

# Building Ideas, Vol. 1

2009–2010

Systemic Action Research  
in the Built Environment



# About

Town+Gown is a systemic action research program to increase research, analysis, and review related to the City's built environment. Aimed at collectively increasing evidence-based analysis, information transfer and understanding of the City's built environment, Town+Gown marshals and coordinates research between the City's public works programs and local academic institutions with programs of study relevant to the Built Environment disciplines: Management, Economics, Law, Technology and Design.<sup>1</sup>

Town+Gown responds to the need for enhanced research activity in the Built Environment. Town+Gown's systemic action approach seeks to increase less-than-desired levels of research. In the absence of government participation in research and a cooperative, pragmatically-focused research methodology, both industry and academia have tended to produce lower than optimal levels of Built Environment research. Furthermore, the research produced tends to be remote from practitioners' needs and not effectively shared among the individual disciplines. Using the

City's physical built environment as a laboratory for the Built Environment disciplines, Town+Gown will increase place- and data-based Built Environment research and its practical application.

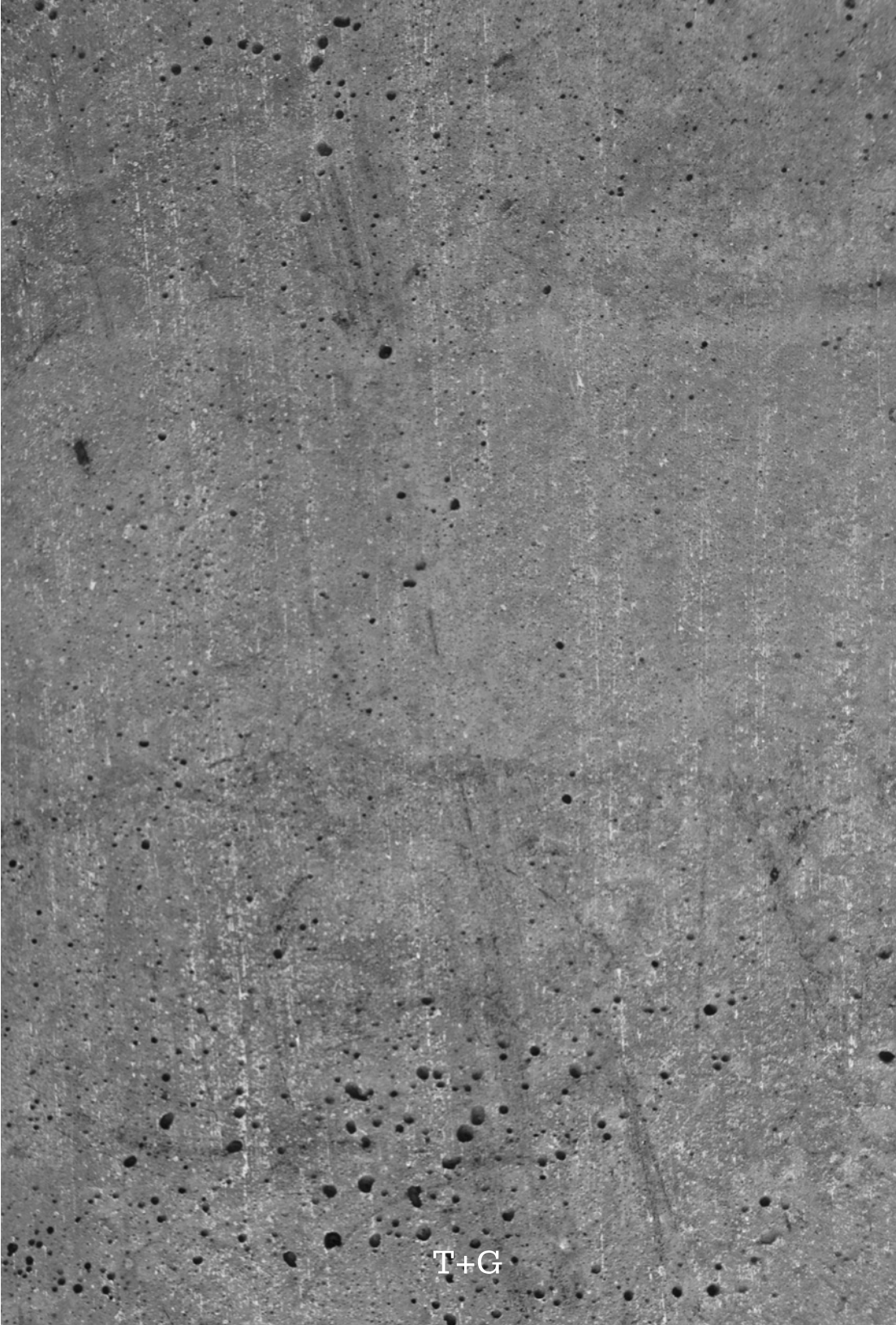
Town+Gown taps into existing action- or service-learning and research programs, highlighting the importance of practice as a source of knowledge. By working with both practitioners and academics, Town+Gown also serves as the facilitator and caretaker of a City-wide Built Environment research agenda. Each year the program develops a City-wide

research agenda to facilitate partnerships between academic programs and City agency practitioners on research projects. Town+Gown-supported collaborations during the 2009-2010 academic year concluded with 13 completed research projects for eight City agencies produced by student teams from five of the City's graduate programs (plus the project designing this review). All of these are abstracted in this volume of **Building Ideas**.

This volume of **Building Ideas** represents the capstone of Town+Gown's first completed year of operation. The 2009-2010 projects will serve as the foundation for the first cycle of reflection and action in 2010-2011, consisting of collaborative roundtable discussions within the Town+Gown community. The results of these discussions are expected to lead to further research and/or changes aimed at improving built environment practices and policies.

1. Paul Chynoweth, *The Built Environment Interdiscipline: A Theoretical Model for Decision Makers in Research and Teaching* (Proceeding of the CIB Working Commission Building Education and Research Conference 2006), <http://www.lawlectures.co.uk/bear2006/chynoweth.pdf>, pp. 1, 5.

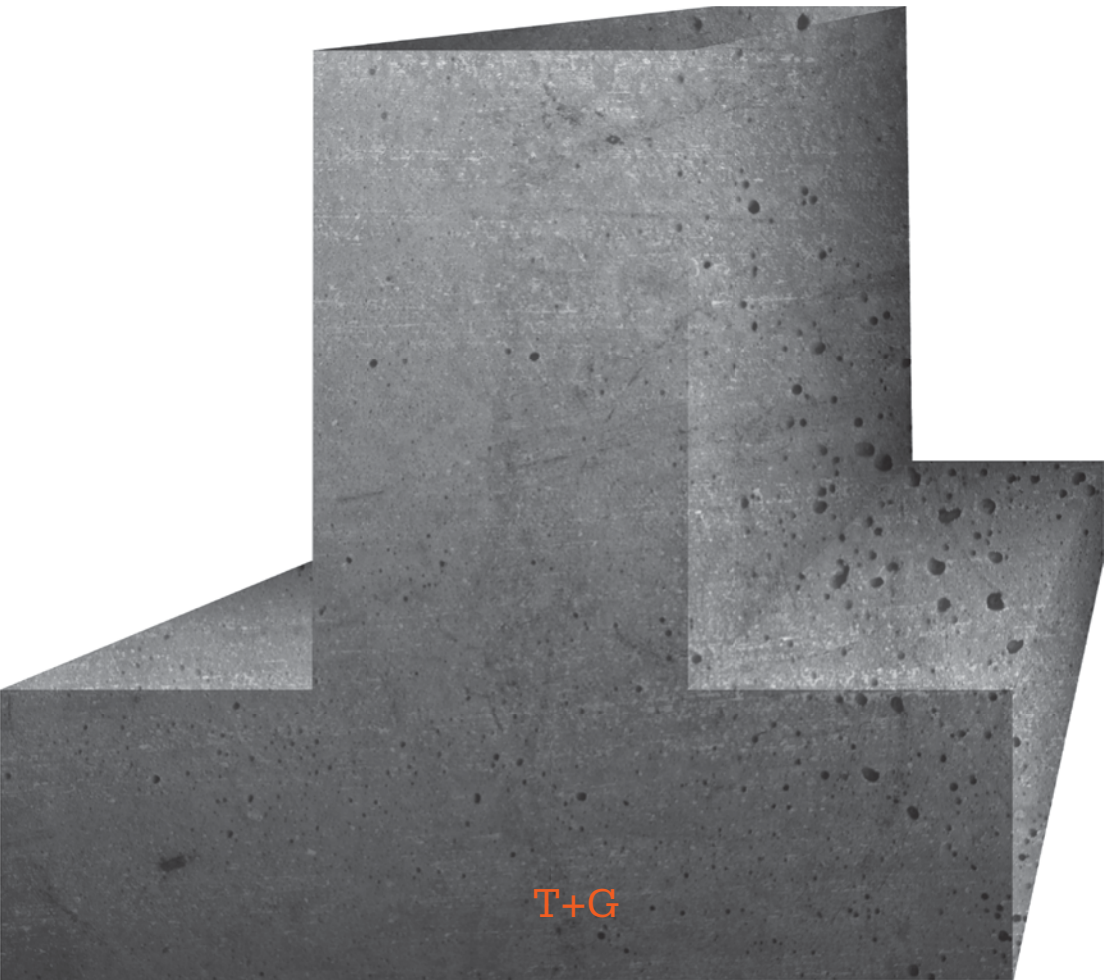
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## Management

For the projects under Management, the City acts primarily, but not always, in the role of an owner. A critical objective for an owner is to align its interests in budget, schedule, safety and quality with those of its agents in construction. Since project needs, materials, building methods and information technology continually change “on the ground,” construction market participants adapt to such changes by using an evolving menu of service delivery methodologies as well as various management theories, techniques and tools, not dissimilar to those found in other industries or sectors. For some of these projects, the City, as regulator, looks to the management discipline for solutions.

# Developing Green Buildings Practices



Graduate student Erik Berliner produced a professional decision report to develop and analyze policy alternatives for green building regulation and related enforcement practices for New York City, in view of PlaNYC’s active agenda to increase the use of green building practices.

### Methodology

Focusing on the buildings sector and its role in the overall greenhouse gas emissions, Berliner developed the alternatives based primarily upon the results of a literature review as the planned survey was unsuccessful. The literature search did, however, reveal various municipal practices that formed the basis for some of the alternatives.

### Research Findings

Berliner identified four possible practice types, based on best practices from other jurisdictions and potential practices discussed but not yet tried. The four identified practice types, ranging from requiring all commercial and large

residential building to be built to LEED standards to requiring new construction to use green materials—were evaluated against implementation feasibility, enforceability, stakeholder support and relation to PlaNYC. Of the practice types, Berliner found that instituting a priority permitting process for new development projects that reduce electricity usage by 15 percent more than current code requirements would be most effective.

### Next Steps

The author suggested follow-up research on appropriate implementation methodologies.

### RECOMMENDATION

	LEED	Permitting	CA Code	Green Materials
<b>Feasibility</b>	Legislation required	DOB discretion	Legislation required	Legislation required
<b>Enforcement</b>	Standards are built in	Easy to enforce	Standards are built in	Standards are built in
<b>Stakeholders</b>	Developers likely to resist costs	Likely support among most	Significant changes to status quo—broad opposition likely	Builders and developers likely to object to loss of freedom
<b>PlaNYC</b>	Substantial carbon emissions reductions	Substantial carbon emissions reductions	Substantial carbon emissions reductions	Emissions reduction likely but hard to measure

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# Benchmarking Municipal Green Buildings Programs

Graduate students Will Baker, Shoulong Du, Aalia Kamlani, Fiona Li, Mark Mozur and Maurice Staner, with Academic Advisor Howard Apsan (the “Team”), were asked to develop a benchmarking framework with which to compare the City’s green buildings policy approach to those of other cities.

## Methodology

The Team, finding existing benchmarking methodologies lacking because they do not reflect the underlying public policy conditions, created six benchmark indicators it deemed to be integral components for an effective green buildings policy that reflect such conditions. The Team also developed policy typologies for the cities both the client agency and the Team selected for comparison with the City.

## Research Findings

While the Team identified important successes for each city, from which the City can learn, the City stands out as a leader in certain key areas. In its recommendations section, the Team highlighted lessons to be learned from other cities as suggested recommendations for the City.

## Next Steps

The Team suggested further analysis to develop quantitatively-based performance assessments of different typologies and programs, in particular, focusing on actual energy usage and greenhouse gas emissions, which would require access to data, including participation rates.

### FINDINGS

#### Strategic Planning



#### Implementation



#### Existing Buildings



#### Rating Systems



# New York City Environmental Review Process Reform

Graduate students Keiko Aikawa, Ruben Espejel, Sebastian Eugene, Jennifer Singh and Yohei Takashima, with Academic Advisor Kevin Kelly (the “Team”), were asked to identify characteristics of projects subject to the City Environmental Quality Review (CEQR) that might make them suitable for a management initiative, under consideration, with respect to the CEQR process. This project is one of three projects responding to the larger research question focusing on the impacts of mandated environmental reviews.

## Methodology

From a statistically meaningful sample of projects from the last few years, the Team created a database to test the relationship of various project attributes to the nature of the final action—a negative or positive declaration—and the duration of the process.

## Research Findings

The Team identified several criteria that statistically increased the likelihood of a negative declaration, making these criteria potential candidates to consider as a procedural filter to identify more complex projects.

## Next Steps

Since this project successfully analyzed a discrete component of an initiative underway, the Team did not suggest ideas for follow-up research.

## ANALYTIC FRAMEWORK





# NYC Capital Budgeting: The Impact on the Operating/ Expense Budgets

Graduate students, Laura Foster, Zaynab El Bernoussi, Hideto Hakamada, Aurora Hui Wang and Mio Washizu, with Academic Advisor Donna Keren (the "Team"), were asked to provide a conceptual model to control the burden of capital projects on operating budgets over the long-term.

## Methodology

After a literature review of the City's current practices, international best practices and capital budget reform research, the Team conducted interviews, in order to identify existing administrative and political constraints.

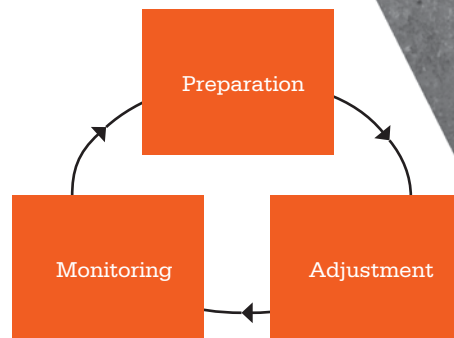
## Research Findings

The Team found that the problem of a high public debt burden has negative effects on operating budgets, both at the City and elsewhere, and identified tools from other jurisdictions. In the City, identified constraints, such as participation in the budget process by a wide range of political actors, agencies' perceptions about capital funds and the cost of additional budgeting monitoring, may likely render such tools infeasible. The Team's recommendations, operating within the scope of the existing budget process, included developing more robust information as part of the budget development phase, focusing more rigorously on changes to the financial plan, and systematic improvements to the monitoring function, including developing a cost multiplier to use in future capital budgets.

## Next Steps

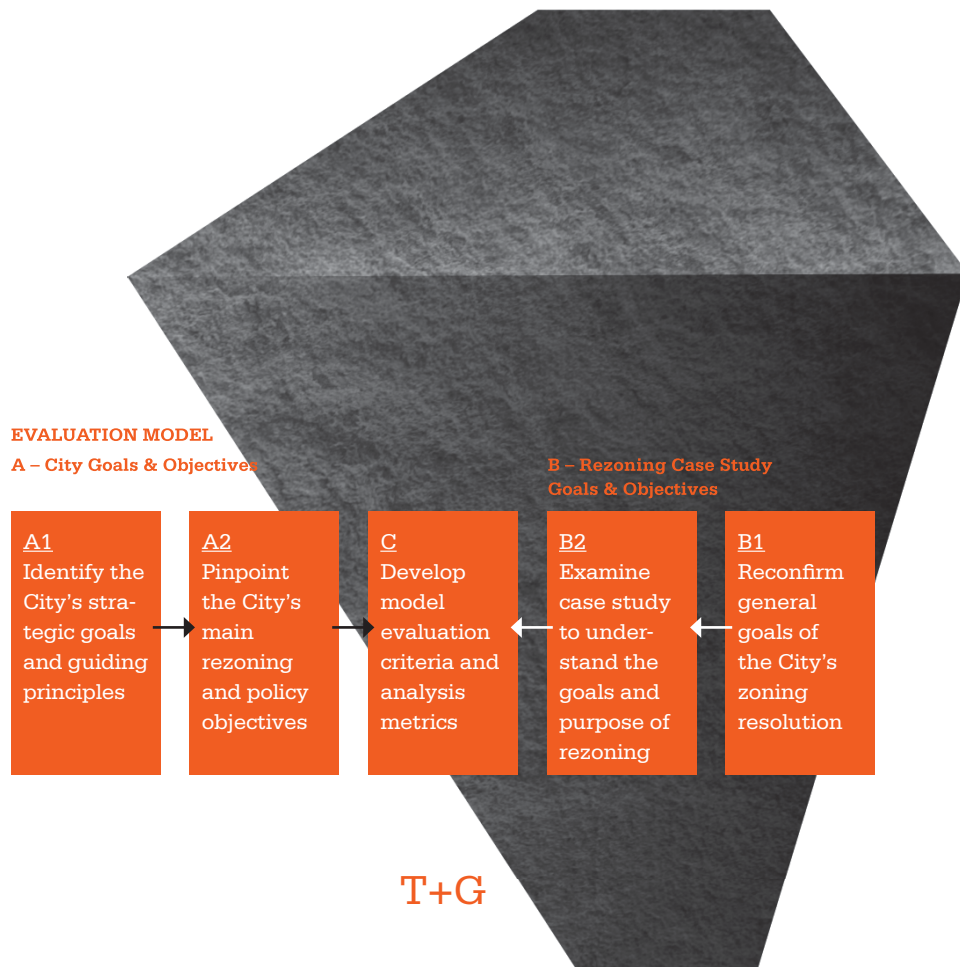
The Team did not discuss follow-up research.

## ANALYTIC FRAMEWORK



In the projects that follow under Management with Urban Planning Twist, some management issues are made more powerful when the owner is a governmental entity with formal municipal planning powers.

# Ex Post Facto Rezoning Evaluation Model



Graduate students, Justin Fusaro, James Mettham, Mark Page, Jr., and Brian Tubman, with Academic Advisor Frank Fish (the “Team”), were asked to develop an evaluation model to assist the evaluative review of the results of zoning actions.

### Methodology

The team conducted a literature review on evaluation tools and planning techniques for land use activities as well as best practices. Based on the results of the literature review and, in particular, approaches to general planning program evaluations, the Team developed its own high-level, step-down approach and used this approach to perform an ex post facto evaluation of 2001 Long Island City Rezoning, which the client selected as the case study. The Team also incorporated criteria used in jurisdictions identified as having best practices into the model.

### Research Findings

The Team’s research revealed a widespread absence of routine review of zoning activities to evaluate whether the consequences were as expected or differed from estimated effects. The Team was able, however, to incorporate research findings into their evaluation model. These included general approaches to planning program evaluation, such as goal attainment and impact evaluation/assessment, and related techniques such as spatial comparisons, decision consistency/indicators and value-driven approaches. The model framework permitted the Team

to compare overarching City strategic goals and objectives, re-imaged as three rezoning policy categories of value creation, environmental sustainability and social equity, with the stated 2001 rezoning goals and objective, across a number of criteria. The Team found the actual results for the 2001 Long Island City Rezoning to be mixed in the current context, but concluded they likely reflected priorities in 2001.

### Next Steps

In the post-mortem evaluation of the project, the Team identified possible improvements to techniques and areas for future research to obtain greater understanding of the impact of an individual rezoning, including analysis to prove causality, techniques to develop weighting of goals, and analysis to evaluate correlation between rezoning effects.

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# Landmark Designation: How Do Other Cities Do It?

Graduate students Daniella Bonilla, Mireille Martineau, Chris Minniti and Maria Pedroza, with Academic Advisor Kei Hayashi (the “Team”), were asked to perform a comparative case study of landmark designation processes and identify best practices across the country. The Team analyzed this project from a city planning perspective, while a related project looked at this project from a legal perspective.

## Methodology

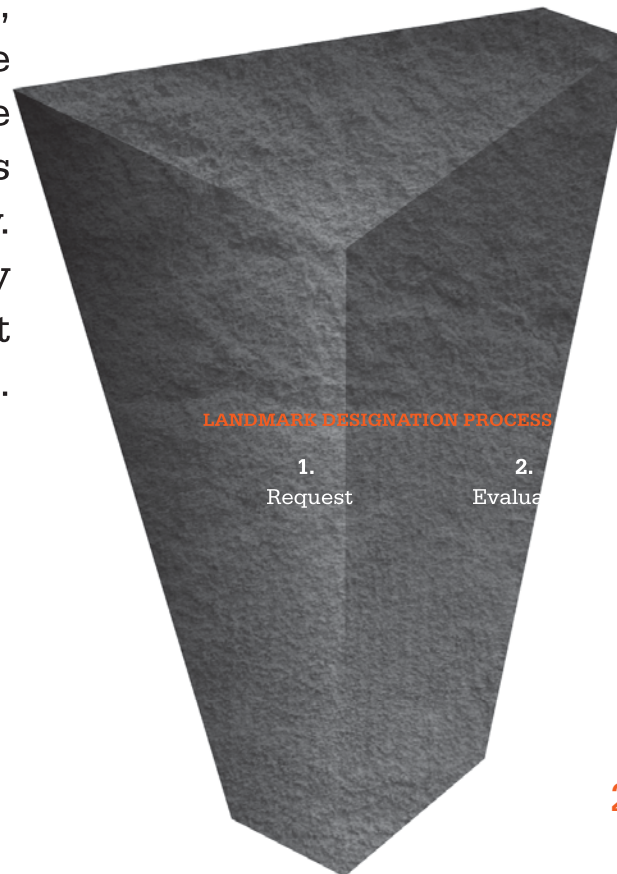
Using a statutory analysis of the designation process in several cities as a foundation, the Team examined the history, structure and function of the historic preservation bodies in each jurisdiction. The Team mapped the cities’ designation process and performed a typological assessment. Despite the unique features of each city, the Team created a general four-stage model—Request Stage, Evaluation, Determination and Finalization—of their landmark designation processes. After identifying the commonalities and variations among them, the Team constructed a timeline for each, noting sub-processes within them that affected the overall timeline.

## Research Finding

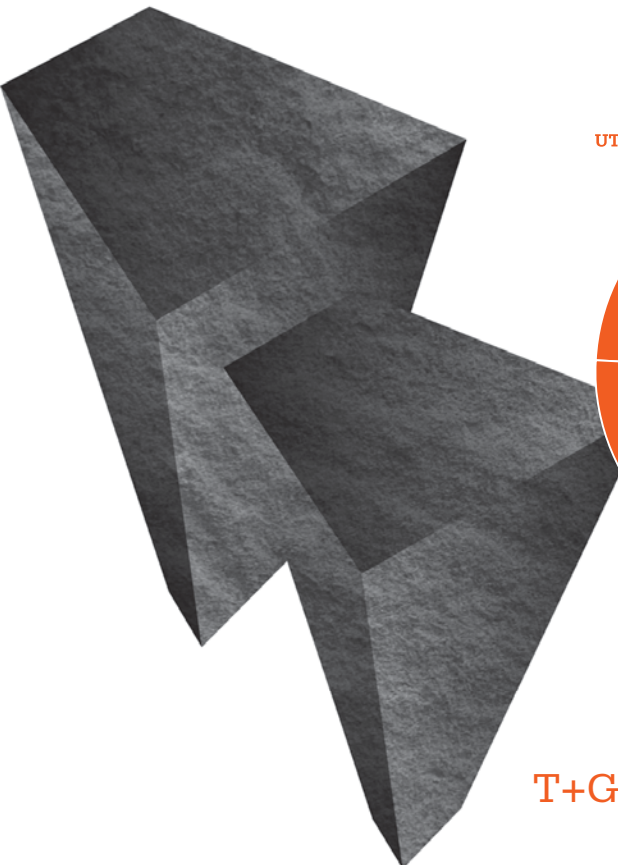
The Team found that the motivations behind the creation of the case study commissions were largely similar, but observed variation in their composition and function. Each of the timelines revealed commonalities among the jurisdictions, including “breaks” in the process, as permitted by the underlying statutes. Given the presence of these breaks, the Team was unable to fully compare the processes, or assign definitive timeframes to each step. The Team found that most of the breaks occurred at the early stage of the designation process, and a correlation between cities with a certain type of break and the time designation takes effect. The typological assessment confirmed the wide variation revealed by the other comparative analysis. The Team also found that each city has its own definition of success.

## Next Steps

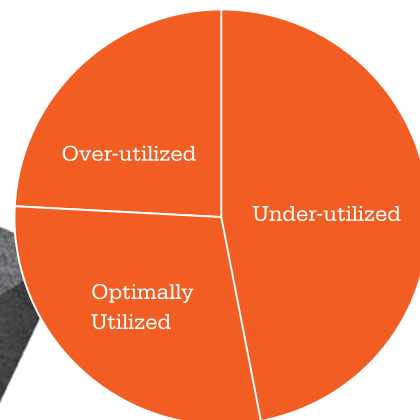
The Team suggested a sophisticated info-graphic-based analysis to better illustrate the various process breaks in order to understand better the impact on the related processes, geographic-based and/or social impact analyses to study the various impacts of landmark designations in particular jurisdictions and research into the metrics of landmark program success.



# Planning for the Optimum Utilization of New York City Schools



UTILIZATION OF NYC SCHOOL BUILDINGS



Graduate students Jennifer Chung, Jorge Ubaldo Colin Pescina, Tanya Fonseca, Heidi Gen Kuong, Christina Ghan, Kye-Joon Lee, Francis Tan and Nathan Tinclair, with Academic Advisor Mathew Lynch and Teaching Assistant Andrew Watanabe (the “Team”), were asked to expand on prior research on the mismatch between existing capacity at long-lived educational buildings and dynamic enrollment trends, on a city-wide basis, further exploring possible solutions.

## Methodology

Using a database of zoned elementary schools, the Team performed multiple linear regression analyses, followed by factor analysis, to identify significant factors related to variance in city-wide utilization rates. The Team followed such analyses with micro-level qualitative analyses, using four case studies and related interviews to further assess the factors statistically correlated with utilization and explore contextual explanations.

## Research Findings

Statistical analyses found that school quality and expenditures, the physical size of the school building and demographic changes in school-age population were significant contributors to the city-wide mismatch between buildings and enrollment which produces under-utilization and over-utilization of school facilities. The contextual case-study

analysis suggested a number of solutions, among them, the multi-use of under-utilized buildings for both school and non-school programming and the flexible design of future buildings.

## Next Steps

The Team suggested, for future research, further quantitative analyses using additional data that conforms better to the Public Use Microdata Area (PUMA) level, additional micro-level qualitative analyses to identify additional innovative contextual solutions as well as a study to analyze the decision-making process of parents selecting schools for their children.

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For the projects under Economics, the City acts in the role of either economic policy maker or regulator. The City builds and funds, through its capital program, a significant portion of New York City's public realm. The public works or capital programs of all levels of government are, in essence, work orders for facilities relating to "social" or "public" goods and to "mixed goods" that correct for negative and positive externalities. While engaging in such activities, the City acts in its role of economic policy maker. In its role of regulator, the City directs and regulates private capital participation in the public realm and regulates the safety of the construction process and the products of construction of both public and private owners.

# Long Term Capital Investment and Green Construction in New York City

Graduate students Xiao Yi Chen, Serdar Oztopal and Roberto Pesquera, with Academic Advisor Michael Silverman (the “Team”), were asked to explore aspects of financial impact of green construction practices in view of PlaNYC’s active agenda to increase the use of green building practices. The Team specifically explored issues related to the time horizon of the investment decision methodology as well as methods for quantifying costs and, especially, benefits that are not conventionally subject to quantification.



## Methodology

The Team’s two-step approach involved an extensive literature review of (i) financial impacts of green building practices, focusing on those impacts that have been more difficult to quantify, such as health and productivity gains, waste reduction and smog reduction, and (ii) cost-benefit modeling, focusing on long-term investments. From the literature review, the Team developed a cost-benefit analysis model and applied the model to different scenarios requiring green building guidelines in order to determine whether the benefits of green building practices at City-owned buildings would outweigh the costs over a period appropriate to projects with long useful lives, producing a positive net present value.

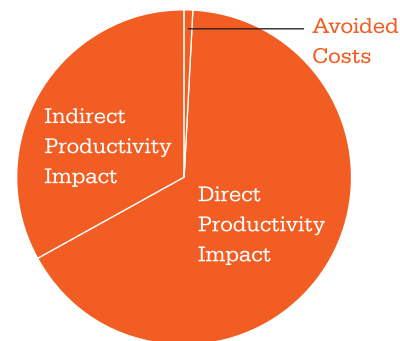
## Research Findings

After applying the model, the Team was able to estimate a series of long-term cost savings, focusing on the three impacts, that could accrue to City operations. Of the three impacts, productivity gains appeared to provide the largest benefit from green building practices. The need to be sensitive to the time horizon in investment analysis of green construction practices underlay the findings. The Team listed published resources from their extensive literature review.

## Next Steps

The Team noted data and analytical challenges for the other impacts—waste and smog reduction—that result from the nature of the systems within which these conditions operate. The Team recommended future analyses of these systems, including expanding the model to include related City operations, in the case of recycling, as well as private sector investments.

CONTRIBUTION OF VARIOUS FACTORS



To obtain a copy: [http://sipa.columbia.edu/academics/workshops/sample\\_reports.html](http://sipa.columbia.edu/academics/workshops/sample_reports.html)

# Modeling the Effects of CEQR

Graduate students Jaimie Anzelone, Terri Belkas, Gary Bennett, Iana Dikidjieva and Nicole Wishart, with Academic Advisor Jeannette Rausch (the “Team”), were asked to develop and assess models to evaluate the effects of the City’s Environmental Quality Review (CEQR) on public and private construction projects subject to CEQR. This project is one of three projects responding to the larger research question focusing on the impacts of mandated environmental reviews.

## Methodology

The Team pursued multiple avenues of research: both technical and literature reviews, including an in depth assessment of the CEQR Technical Manual, interviews with experts and practitioners, and an effort to identify and analyze publicly available quantitative information related to environmental review.

## Research Findings

The Team identified two possible evaluation models—the standard cost benefit analysis model and a risk assessment model. After weighing the models against feasibility and comprehensiveness criteria, the Team concluded that the risk assessment model would be a more effective way to measure the impact of an environmental law such as CEQR.

## Next Steps

The Team recommended the creation of a database in order to properly execute a risk assessment model.

EVALUATION MATRIX FOR THE RISK ASSESSMENT MODEL

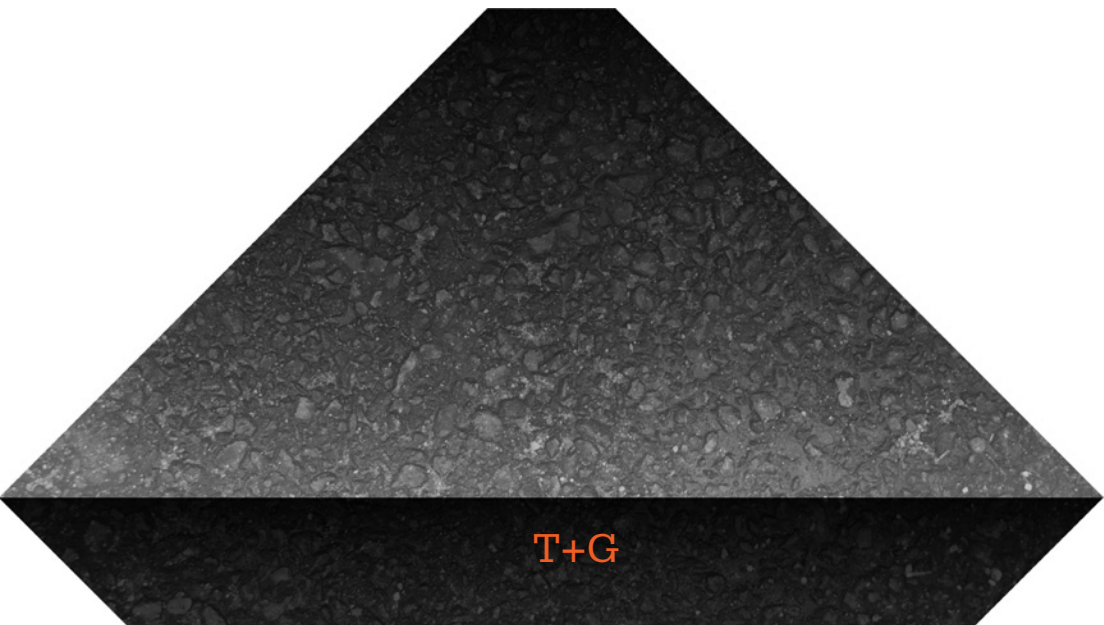
Criteria		Ranking		
Feasibility	Accessibility	High - Few main sources	High - Can be readily implemented	Medium-High Allows faster assessment of CEQR on key variables
	Time	High - Less than one year		
Comprehensiveness	Environment	Medium - Some Subjectivity	Medium - Focuses on developers and environment	
	Developers	High - Model is effective		
	City	Low - Does not comprehensively address impact on the City		

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The City, when it acts as a law maker, acts in the role of a regulator and policy maker, a role closely related to its role under Economics. In addition, the City acts as an owner, primarily through the contractual relationship between it and its designers and contractors. The contractual relationship is the product of industry standard practice, governing law and past experience.

# Landmarks Designation Process: How Do Other Jurisdictions Do It?



Law student, Jennifer Effron, was asked to review the landmarks designation processes in six jurisdictions—Boston, Philadelphia, Washington, D.C., Chicago, Seattle and San Francisco—and compare them to that of New York City, in order to provide legal background and analysis for a complementary project analyzing the designation process from a city planning perspective.

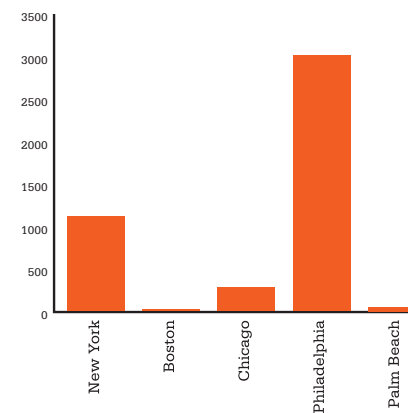
## Methodology

Effron examined the statutes and regulations governing the landmarks process in several U.S. cities. Her research included a review of each city's landmarks laws, eligibility criteria for landmark designation and organizational structure.

## Research Findings

Effron found that each city's designation process features a point at which proposed landmarks and historic districts remain without decision for an unlimited period of time. Some jurisdictions allow extensions for pending designations. Firm procedural time limits are triggered when a proposed landmark or historic district meets the statutory criteria. New York is in the minority of the jurisdictions studied where the executive officer appoints the chair of the commission and where the commission chair receives compensation. Designation decisions in only two jurisdictions, excluding New York, are final.

## INDIVIDUAL LANDMARKS By City



## Next Steps

Effron noted, as an area for further research and analysis, a study comparing the nature and depth of review performed by the various commissions and their staff.

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# Environmental Impact Review in New York City: Taking a “Hard Look” at Urban Environmentalism

## CBA EQUATION



Law student, Meghan O’Malley, was asked to review both State and City environmental impact review statutes—outlining their legislative histories and process requirements and then comparing them—in order to provide legal background and analysis for a complementary project focusing on the City’s environmental review process. This project is one of three projects responding to the larger research question focusing on the impacts of mandated environmental reviews. From the initial analysis, O’Malley explored the impact of CEQR in the context of recent sustainable environment issues.

### Methodology

O’Malley reviewed state and local statutes and regulations to detail the processes as well as identify legislative history and statutory criteria; she also performed additional non-statutory research related to greenhouse gas and climate change analysis.

### Research Findings

O’Malley found that adding greenhouse gas and climate change analysis to existing environmental impact review processes, based as they are on earlier views of the environment that are partially at odds with the current view

that urban area density makes a positive contribution to lower greenhouse gas emissions, may have negative unintended consequences in other areas of valid public concern, such as affordable and low-income housing.

### Next Steps

While O’Malley did make interim suggestions, she referred to a related project to develop a cost-benefit analysis of CEQR as one way to inform future changes to the environmental impact review process itself.

# How Can Public Owners Better Match Risk Shifting/ Mitigation Strategies to Risks?

T+G

Law students, Mathew Dudley and Cecily Goodrich, were asked to review all statutes related to public and private construction in New York, in order to provide foundational legal analysis for a project underway analyzing risk allocation provisions in public and private construction contracts. Contracts exist in a statutory environment which, in some cases, restrict the allocation of risk possible among contract parties.

#### Methodology

Dudley researched and outlined the statutes governing procurement of construction for all public owners in New York, while Goodrich researched and outlined all other statutes related to construction of public and private projects.

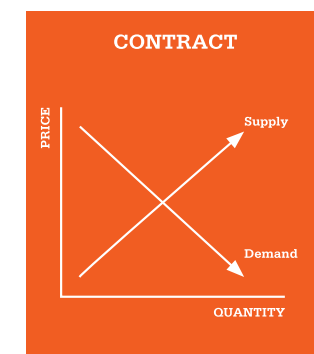
#### Research Findings

As these projects provide foundational analysis for another project, there were no particular findings. Dudley, however, provided additional analysis of statutory construction in New York.

#### Next Steps

The broader research project is expected to be complete by the end of academic year 2010-2011.

#### "THE LENS OF THE CONTRACT"



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## Design

Public capital programs generate public architecture that becomes part of the visible Built Environment. It has been said, “*The production of beauty, especially by simple and inexpensive means is a very subtle problem and can be solved successfully only by a combination of ability, experience and care.*”<sup>1</sup> This expression of the challenges inherent in municipal architecture—or the City’s capital program—provides an architectural and engineering context for design questions.

For projects in the Design category, the City would primarily act as an owner and a purchaser of design—architectural and engineering—services.

No projects under this heading from 2009-2010.

1. Attributed to I.N. Phelps Stokes.



## Technology

The City has an interest in technology solutions both as an owner and as a regulator.

# Bridging Energy Gaps: Energy Efficiency Research in New York City Area

Graduate students Nana Eduafo, Nicholas O'Brien, Scott Saverance and Karen Villafana, with Academic Advisor Kathleen Callahan (the "Team"), were asked to explore the state of energy research and development (R+D) at regional academic institutions and identify prospects for connecting city agencies, such as DCAS, involved in implementing PlaNYC's goals of increased energy efficiency and reduced greenhouse gas emissions, with academic institutions involved in energy R+D.

## Methodology

After a series of analyses evaluating an initial list of institutions and programs that conduct energy-related work against identified City energy technology needs, especially those with respect to City-owned buildings, the Team was able to identify a group of key institutions with projects directly applicable to City needs, analyzing them further to identify organizational capacities and specific energy research topics. The Team then interviewed these institutions to refine further the nature of their energy R+D and assess their interests in collaborative academic-based conversations with the City.

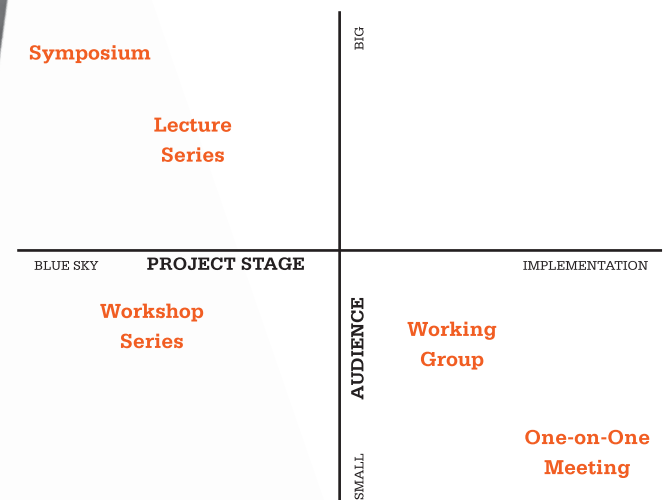
## Research Findings

The Team found that the state of regional academic energy R+D is robust, spread across many academic disciplines and effected through a variety

of organizational forms, including institutes, consortia and centers, of varying sizes. The Team created a detailed database of these resources. Most energy R+D is sponsored by federal and state government programs, and researchers with full- or pilot-stage projects often partner with private entities for commercial purposes. Numerous conferences, workshops and symposia regularly occur within the region. The robust nature of regional energy R+D presents opportunities as well as challenges to the City as it builds on relationships with academia, pilots and implements new technologies, and tracks developments in a changing field.

## Next Steps

The Team recommended a range of activities to develop and maintain academic relationships, and made suggestions about piloting technologies and using the results of research.



To obtain a copy: [http://sipa.columbia.edu/academics/workshops/sample\\_reports.html](http://sipa.columbia.edu/academics/workshops/sample_reports.html).

# Town+Gown in 2010-2011 Academic Year

Publication of *Building Ideas* signals both the end of the 2009-2010 Academic Year and the beginning of the first collaborative reflection and action phase during 2010-2011 Academic Year. To obtain the 2010-2011 Research Agenda, go to the DDC website at <http://www.nyc.gov/html/ddc/html/home/home.shtml>

Town+Gown currently consists of:

#### **Town Group**

New York City agencies that participate in the City's built environment.

#### **Gown Group**

Academic institutions with graduate and undergraduate programs in fields that are relevant to the Built Environment.

#### **Applied Analysis and Research Group**

Practitioners who participate actively in the program and are available to provide practical context to student teams.

#### **Incubation Group**

People interested in both the Built Environment and the Town+Gown program.

If you are not already a member of Town+Gown and would like information on how to become a member, please contact Terri Matthews, Director, Town+Gown (718 391 2884 or [matthewte@ddc.nyc.gov](mailto:matthewte@ddc.nyc.gov)).



## 2010-2011 Research Agenda

### Management

How Can the Risk Management Model from the Healthcare Industry Improve Construction Practices?

Why Does It Cost So Much to Build in New York—Public Projects?

How to Balance Cost and Quality More Effectively?

How Can Public Owners Better Match Risk Shifting/Mitigation Strategies to Risk?

How Do Public Agency Construction Practices Vary and What Is the Relation of Variance to Cost and Schedule?

How to Ensure Financial and Environmental Sustainability of Public Art?

How to Manage the Impact of Politics of the Capital Budget on Project Costs and Execution?

How to Increase Project Planning and Scheduling Certainty?

How Do Other Cities Do It—Pro-active Infrastructure Maintenance?

What Tools Have Been the Most Successful in Enabling Agencies to Better Manage Scope Changes as Large-Scale Capital Projects Evolve?

Future Workforce Needs and Development—Sources for Future Construction Professionals and Skilled Workers?

How to Bridge Organizational Divides to Create Culture of Innovation within Built Environment Agencies?

How to Evaluate Contractor Capacity to Undertake Public Projects?

What is the State of Building Information Modeling and Integrated Project Delivery in Public Sector Construction?

What Can Public Construction Cost Data Tell Us?

How Can a Public Owner Apply Continuous Improvement Methodologies to Standardization Practice in Construction?

How Can Public Owners Embrace Life Cycle Costing?

How Can the City Apply Life Cycle Costing to its Street and Public Space Programs?

### Management with an Urban Planning Twist

How Can Urban Planning Strategies Help Manage the Inevitable Mismatch between Static Capital Assets and Demographic Trends?

How to Develop an Evaluation Tool for Environmental Assessment and Impact Surveys?

What Is the Impact of Less-Than-Perfect Levels of State-of-Good-Repair Investments— or Is Almost “Just-in-Time” Repair Good Enough for Infrastructure Systems?

How Do Other Cities Do It—Design Oversight of Public Realm?

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2010, The City of New York  
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