost. Energy-efficient buildings can capture rent or value premiums and may face lower utility cost or regulatory obsolescence risk (Eichholtz et al., 2010, 2013; Fuerst & McAllister, 2011). The implication is that LL97 is best evaluated as stringent performance regulation whose private cost depends on building condition, energy prices, incentives, financing, and the value of avoided emissions exposure.

Implementation evidence also began to emerge in 2026. In April, NYC DOB reported that approximately 93 percent of covered privately owned properties had submitted the first required LL97 compliance filings, representing 91 percent of covered buildings, and that more than \$1.46 million from carbon-offset certificate sales had been directed toward energy-efficiency projects in affordable housing (NYC DOB, 2026c). Filing compliance is not the same as realized emissions reduction, and the first-year data should not be interpreted as proof that the law has achieved its long-run carbon target. It does, however, show that the performance regime has moved from statutory design into large-scale implementation and that an offset channel is operating alongside penalties.

New York's central policy tension therefore comes from the combination of two channels rather than a single "environmental regulation" variable. High process friction can delay discretionary development, while high performance standards can require large building investments. Streamlining the former does not logically require weakening the latter.

LONDON: CARBON STANDARDS WITHIN A DISCRETIONARY PLANNING SYSTEM

London provides a useful middle case. Environmental Impact Assessment in England is governed by the Town and Country Planning (Environmental Impact Assessment) Regulations 2017. National planning guidance generally sets statutory decision periods of 13 weeks for major planning applications and 16 weeks where EIA applies, although extensions of time and project complexity can lengthen actual decisions (Ministry of Housing, Communities & Local Government, 2020, n.d.). Large London projects may also be referable to the Mayor, adding a metropolitan layer of review.

The London Plan imposes demanding climate-performance requirements. Policy SI 2 requires major development to be net zero-carbon in operation and to follow the “be lean, be clean, be green, be seen” energy hierarchy. Major projects must demonstrate a minimum 35 percent on-site reduction beyond the relevant Building Regulations baseline, with minimum contributions from energy-efficiency measures, and any remaining shortfall to net zero may be addressed through carbon offset arrangements (Greater London Authority [GLA], 2021). Referable development proposals are also required to calculate and reduce whole-life-cycle carbon, capturing embodied as well as operational emissions (GLA, 2022).

These requirements create design, modeling, documentation, and potentially offset costs. Yet they also generate measurable environmental commitments. The GLA’s 2024 Energy Monitoring Report, published in 2026, reports that referable developments approved in 2024 were projected to achieve roughly 56 percent carbon savings relative to national Building Regulations, that 90 percent proposed heat-pumped systems, and that more than 90 percent were meeting GLA whole-life-cycle-carbon benchmarks (GLA, 2026). These are projected or design-stage outcomes rather than verified post-occupancy savings, but they show that the planning requirements are securing measurable commitments. London also provides a market-value channel: evidence from BREEAM-certified commercial buildings indicates that environmental certification can affect rents and asset values, although the premium is not fixed as green supply expands (Chegut et al., 2014).

London’s broader development-efficiency problem cannot be attributed to carbon regulation alone. Ball (2011) finds substantial and variable planning delay in major housing projects in southern England. Hilber and Vermeulen (2016) show that regulatory supply constraints materially increase the responsiveness of English house prices to local demand, and Cheshire and Hilber (2008) estimate large regulatory costs in British office markets. These studies concern the planning system broadly, not Policy SI 2 specifically. Their relevance is institutional: modern climate obligations are being added to a planning environment whose discretionary

character and supply constraints long predate current decarbonization policy.

The City of London Corporation’s Planning for Sustainability Supplementary Planning Document, adopted in February 2025, illustrates a further evolution toward detailed and standardized sustainability guidance. Such documents can increase compliance requirements, but they can also reduce uncertainty by defining the analyses and design principles expected at application stage. This is important for the paper’s central hypothesis: predictable stringency may be easier to finance than uncertain negotiation, even when the substantive standard is demanding.

London therefore occupies an intermediate position. Its process remains discretionary and can be slow, but its climate requirements are increasingly expressed through standard metrics, templates, and explicit performance thresholds. Environmental ambition adds cost, yet the incremental burden is more readily priced when requirements are known early in the design process.

SINGAPORE: MANDATORY STANDARDS, CENTRALIZED ADMINISTRATION, AND TARGETED INCENTIVES

Singapore is the strongest institutional contrast. Haila (2015) describes Singapore as a property state in which public control of land and active state participation in development play a central role in the urban land market. This structure allows planning, land release, and environmental requirements to be coordinated more directly than in jurisdictions characterized by highly fragmented private ownership and multiple autonomous review bodies. The point is not that Singapore lacks regulation. Rather, its regulation is more centralized.

The Building Control (Environmental Sustainability) Regulations require minimum environmental-sustainability standards for new buildings and existing buildings undergoing major additions and alterations. BCA’s current guidance emphasizes that the sustainability regime is mandatory and enforced under the Building Control Act (Building and Construction Authority [BCA], 2026a). Since 2010, selected Government Land Sales sites have been subject to higher Green Mark standards, and current rules require particularly high Green Mark performance for specified GLS development (BCA, 2026b). Green Mark itself, launched in 2005, evaluates building environmental performance and has become the central certification framework for Singapore’s built environment (BCA, 2026c).

Singapore therefore should not be characterized as purely incentive-based. A more accurate description is “mandatory baseline plus targeted incentives.” One example is the Built Environment Transformation Gross Floor Area Incentive Scheme, jointly administered by BCA and the Urban Redevelopment Authority. The scheme allows eligible private developments to receive up to 3 percent additional

GFA beyond the Master Plan Gross Plot Ratio for meeting stipulated higher standards in digitalization, productivity, and sustainability. It was launched in November 2021 for a five-year validity period through November 23, 2026 (BCA, 2026d; URA, 2021). Because the scheme is time-limited, it should be treated as evidence of an incentive design rather than as a permanent feature of Singapore's planning system.

The incentive channel matters economically because it converts part of the sustainability investment into developable value. This is closer to the innovation-offset logic of Porter and van der Linde (1995) than a regime relying only on penalties. However, the incentive does not replace mandatory environmental standards; it sits on top of them. That distinction makes Singapore a richer comparison than a simple "carrot versus stick" narrative.

Administrative integration is equally important. URA states that a complete development application routed through CORENET 2 generally takes about 20 working days to assess, a technical processing target that should not be confused with an end-to-end entitlement timeline (URA, 2026a). CORENET X is a general building-regulatory platform rather than an environmental policy instrument; it enters this analysis because it changes the administrative architecture through which environmental and other technical requirements are coordinated. In July 2026, BCA reported that since CORENET X became mandatory in October 2025 for new projects of at least 30,000 square meters GFA, more than 140 projects involving 300 firms had been submitted and participating firms had reported regulatory-approval time savings of up to two months, along with fewer resubmissions and reduced abortive work (BCA, 2026e). The government then recalibrated the mandate: from October 1, 2026, CORENET X was scheduled to become mandatory for new projects of at least 5,000 square meters GFA, while smaller projects could continue to use CORENET 2.0 (URA, 2026b). The adjustment is analytically relevant because it applies process intensity in proportion to project scale and complexity rather than uniformly.

Environmental performance still carries first cost. BCA's published life-cycle cost evidence for Green Mark projects reports non-residential green cost premiums ranging from roughly 0.12 to 4.40 percent across rating levels, with median simple payback periods generally below six years and positive net-present-value savings per square meter (BCA, 2020). Heinzle et al. (2013) find willingness to pay for stronger Green Mark certification among prospective condominium investors. BCA also reports that 2,590 Green Mark-certified buildings as of March 2025 were collectively saving more than 4.2 billion kWh of energy annually (BCA, 2025). These figures come from different methods and should not be aggregated into a single benefit estimate. Together, however, they show that Singapore's sustainability regime produces measurable first costs, operating savings, and market-value channels rather than only procedural requirements.

Singapore's institutional model cannot simply be transplanted to New York or London. Its scale, city-state government, land system, and administrative structure are major confounders. The transferable principle is narrower: where environmental obligations are established early, encoded in technical standards, and reviewed through integrated systems, high sustainability requirements need not produce equally high procedural friction.

COMPARATIVE ANALYSIS

Process Regulation: Delay and Uncertainty

The clearest cross-city difference appears in process architecture. New York's discretionary projects can spend years in pre-certification and environmental review before the formal ULURP clock concludes. London has statutory decision targets but operates within a discretionary system whose actual delays and supply constraints are well documented. Singapore's technical approval structure is comparatively standardized, centrally coordinated, and digitized, although its published 20-working-day CORENET 2 target is not directly comparable to a full New York or London entitlement. These differences are therefore evidence about mechanisms—sequencing, coordination, and predictability—not a comparable "days to approval" dataset. They are most consistent with the expectation that administrative design can generate development cost independently of environmental stringency.

From a finance perspective, uncertain duration is especially costly because it cannot be fully priced at the outset. A known requirement for a higher-performance façade, heat pump, or carbon calculation can be incorporated into a pro forma. An approval process that may take one year or three years creates a distribution of financing, inflation, interest-rate, and market risks. In the conceptual framework introduced in Section 2.4, this is the difference between $C_{\text{performance}}$, which can often be budgeted, and $C_{\text{uncertainty}}$, which changes the option value and timing of investment. This distinction helps explain why process reform may produce large efficiency gains without changing the substantive environmental target.

Performance Regulation: First Cost versus Life-Cycle Value

All three cities impose meaningful performance obligations, but the instruments differ. New York's LL97 establishes emissions limits for large buildings and attaches penalties to excess emissions. London's planning policy requires net-zero operational-carbon strategies and whole-life-carbon assessment for specified projects. Singapore establishes mandatory environmental-sustainability requirements and Green Mark standards, with higher standards on selected state land.

The first-cost effect is therefore real in all three systems. Yet the evidence also demonstrates that green performance can generate operating savings and market value. The academic

literature on U.S. office buildings, Singapore’s Green Mark valuation, and BCA life-cycle studies all point toward partial economic offsets. This is the point at which the Porter Hypothesis becomes relevant: performance regulation can induce investment that is not socially or privately worthless, even though it raises initial capital requirements.

Market-Based Valuation and Incentives

The third channel changes the incidence of regulatory cost. In New York, value creation is mainly indirect: efficient buildings may benefit from lower energy use, reduced LL97 exposure, and stronger marketability. London combines market-recognized green performance with carbon offset mechanisms and increasingly standardized

reporting. Singapore goes further in directly linking selected sustainability outcomes to development economics through bonus GFA, while Green Mark certification can also influence buyer or investor perceptions.

This comparison does not establish that incentives are always superior to penalties. Incentives can create fiscal or planning trade-offs, and weak baseline standards can make voluntary schemes insufficient. The stronger inference is that environmental policy can be designed to create positive development value alongside mandatory floors. Singapore’s “mandatory baseline plus incentive” architecture is therefore more informative than a simple contrast between strict and lenient regulation.

Table 2. Comparative Assessment of the Sustainability–Efficiency Trade-Off

Dimension	New York City	London	Singapore	Interpretation
Environmental requirements	Penalty-backed building-emissions limits plus CEQR for discretionary actions	Net-zero operational-carbon strategy and whole-life-carbon assessment	Mandatory environmental-sustainability rules plus Green Mark	Requirements are substantial in all three systems, but instruments are not directly comparable
Process friction	High for discretionary projects; lengthy pre-certification can dominate timeline	Moderate to high in discretionary planning; statutory targets do not eliminate actual delay	Comparatively centralized and digitized; CORENET X targeted to larger projects	Administrative design is an independent cost variable
Performance cost	Building-specific retrofit and compliance cost under LL97	Design, modeling, offset, and carbon-performance costs	Green cost premium rises with performance tier in BCA case evidence	First cost must be distinguished from life-cycle value
Direct incentive/value channel	Mostly operating/market value plus offsets and financing/support programs	Market certification/value plus carbon-offset architecture	Time-limited bonus GFA plus certification and operating value	Incentive architecture can offset part of compliance burden
Implementation / outcome evidence	2026: ~93% of covered private properties filed first LL97 reports; realized emissions outcomes still developing	2024 referable projects projected ~56% carbon savings; >90% meeting WLC benchmarks	2,590 Green Mark buildings saved >4.2 billion kWh annually by 2025; CORENET X users reported time savings	Indicators are non-harmonized and should not be used as a causal league table

Note. The classifications synthesize the evidence reviewed in Sections 4–7 and are analytical characterizations rather than a controlled causal ranking. The implementation indicators are deliberately non-harmonized: New York reports first-year filing participation, London reports modeled design-stage carbon savings, and Singapore reports processing targets and early implementation experience. They should not be interpreted as equivalent outcome metrics.

The combined evidence is consistent with a conditional version of the trade-off hypothesis. Environmental regulation is most likely to reduce development efficiency when substantive goals are delivered through uncertain process and when delay, resubmission, and inter-agency coordination costs are not bounded early. Conversely, demanding performance standards can coexist with relatively efficient development when obligations are predictable, standardized, and integrated into the approval system. The cross-city comparison therefore points to a more precise proposition: the principal trade-off is not simply between environmental stringency and development, but between environmental stringency and the administrative architecture through which that stringency is implemented.

The evidence also cautions against claiming that Singapore is environmentally superior simply because its process is faster. Procedural efficiency and environmental stringency are separate variables. A fast system can adopt weak standards, and a slow system can adopt ambitious ones. The policy objective is to occupy the high-stringency, low-friction quadrant: demanding environmental outcomes with predictable administration.

POLICY IMPLICATIONS

Four policy implications follow from the comparative evidence. First, environmental standards should be measurable and front-loaded. Developers can finance demanding requirements more effectively when applicable

thresholds are known at land acquisition and schematic design. London's energy hierarchy and whole-life-carbon templates, and Singapore's Green Mark criteria, provide clearer ex ante signals than an open-ended process in which the scope of required analysis evolves through multiple rounds of review.

Second, cities should match process intensity to project risk. New York's 2026 CEQR exemption pathway for certain HPD-funded projects illustrates the principle of risk-proportionate review. Broader reform could expand categorical thresholds, standardized methodologies, and safe harbors where recurring project impacts are well understood, while preserving full review for projects with genuinely significant environmental consequences.

Third, agencies should favor concurrent and digital review over sequential review, but should calibrate digital-process mandates to project complexity. Singapore's CORENET architecture is not transferable in full, and CORENET X is not itself an environmental regulation. Its relevance is administrative: shared submissions, common data standards, and coordinated review can reduce duplicated information requests across technical domains. The July 2026 decision to schedule mandatory CORENET X use for projects of at least 5,000 square meters GFA while allowing smaller projects to remain on CORENET 2.0 illustrates a broader principle: process integration should be targeted where expected coordination benefits justify transition and compliance costs (BCA, 2026e; URA, 2026b).

Fourth, policymakers should evaluate environmental regulation using life-cycle economics. Upfront capital expense should be reported alongside energy savings, avoided penalties, operating resilience, incentives, and potential rent or asset-value effects. This is especially important for LL97, where a gross retrofit-cost estimate may overstate or understate the true long-run economic burden depending on building condition and financing.

Finally, incentive design can complement, but should not replace, mandatory standards. Singapore's bonus-GFA scheme shows how development value can be linked to higher sustainability performance, while its baseline environmental rules remain compulsory. New York and London may have less scope for identical density incentives, but tax credits, expedited review, financing support, or zoning bonuses can similarly reward projects that exceed baseline performance.

LIMITATIONS AND FUTURE RESEARCH

The paper's main limitation is comparability. New York, London, and Singapore differ in land ownership, political structure, legal appeal rights, housing tenure, taxation, and construction markets. Singapore's public land institutions are especially important. Its administrative performance cannot be attributed to environmental policy alone.

A second limitation is asymmetry of outcome data. New

York offers unusually detailed evidence on discretionary review duration, London publishes modeled carbon savings for referable projects, and Singapore publishes agency processing targets and Green Mark performance data. These are different measures. Future research should assemble matched projects by use, scale, and development type and collect application dates, approval dates, consultant costs, financing assumptions, energy models, embodied-carbon estimates, and post-occupancy outcomes.

A third limitation concerns causal attribution. English planning research documents the cost of a restrictive and discretionary planning system, but it does not prove that London's climate policies caused housing scarcity. Similarly, New York's high development costs cannot be attributed to CEQR or LL97 alone. Labor, land values, financing, tax policy, zoning, and construction rules all matter. The contribution of this paper is institutional decomposition, not a claim of single-cause explanation.

A fourth limitation concerns source type and temporal change. Agency reports can document rules, processing targets, and implementation activity, but they may emphasize program success and are not substitutes for independent outcome evaluation. Environmental regulation and digital approval systems are also moving targets. New York's LL97 implementation, London's carbon guidance, and Singapore's CORENET X rollout continued to evolve during 2025–2026. Policy information in this article is current through September 14, 2026; subsequent changes are outside the study period.

CONCLUSION

Environmental regulation can create a real trade-off with real estate development efficiency, but the magnitude and form of that trade-off depend on both substantive standards and administrative design. The comparison of New York City, London, and Singapore shows why environmental ambition should not be used as a proxy for regulatory burden and why regulatory speed should not be used as a proxy for environmental quality.

Within the evidence reviewed, New York provides the clearest documented case of extended discretionary pre-certification. CEQR and pre-certification can consume a large share of the discretionary development timeline, while LL97 separately imposes stringent building-performance obligations; first-year filing data show that the law has entered broad implementation, but not yet whether long-run emissions targets will be realized. London also operates through discretionary planning, but its carbon requirements are increasingly standardized through explicit targets and assessment methodologies; the evidence on English planning delay should therefore be separated from the incremental effect of climate policy. Singapore combines mandatory sustainability standards with centralized administration and selected incentives, and its 2026 recalibration of CORENET X

illustrates a further principle: process modernization works best when its own compliance burden is proportionate to project complexity.

The broader conclusion is consistent with the regulatory-tax literature, real-estate investment under uncertainty, and the qualified form of the Porter Hypothesis. Regulation can create deadweight cost when it restricts supply or adds uncertain process, but performance standards can also induce resource efficiency and generate market value. The comparative evidence is therefore most consistent with a high-stringency, low-friction design objective: environmental outcomes should be measurable and enforceable, while review should be predictable, risk-proportionate, and coordinated. Whether particular reforms achieve that combination remains an empirical question for project-level research.

Data and Materials Availability

All evidence used in this article is drawn from publicly available peer-reviewed publications, statutes, official guidance, agency documents, and government reports cited in the text. No proprietary project-level data or human-subject data were collected.

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