High Performance Goals & Objectives For Lower Manhattan

Preliminary Report

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The following document was developed following a two-day workshop held at the Pocantico Conference Center of the Rockefeller Brothers Fund. Participants were chosen because of their familiarity with sustainability, high performance buildings and/or involvement in Lower Manhattan. This report was written by the staff of Earth Day New York, based upon discussions that took place there and subsequent input. It reflects a compilation of many views and not necessarily those of individual participants, the participating organizations or the Rockefeller Brothers Fund. This work is being supported under contract to the US Department of Energy.

High Performance Goals & Objectives For Lower Manhattan

Executive Summary

The redevelopment of Lower Manhattan is a unique and historic opportunity to establish a model for growth, planning and design that is energy efficient and environmentally responsible. Can we plan for 'sustainable' growth and ultimately, create a place that has a regenerative impact on the people, and the environment, of New York City?

The rebuilding on the World Trade Center site can dramatically alter the paradigm of urban development to create smarter, healthier, more resilient, secure buildings that are an integral and contributing part of the city environment.

Urban development in a sustainable world must not only consume resources. It must find ways to "give back," not just economically but in terms of urban amenities, energy production, water management, etc.

The recommendations enumerated here do not approach the specificity of guidelines. They are more in the nature of ideas, goals and objectives that need to be researched and further explored. A wide range of government, non-profit and research institutions will help support the detailed analyses required to assess these issues. The US Department of Energy has already agreed to fund the studies outlined at the end of this report.

We offer this early draft in a spirit of collaboration and in recognition of the timeframe that has been established by the LMDC. We begin the process by helping to clarify some of the fundamental ideas and information that will be needed to achieve sustainable design and development in Lower Manhattan.

If ever there was the opportunity to promote a new urban model, this site presents it. It should reflect the integrated progressive planning principles of Grand Central Terminal and Rockefeller Center and create a next generation "Central Park" defining New York City's relationship to nature in the 21st Century. With forethought and good design, Lower Manhattan will become a vibrant 24-hour community rich with urban amenities. Careful planning can facilitate regional access, ensure setbacks allowing for daylighting and green spaces and manage tourist traffic so that it enlivens but doesn't overwhelm. It must better integrate aboveground and belowground spaces and improve the relationship of the site and Lower Manhattan to the rivers, to the sun and to the sky.

This document presents a series of recommendations regarding policy, infrastructure and buildings that we hope will make the case for careful consideration of high performance opportunities for Lower Manhattan. We are all engaged in a grand experiment to envision and develop a lasting 21st Century symbol of American spirit and ingenuity -- sustainability should be at its heart.

GUIDING PRINCIPLES

The original World Trade Center became a symbol of America by default. Whatever rises from the ashes must be a symbol of intent and current societal priorities. If our intent is to be more sustainable, we must begin by presenting ideas that address the realities of Lower Manhattan.

Human design has much to learn from nature: a sustainable system where everything provides food for something else in an endless cycle of use and re-use. In the man-made world, we waste much more than we use. Our approach is simply not sustainable.

How can we learn to use resources as nature does?

- Harvest the clean, limitless, natural energy of the sun, wind, and waterways
- Extract more value from material and energy resources before "wasting" them
- Match the grade or quality of a resource to its use.

Drinking water should not be used for flushing toilets. When potable water goes down the drain, it should be captured along with rainwater and used for non-potable purposes such as irrigation or toilet flushing. Storm drains should not run directly into sewers in an era of vanishing clean water resources?

How can we mimic natural systems in a building?

Every surface should have more than one function. A building with a series of terraces at higher elevations provides a gathering place that offers sunlight, green space, views and other amenities to its occupants. They can also be solar collectors, water collectors, transparent daylight providers, etc.

In nature, resources are used and re-used, never wasted. If we burn fossil fuels to create electricity, the 'waste' heat should be captured to create heating or cooling and the 'waste' heat from that process should be used to pre-heat domestic hot water. The efficient use of 'waste' heat can dramatically decrease the burning of fossil fuels.

We should design and build in ways that facilitate future transformation. How can we design buildings: to make it easier to modify them in the future; to add new energy sources; to change walls, wiring, cabling with little or no demolition; and, to facilitate deconstruction, reuse and recycling when the useful life of a building product is over?

Humans spent hundreds of thousands of years evolving in a natural environment. People need access to light, air and nature to be happy, healthy and productive. If we design our buildings to provide what people really need, the buildings will "sell" themselves.

If ever there was the opportunity to create a new urban model, this site presents it. It should reflect the integrated progressive planning principles of Grand Central Terminal and Rockefeller Center and create a next generation "Central Park" defining New York City's relationship to nature in the 21st Century. With forethought and good design, Lower Manhattan will become a vibrant 24-hour community rich with urban amenities. Careful planning will facilitate regional access, ensure setbacks allowing for daylighting and green

spaces and tourist traffic that enlivens but does not overwhelm. It can better integrate above- and below-ground spaces and improve the relationship of the site and Lower Manhattan to the rivers, to the sun and to the sky.

The public planning should radiate out from the center, creating additional opportunities for more incremental improvements in existing buildings downtown. If successful, this great experiment will spark a transformation in thinking that helps to better integrate our man-made structures within our natural environment making them more sustainable, resilient and healthy.

Can we open up the underground to light and air? Can we provide daylight and views of nature deep into a floor plate? Can we create green space in the canyons of Lower Manhattan? Can we become more effective and resource efficient? This is the path to sustainability.

POLICY RECOMMENDATIONS

The City and State should expand and create new funding mechanisms to finance sustainable projects in Lower Manhattan.

The State should explore fully funding all Green Building Tax Credit applications for Lower Manhattan.

The City, State and Federal government should consider modifying existing incentives to promote green building development (e.g. the Industrial and Commercial Incentive Program (ICIP), the Energy Cost Savings Program (ECSP), the 80/20 Program, J-51, City and State Industrial Development (IDA) bonds, etc.)

NYSERDA and other appropriate agencies should target specific educational efforts towards building owners and operators in Lower Manhattan to ensure that they are fully aware of the current incentive programs available to them.

NYSERDA should provide increased funding to buildings in Lower Manhattan (e.g. 60-75% rather than 50%).

The LMDC and Port Authority should study, model and analyze the environmental dynamics of Lower Manhattan.

The LMDC should commit a percentage of the Federal, State and City funding for design and analysis of environmentally responsible opportunities for Lower Manhattan.

The LMDC and Port Authority should approach NYSERDA, US DOE, US EPA and other governmental agencies for help in modeling and analysis.

The LMDC and Port Authority should develop and compile a baseline of site resources and infrastructure and make it available to qualified researchers.

Government agencies and universities should conduct solar, tidal and wind studies and make them available to the LMDC and Port Authority, developers and designers to help inform building design, massing and orientation.

The LMDC and Port Authority should develop mandatory high performance building guidelines for both new and existing buildings in Lower Manhattan.

The LMDC should develop a RFP to create guidelines for new construction and existing buildings drawing upon the Battery Park City Authority (BPCA) Guidelines, NYC Department of Design and Construction (NYC DDC), NYS Green Building Tax Credit (NYS GBTC) and LEED™ guidelines.
The LMDC and Port Authority should establish a review committee to assess the guidelines, evaluate proposed plans and make recommendations to design teams.
The LMDC and Port Authority should require project teams to participate in at least two workshops in conceptual and schematic design with high performance building experts to raise opportunities specific to any proposed building.

The City, State and appropriate agencies should "rethink" the way they build infrastructure. In 1984, the City Planning Commission called for a major "rethinking" of construction, maintenance and repair programs for all infrastructure elements found in the public right-of-way. Since that time, not much has changed. Innovative planning can help avoid "cycles of disruption", adjust to a scale that "matches the change in the City" and eliminate some of the heavy financial and psychological costs of living and doing business in New York.

The recommendations of The Planning Commission's 1984 Statement included:

- Develop a regulatory code with standards for design, construction and repair including the assignment of utilities to specific corridors or zones and requiring shared access chambers to reduce the number of roadbed penetrations;
- Reserve space for future expansion and installation of new services; and
- Establish an office with broad oversight responsibility.

The City, LMDC and PA should aggressively study and pioneer creative infrastructure options for the 16-acre site.

The LMDC, working with NYSERDA should develop an Energy Plan and Strategy for Lower Manhattan that minimizes environmental impacts and provides reliable and secure power, and potentially, district heating and cooling.

The LMDC should develop a RFP for a study that would explore ways to use water more efficiently in the district and identify the city infrastructure needed. Topics should include: black/gray water systems and rainwater cachement and utilization.

The City should review and revise NYC Building Code and zoning requirements to make them consistent with and supportive of, high performance building guidelines such as BPCA, NYC DDC, NYS GBTC and LEED (e.g. investigate and remove the barriers to the use of gray water systems, modular cabling, etc. and encourage mixed-use development and interdependence between buildings). The Code's impact on daylighting should definitely be reviewed. Original building codes were based on access to light and air; a revision in 1961 assumed that the need for daylight was minimal thanks to electric lighting. This policy is wrong and should be changed.

The City should explore zoning incentives for heat island mitigation, renewable energy use, daylight access, zero runoff, etc.

The City and State should develop cost benefit analyses that account for externalities (e.g. cost of water treatment, electrical infrastructure, public health impacts, etc.) to assist in the assessment of avoided infrastructure costs for buildings that improve their environmental footprint. These models should be used to validate incentive programs.

The City should study ways to require any new building or major retrofit to measure and meter down to the end-user for all utilities including energy, water, waste, storm, sewer, etc. The City needs a system that rewards efficiency and avoided costs and penalizes waste.

The City, State and Port Authority should develop congestion pricing strategies (e.g. tolls and parking should be higher during peak hours). The City of London is currently experimenting with this type of program.

The City and State should study and promote ways to eliminate the use of potable water for sewage transport and provide a compensating credit or incentive for avoided costs.

The Public Service Commission (PSC) should do everything it can to create incentives and remove barriers to energy conservation, distributed generation, peak load reduction and sustainable/renewable fuels and technology. It should consider time-of-day and time-of-year pricing and review regulatory barriers related to standby charges and interconnection issues. It is critical to develop ways to reverse the utility rate bias that rewards those who use **more** energy with a lower rate. At minimum, the PSC should mandate that Con Edison waive its "standby" rate below Houston Street.

The PSC should move from "rate cap" regulation (i.e. limiting the rate utilities can charge) to a "revenue cap" (i.e. limiting the amount of revenues utilities can collect in any given year). This change shifts their profit center from increasing "throughput" to decreasing system expense and aligns shareholder interest with the public interest in lower costs and greater environmental benefits from energy efficiency and clean distributed generation.

Con Edison should provide funding as they have in other parts of the city that encourages distributed resources to alleviate their distribution system spending and explore other ways they can facilitate the creation of "safe harbor" buildings in Lower Manhattan, powered by clean distributed generation and protected from future electrical distribution outages.

The City, State and PA should explore bulk purchasing of green power and cleaner fuels. By aggregating demand in Lower Manhattan by type (electricity, oil, gas, steam, etc.) and utilizing government credit, it may be possible to support the rapid development of new green energy sources and reduce rates at the same time. For example, the Port Authority working with the NYS Power Authority could develop a RFP for clean energy sources for electricity and oil for some portion of their aggregated customers. Access to the private sector could be offered through a cooperative.

INFRASTRUCTURE

We recognize that it may be years before new buildings are developed in Lower Manhattan. The infrastructure that is built in the next few years will either foster or discourage sustainable development. Now is the time for infrastructure alternatives to be explored. The public officials overseeing the planning should consider the public infrastructure and private investment decisions holistically so they complement each other.

Transport

Create a more pedestrian-friendly and/or auto-free downtown. The relatively narrow width of Lower Manhattan facilitates easy access to the central business district by foot. By limiting traffic in Lower Manhattan, it would be possible to open up the streets to more green space, sidewalk cafes, green markets, pocket parks and other urban amenities.

The City should explore a wide variety of traffic calming measures to decrease automobile, truck and bus traffic including auto-free zones.
The City should allow parking only on the perimeter and limit tour buses on inner streets.
Developers should build canopies, arcades, or infrastructure where buildings are connected to support a sidewalk environment.
The City should develop bike paths and building owners should provide covered and secure bike parking.
The City should explore ways to promote the use of alternative transportation and develop pedestrian support systems in Lower Manhattan (e.g. pedicabs/rickshaws, small electric cars and other clean-fuel technology).

Improve mass transportation. To make the pedestrian environment work well, mass transit must provide quick and easy access throughout the district and beyond. The Port Authority and MTA should:

Improve connectivity between transit modes by expanding intermodal transfer opportunities.
Connect the regional rail systems to Downtown (MetroNorth, PATH, and Long Island RR with city subway, bus and ferry routes).
Improve mass transit linkages to all three airports.
Develop clean efficient aboveground people-moving solutions (e.g. a light rail shuttle system, monorail).
Study ways to provide daylighting and outside air to belowground systems and improve the acoustical environment.

Develop alternatives to truck delivery and waste removal strategies.

The LMDC and Port Authority should study the development of an underground system for movement of goods and waste. Planning has already begun on an underground concourse for moving people. Planners should consider paths for goods and waste transport, water and recycling systems, etc.

The transit agencies should explore rail delivery and removal strategies (e.g. use the subway system at night). People and trash would not be transported in the same cars, but more effectively utilizing the system "off hours" could create new jobs and additional revenue, in addition to decreasing pollution and congestion above-ground.
The city should encourage boat/barge delivery and removal strategies (e.g. study the use of the downtown piers for removal and delivery of goods at night).

Outdoor Environment

Lower Manhattan is one of the most densely populated districts in New York City with the least amount of green space. The people of the neighborhood have suffered extraordinary assaults on their local environment. The planning and redevelopment of the area should reflect a special level of care and protection to ensure the people of Lower Manhattan an exemplary urban environment.

Reconnect Lower Manhattan to natural sources.

The City and LMDC should find ways to encourage the use of the rivers as an aesthetic and community resource and increase access for the public to the sun, air and water.
The City and LMDC should develop a "greening" plan for Lower Manhattan streets and waterfront, focusing especially on primary circulation corridors. A goal should be to create a greenway from river to river. Building massing, building–to-building separation (street width) and building exterior reflectance should be developed to minimize daylight theft (reduce shading) of offsite structures and increase daylight access to public spaces, parks in particular.
The City should find ways to promote green roofs and terraces (both new and retrofitted) on public infrastructure and private buildings.
The LMDC and Port Authority should study various vegetation options and document the benefits including air/water quality, heat island mitigation, shading, etc.
The City, LMDC and Port Authority should ensure the development of a major green market within the district.

Control downtown pollutants at their source.

The LMDC, Port Authority and other appropriate government agencies (e.g. US EPA) should analyze primary downtown sources and develop pollutant reduction plans that establish specific targets for reduction of emissions.
The City and transit agencies should require clean fuels in all mass transit and public and private services including ferries, sanitation, tour buses and construction vehicles (e.g. low-sulfur, CNG, hybrid, and fuel-cells). Incentives should be evaluated.
The LMDC and Port Authority should require developers to document how they plan to minimize and mitigate negative environmental impacts on downtown neighborhoods.

Energy

New York City is in a "load pocket" and will continue to need to generate power within its borders. Lower Manhattan should be an incubator zone for the development of clean decentralized energy resources that are integrated with the grid and provide clean, resilient and secure power, and possibly, district heating and cooling.

The City and State should develop special programs for Lower Manhattan that provide incentives for energy efficiency improvements in new and existing buildings and for the decentralized use of clean energy technologies including solar, fuel cells and biomass.
The LMDC, Port Authority, NYS Power Authority and Con Ed should explore the potential for clean local electrical generation that would utilize the waste heat for district heating and/or cooling (combined heat and power).
The City should take this unprecedented opportunity to develop a "right of way" for all utilities that facilitates access/repair.
The transit agencies should investigate recovering thermal and kinetic energy from the NYC Transit and PATH relief ventilation shafts on the site.
The transit agencies should consider the use of their buildings/structures as PV and/or wind hosts to supplement electrical demand in the mass transit system.
The City should investigate simple controls systems for street lighting to save energy and reduce light pollution.

Water

The City, LMDC and Port Authority should study and develop a plan to significantly reduce potable water consumption in the district. Ideas to be evaluated should include the use of rainwater runoff, gray water systems, porous pavement in public spaces and area-wide cisterns to capture storm water for irrigation.
The transit agencies should investigate the capture and utilization of rainwater runoff in their systems.
The LMDC, Port Authority and other appropriate government agencies should study the use of river/harbor water as a resource/utility.

BUILDINGS

General Principles

Flexibility and Adaptability

Rapid advances in new technology, unpredictable change and the critical need to manage more and more information are driving industry as never before. Buildings must be designed to accommodate change, to be re-configurable to adapt to new uses and new technology, and to minimize the need for demolition, deconstruction and waste.

A huge amount of New York City waste comes from the endless reconfiguration of office space. Buildings should be designed so that they can utilize modular components, prefabricated assemblies, and "plug and play" technology (such as modular cabling, partitions, etc.). Buildings should also be designed so that they can be easily retrofit with future technologies focusing on renewable and sustainable systems (such as PV, fuel cells, biofuels, renewable materials).

Process – Climatic and 'Whole Building' design

Projects built in Lower Manhattan should be required to establish environmental goals and objectives, and ultimately performance benchmarks to guide the design. These commitments should be developed by the project team with community and expert input and should be made publicly available.

Sophisticated tools to simulate energy and environmental performance have become an essential aspect of building design today. These tools are able to: simulate energy use, daylighting, natural ventilation, air quality and comfort; to 'optimize' building performance; and to quantify global warming, acid rain and environmental pollution.

Buildings in Lower Manhattan should be required to utilize appropriate energy and environmental analysis tools to facilitate greater integration during the design phases of the project. Opportunities should be evaluated for design and technology trade-offs that enhance performance and cost effectiveness. NYSERDA, generally provides 50% funding for technical assistance up to a limit of $100,000. Those limits should be increased for Lower Manhattan.

In addition, the LMDC and Port Authority should encourage modeling of paired or multiple buildings to explore the benefits and economies to be gained from combining complementary energy and occupancy patterns.

Developers should require validation and documentation of simulated performance during each phase of the design process. These results should be compared throughout the development process against initial design 'performance benchmarks'.

Developers should require that new buildings be commissioned to ensure that they perform to original design intent. The commissioning plan, specifications and contract

requirements should be completed during the schematic and design development phases of the project, and executed during the completion of construction and building startup.

Building owners should periodically recommission their existing buildings to significantly reduce energy consumption with little or no investment. The cost of recommissioning is usually paid back quickly through improved system performance, reduced energy costs and improved occupant comfort.

Consider Climate Impact

Building design should strive to be 'climate neutral' in terms of a building's net contribution to climate change by maximizing energy efficiency opportunities. Burning fossil fuels puts greenhouse gases into the atmosphere; energy produced by solar or wind does not. Developers and designers should consider ways to avoid or offset climate impact (e.g. planting trees to absorb CO_2).

ENERGY

Design for the highest energy efficiency practical.

Today, a building's energy performance is required to meet or exceed the NYS Energy Conservation Code with a baseline of ASHRAE 90.1 1999. New projects should perform better than this target and, in the future, energy efficiency targets should continue to be increased.

Analyze building load profiles and explore district energy options.

The LMDC should ask Con Edison to develop a database of energy use for current buildings in Lower Manhattan and make it available to government and university researchers to help them accurately model existing conditions. The research should review current real estate standards of practice with regard to 'connected load' and compare with actual electrical use and develop accurate electrical loads assumptions that can be used as a more realistic basis for new and renovated building designs.

The LMDC and PA working with appropriate government agencies should study how building loads can be integrated with the load profiles of other buildings in Lower Manhattan to take advantage of different energy use patterns, electric vs. thermal loads, and opportunities for load aggregation and purchasing. It is possible to build a mix of fuel utilization and loads that results in a much more cost effective and efficient system than stand-alone buildings. Buildings with complementary energy profiles should be identified for further analysis.

The LMDC and PA working with appropriate government agencies should develop computer models for buildings that are 10-30% better than current standards to clarify how to increase energy efficiency in both new and existing buildings utilizing good design and cost effective technologies. The models should be made widely available.

Developers and designers should carefully analyze their proposed building load using sophisticated computer simulations, not rule-of-thumb.

Decrease a building's load.

Existing building owners, developers, tenants and their designers should explore various ways to lower internal plug loads and connected load (e.g. using flat screen monitors, laptops, ENERGY STAR and high SEER-rated equipment).

Good building design which facilitates daylighting in combination with effective electric light controls can reduce hourly, as well as peak demand for power, by at least 40% for about a 20 ft depth.

Explore ways to reduce and/or shift building peak loads.

Existing building owners, developers and designers should evaluate opportunities for demand limiting or demand shifting (e.g. thermal storage) strategies or the use of dual fuel equipment that can shift electrical loads to alternative fuel sources (e.g. absorption refrigeration, gas generator/electric chillers, dual fuel boilers).

Consider the use of clean fossil fuel distributed power within the district.

Existing building owners, developers and designers should analyze on-site generation for a significant part of a building's electricity if the building can capture and use waste heat or if reliability is extremely important to the tenants.

Existing building owners, in conjunction with appropriate government agencies, should explore ways to recover energy that is currently being wasted from existing buildings and processes in Lower Manhattan (e.g. can braking elevators recover energy like hybrid cars?).

Buy "green power" for all or part of a building's remaining energy needs.

Existing building owners, developers and tenants should investigate the availability and cost of procuring 'green power' alternatives for Lower Manhattan.

Meter energy consumption at point-of-use.

Developers and existing building owners should provide point-of-use monitoring for individual tenant spaces to help quantify and provide an incentive for tenants to achieve greater energy efficiency in their operations.

Envelope

Evaluate orientation and massing. Orientation and massing decisions should be based on an analysis of local site and climatic conditions: to understand how to take advantage of different exposures for sun, wind and views; to minimize heat gain and air conditioning loads; to minimize infiltration; and to provide maximum daylight availability.

The LMDC and PA working with appropriate government agencies should analyze climatic conditions and make the results available to owners and developers building on the site or renovating in the district.

Use high performance glazing. All building glazing should be specified to provide a combination of good daylighting and sun control to reduce the need for electric lighting, minimize solar gain and cooling loads or maximize solar gain for heating.

Improve sun control. Properly designed sun control systems like louvered shades can reduce solar gains and at the same time redirect daylight to the interior, increasing their economic benefit and occupant comfort. In Lower Manhattan, the effect of adjacent buildings, site conditions and the 'solar envelope' of the building must be evaluated. Sun control may include site elements, exterior shade devices, screens, films or coatings that prevent solar gains directly to the interior.

Improve thermal and moisture control. Insulation, thermal break design, and the control of moisture migration and condensation are critical to energy performance, indoor air quality and overall durability of building systems.

Developers should require, and designers should use heat and moisture transfer analyses of exterior wall and roof systems.
Designers should evaluate critical details of construction (e.g. building joints, exterior wall attachment and anchor points, air and vapor barriers, etc.) to ensure adequate thermal breaks and condensation performance.

Mitigate the 'heat island' effect, increase efficiency and functionality of roof.

Designers should use light colored materials on all exposed roof areas and/or develop green roofs, terraces and setbacks. Light colored materials have the added benefit of reflecting significantly more daylight down into otherwise darkened building, street or park areas.

Developers and their designers should consider landscaping and stormwater opportunities for roofs and setbacks. An aggressive goal would be to achieve 60% vegetative cover and 90% rainwater retention. Captured water can be utilized for cooling tower make-up and irrigation.

Daylighting and Lighting

Design to achieve maximum daylighting. Daylight should provide at least 40% of the total lighting requirements for the building and about 20-30 ft of naturally lit space from the perimeter. Daylighting controls are essential, for without them, there will be occupant comfort returns, but no direct savings in lighting. Whenever possible, visual access from indoor space to the outside/natural environment should be provided.

Developers should consider narrow floor plates, but in any case, provide access to daylight for all permanently occupied spaces (e.g. deep daylighting, view corridors).

Designers should evaluate the relationship between sun paths, the building floor plate and façade glazing (and possibly skylights, clerestories, or atria) to bring usable daylight deep into the building.
Developers should require high performance glazing, and designers should evaluate sun control, and/or light shades to control glare.
Tenants/occupants should utilize daylighting controls to ensure that they receive the economic benefits of good daylighting design.

Improve Lighting Quality.

Designers should analyze light distribution and lighting comfort criteria for natural and electric lighting combinations using sophisticated computer tools such as Radiance.
Designers should use high quality luminaries for color rendition similar to daylight where appropriate.
Designers should employ an ambient/task/accent lighting system and provide flexible task lighting with a range of positions.
Designers should provide dimming capability for greater occupant control and energy savings.

HVAC & Controls

Select highly efficient equipment.

Developers should select equipment on the basis of efficiency as well as total effect on building energy use and demand, and should include an evaluation of environmental emissions (CO_2, NOx, SOx).

Design to allow natural or mixed ventilation and/or "free cooling".

For building types that can accommodate natural ventilation, developers and/or owners should analyze opportunities for operable windows and louvers that can be controlled by occupants. Typical apartment layouts/floors should be analyzed to document the energy, air quality and comfort benefits of natural ventilation schemes.

For building types that do not easily accommodate natural ventilation (e.g. high-rise office buildings), developers and/or owners should analyze opportunities for 'free cooling' using waterside and/or airside economizers.
Developers of new buildings should consider the use of building facades that can provide free cooling or heating by controlled heat rejection during the summer and pre-heating during the winter.
Developers on the site should consider the use of geothermal heat exchange or the use of the former WTC river water system for free cooling.

Design to facilitate flexible fuel choices. Equipment that is capable of using different fuel sources such as electric, gas, steam, etc. can offer greater flexibility in controlling peak electric demand costs, provide fuel backup to operate during emergency conditions, and promote more competitive energy procurement.

Developers and owners retrofitting existing buildings should consider systems that can utilize more than one fuel to improve reliability and provide flexibility and cost advantages.
Developers and owners retrofitting existing buildings should consider systems that provide enhanced efficiency and recoverable waste heat if it can be used for other applications.

Maximize individual control of thermal and lighting conditions for enhanced personal comfort, productivity and energy use.

Designers should evaluate control strategies that integrate control of architectural elements (such as sun shades, natural ventilation, daylight dimming, etc.) with mechanical/electrical systems (such as HVAC and lighting).
Designers should zone comfort control, air supply and lighting to accommodate small areas of control that can be customized for personal comfort control.
Designers should provide flexible control strategies that can be easily modified and reconfigured for different space layouts and changing work environments (e.g raised floors and under floor air).
Designers should identify opportunities for the use of wireless control strategies that can be moved without requiring demolition or waste.

INDOOR ENVIRONMENTAL QUALITY

Improve IAQ.

Building owners and their designers should evaluate the advisability of natural ventilation and/or operable windows based on outside air quality.
Developers and existing building owners should provide outside air to meet ASHRAE 62 - 2001 or greater.
Designers should locate outside air intake away from noxious sources.
Developers and existing building owners should provide high efficiency filtration to remove particulates within the building (to MERV 13 (minimum efficiency reporting value) approximately 90% efficient).
Designers should ensure ventilation effectiveness (proper air distribution and mixing) to all occupied building spaces.
Buildings should provide a purge mode to flush out indoor pollutants when needed (e.g., during renovations, intensive cleaning activities).
Building owners, tenants and their designers should provide expanded occupant control of ventilation air, whenever possible.
Developers/building owners should develop an indoor air quality program that ensures good air quality during construction, commissioning and startup, and building occupancy. Reference the SMACNA IAQ Construction Guideline.
Building owners should monitor on a continuing basis, ventilation effectiveness, carbon dioxide and other indicator gases.

Improve Thermal Comfort.

The building envelope should be carefully designed to improve thermal comfort by using high-performance glazings, adequate insulation levels, air barriers, etc. A high-

performance envelope can also eliminate the need for supplemental perimeter mechanical systems (e.g. radiators).
Designers should consider the impact of the building envelope on thermal comfort (e.g. the mean radiant temperature of the exterior windows/walls and the rate of air infiltration/exfiltration allowed).
Designers should reference ASHRAE 55 – 1992 Addendum 1995 for comfort levels.
Building owners, tenants and their designers should provide expanded occupant control of temperature, whenever possible.

Control Moisture.

Designers should eliminate the potential for standing water in HVAC systems and moist surfaces that promote mold growth (e.g. condensation, pipe leaks).
Construction drawings should detail the continuity of the moisture protection strategies.
Designers should reference ASHRAE 62 for moisture control standards.

WATER

Developers, building owners and their designers should develop a plan to significantly reduce potable water consumption. Reductions of 20-30% or more should be considered as targets.
Developers and designers should use porous pavements and landscaping to reduce or capture runoff and explore the use of vegetation in, on and around the building for water cachement and preliminary treatment.
Developers and designers should investigate gray water collection and treatment systems.
Designers should evaluate strategies to achieve a substantial reduction of sanitary sewage (e.g. waterless urinals, dual flush toilets) and evaluate ways to use non-potable water (e.g. salt water, rain water, gray water) for toilet flushing and other purposes. Rainwater should be not combined with sanitary sewage.
Developers and designers should evaluate the use of using river water for condensing purposes.

MATERIALS SELECTION

Reduce Toxicity and Global Impact.

Developers and designers should identify ways to limit the introduction of harmful pollutants into the building and minimize materials that contribute to global warming, ozone depletion, smog and acid rain. Review the following:

1. Core & shell materials (insulation, sealants, adhesives)
2. Architectural finishes
3. Fixtures, furnishings & equipment (FF&E)
4. Cleaning/maintenance, pest control products & protocols

Guidelines such as LEED 2.1, the NYC High Performance Building Guideline, and the US EPA's testing protocol for furniture, among others, should be referenced for specific targets.

Conserve Resources.

The LMDC and PA should require, and construction managers should develop Waste Management Plans that encourage waste prevention, recycling and reuse during demolition and construction on any project in the district.
Developers, owners and their designers should provide appropriate infrastructure in every building to facilitate solid waste handling and recycling.
Designers should design with deconstruction rather than demolition in mind.
Designers should maximize the use of recycled content and specify materials that are recyclable and can be recycled into products of equal value i.e. not "down-cycled".
Construction managers should maximize recycling of construction and demolition waste to higher uses whenever possible.
Designers should consider the use salvaged materials or refurbished materials whenever possible.
Building owners should consider leasing rather than buying materials such as carpet and ceiling tiles, where a manufacturer agrees to take back the product at the end of its useful life and recycle it.

All of the above should be implemented without compromise to quality and performance. Refer to LEED 2.1 for recommended percentages and develop percentages for materials not included in LEED.

Use Local Materials.

Designers should specify materials produced within 500 miles as much as possible to avoid the environmental impact of transportation and promote local manufacturers and regional economic development. Reference the Battery Park City Authority or LEED Guidelines.

Use Renewable Materials.

Designers should specify rapidly renewable materials such as bamboo, cork, wheat board, agri-board, etc., whenever possible.
Designers should specify wood products harvested in accordance with the Forest Stewardship Council Guidelines.

OPERATIONS & MAINTENANCE

- Building owners and major tenants should commission mechanical, electrical and plumbing systems to ensure that systems perform as designed.
- Developer/owners should tie final payment for contractors to system performance.
- Owners should develop an O&M manual and implement an O&M plan/schedule to ensure system performance and that the building's environmental goals are maintained as originally intended.
- Building owners and major tenants should develop a housekeeping plan and cleaning regimen utilizing environmentally responsible products.
- The building owner should develop an Indoor Air Quality Management Plan and designate a qualified IAQ manager who is responsible for addressing IAQ problems in the building, controlling sources of pollutants, and communicating with tenants.

- The owner and major tenants should conduct an annual energy audit and adopt a philosophy of continuous improvement towards reducing use.
- The owner and major tenants should conduct a water use audit and adopt a philosophy of continuous improvement towards reducing use.
- The owner should develop a tenant improvement guideline that maintains the buildings environmental goals during renovation and remodeling.
- The owner should revise lease agreements to take into account these various objectives.

PROPOSED STUDIES

Energy Performance Studies

The US Department of Energy is willing to sponsor a study by the National Renewable Energy Laboratory (NREL) to develop detailed information on the load profiles and energy saving opportunities for office towers built in Lower Manhattan. Working closely with the Port Authority, LMDC, and Studio Daniel Libeskind, research efforts will use measured data and designs from the WTC project and provide direct technical assistance. However, the study and documentation will be designed so that the information generated will be useful and educational to others developing on the site.

We are proposing the following topics to be included in the research activities:

1. Analyze solar/daylight resources on outside of buildings and at street level.

2. Evaluate proposed massing schemes for energy and environmental opportunities.

3. Evaluate site comfort zones using a new tool that can model individual comfort conditions.

4. Assess opportunities to save energy in large assembly, lodging and mercantile areas.

5. Assess opportunities to save energy in large office towers (focus of most of the work):

    a. Develop a "base case" energy model of a sample office tower floor plate that just complies with the energy code. This baseline will be used to quantify the performance levels of more efficient designs.
    b. Develop optimized designs for a sample floor that minimize costs for heating, air-conditioning, ventilating and lighting through the use of daylighting (to reduce electric lighting) and careful tuning of glazing and wall systems. Analysis will use the EnergyPlus program combined with other methodologies developed by the

National Renewable Energy Labs (NREL) for arriving at low-energy designs.

c. Analyze air pathways for efficient distribution and ventilation in a sample office tower. Analysis will use computational fluid dynamics (CFD) to study underfloor air and potential for natural stack effects to augment ventilation.
d. Analyze lighting designs to identify best ways to use electric lighting in a sample office tower. Analysis will use modified ray-tracing methods (Radiance).
e. Analyze different types of HVAC systems that can be used to meet the remaining loads for a sample office tower.
f. Analyze how varying levels of loads from plugs (e.g. office equipment), occupancy, and ventilation affect building performance levels, HVAC system sizing, and thermal comfort for a sample office tower.

High Performance Goals & Objectives For Lower Manhattan

PRELIMINARY REPORT

Developed in a two-day workshop supported by the US Department of Energy and hosted by the Pocantico Conference Center of the Rockefeller Brothers Fund

Attendees

Jose Alminana, Principal, Andropogon Associates
John Amatruda, Senior Associate, Steven Winter Associates, Inc.
George Aridas, Senior Vice President, Albanese Development Corporation
Catherine Bobenhausen, CIH, CSP, Principal Scientist, Jacques Whitford Co., Inc.
Kirsten Childs, Principal, Croxton Collaborative
Todd Coulard, Principal, Coulard & Associates
Fiona Cousins, Associate Principal, Arup
Drury Crawley, AIA, Program Manager, US Department of Energy
Randy Croxton, FAIA, Principal, Croxton Collaborative Architects; Chair, Sustainability Committee, New York New Visions
Barry Donaldson, Principal, e4, inc.
Paul Elston, Chair, New York League of Conservation Voters
William Esposito, Jr., CIH, President, Ambient Group, Inc.
Donald Fram, Assistant Chief Architect, Port Authority of NY & NJ
Jean Gardner, Senior Faculty, Dept. of Architecture, Parsons, RDOT
James Garin, Chief of Capital Planning, Bureau of Water & Sewer Operations, NYC Department of Environmental Protection
Mark Ginsberg, Board of Directors, Office of Energy Efficiency and Renewable Energy, US Department Of Energy
Ashok Gupta, Air & Energy Program Director, Natural Resources Defense Council
Andreas Hausler, Senior Associate Principal, Kohn Pederson Fox Associates, P.C.
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Ron Judkoff, Director, Center for Buildings & Thermal Systems, National Renewable Energy Lab
Valentine Lehr, Partner, Lehr Associates Consulting Engineers
Pamela Lippe, Executive Director, Earth Day New York; Principal, e4, inc., facilitator
Michael McDonough, AIA, Principal, Michael McDonough Architect
Daniel Nall, AIA, Senior VP and Director of Advanced Technology, Flack+Kurtz
David Norris, Principal, Carpenter Norris Consulting
Elizabeth Perry, Project Manager, NYSERDA
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