



**MECHANICAL ELECTRICAL PLUMBING**

**MEP**

**Engineering 101**



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# WHAT DOES MEP MEAN IN CONSTRUCTION?



MEP is an acronym that stands for mechanical, electrical and plumbing engineering. These three technical disciplines encompass the systems that make building interiors suitable for human occupancy. MEP installations are addressed together due to the high degree of interaction between them, and also to avoid conflicts in equipment locations - a common problem when electrical, mechanical and plumbing systems are designed in isolation.

Working with qualified MEP engineering companies brings many advantages: installation costs are reduced by optimizing material requirements, while achieving high performance and code compliance. This is very valuable in New York City, where building ownership costs are very high and construction codes are very demanding.

In addition to the NYC Building Code, there is a dedicated code for each of the three MEP fields:

- NYC Mechanical Code
- NYC Electrical Code
- NYC Plumbing Code

Keep in mind that additional codes apply. For example, the NYC Energy Conservation Code has requirements that affect all MEP systems, and any building system with combustion appliances must adhere to the NYC Fuel Gas Code.

Given the complexity of MEP systems, modern engineering consulting firms use software to speed up the design process. Simple and repetitive tasks are automated by a computer, while MEP design engineers can focus on taking the best decisions.

Before proceeding with any project that involves MEP installations in NYC, keep in mind that there are licensing requirements for both design professionals and installation contractors. Only a Registered Design Professional (RDP) can get MEP designs approved with the NYC Department of Buildings, and only licensed contractors can get work permits.

## M: Mechanical Engineering

Various types of mechanical systems are used in residential, commercial and industrial buildings. However, three types account for most of the mechanical design work in multifamily and commercial constructions:

- Space heating
- Air conditioning
- Mechanical ventilation

These systems interact to keep temperature and humidity within a range that provides comfort and health. Mechanical ventilation also ensures that enough fresh air is supplied to keep pollutant concentrations at low and safe levels.

Mechanical installations operate at their best when equipment capacity is adequate; contrary to popular belief, over engineering brings many negative consequences. For example, oversized chillers and boilers tend to cycle rapidly, creating room temperature fluctuations and wearing down equipment at an accelerated pace.

Another consequence of over engineering in mechanical systems is poor control of indoor humidity. ASHRAE recommends keeping relative humidity between 30% and 60% to make indoor spaces optimal for human occupancy, and there are negative consequences when humidity falls outside this range for extended periods. For example, low humidity can irritate the skin and airways, while high humidity stimulates the growth of mold and bacteria.

Other than sizing HVAC equipment correctly, mechanical design involves laying out optimal routes for heat distribution systems: air ducts, hydronic piping or steam piping, whichever applies for the project. If combustion appliances are used, which is the case for most space heating systems in NYC buildings, these must be properly vented to ensure that harmful combustion products are removed.

## E: Electrical Engineering

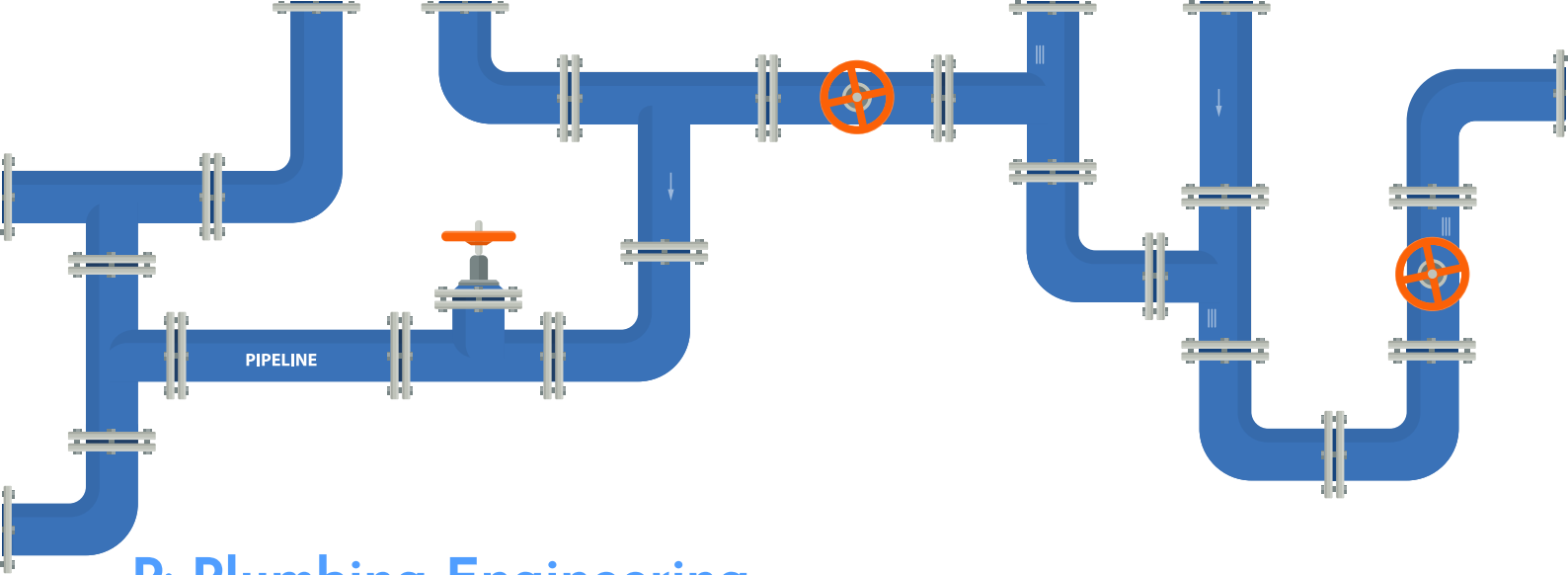
In high-rise constructions such as those commonly found in NYC, one of the main challenges in electrical design is defining the optimal routes for conduit and wiring. However, there tends to be more flexibility than in mechanical systems, since electrical circuits require much less space and can be routed around obstacles more easily. With the aid of MEP design software, conduit and wiring can be laid out while minimizing total circuit lengths, and avoiding location conflicts with mechanical and plumbing installations.

Lighting installations are the electrical system with the highest energy consumption in most NYC buildings, and engineering consulting firms often suggest LED lighting for this reason. Many MEP design software packages are capable of simulating lighting, in order to determine the optimal number of fixtures and their locations.

HVAC is an area that requires close collaboration between mechanical and electrical engineers during the MEP design process. Mechanical engineers calculate heating and cooling loads to determine equipment capacities, while electrical engineers design the electrical circuits and protection measures that allow this equipment to operate continuously and safely. In NYC, only furnaces and boilers use mostly fossil fuels as an energy source; air conditioners, chillers, air-handling systems and hydronic pumps all work with electricity in the vast majority of cases.







## P: Plumbing Engineering

Plumbing installations in NYC are also subject to various technical requirements. Just like mechanical and electrical installations, plumbing requires laying out complex piping routes, and MEP design software widely used by engineering firms to simplify the process.

Plumbing installations interact with both mechanical and electrical systems at many points, which emphasizes the importance of collaboration among design teams:

High-rise buildings typically need water booster pumps, which run with electricity.

Domestic hot water systems typically get their heat through one of the following configurations: a dedicated boiler, a heat exchanger connected to a space heating boiler, or an electric heater (a conventional resistance heater or a heat pump).

Fire protection design can be challenging, since NYC codes are especially demanding in that technical field. In addition to the applicable codes from the NYC Department of Buildings and the National Fire Protection Association (NFPA), Local Law 26 of 2004 makes automatic fire sprinklers mandatory for all business occupancies taller than 100 feet. The law applies retroactively even for existing constructions, where the deadline to complete the building upgrade is July 1, 2019.

## Added Value of MEP Design

When designing building systems, an integrated MEP engineering approach yields better results than specifying each building system in isolation. Interactions between building systems can be especially difficult to coordinate when the design process is isolated, and equipment location conflicts are very likely.

If a modern MEP design software is used, the value of the 3D model produced during the design phase goes beyond the construction process. The model can be conserved as reference for maintenance activities, and can be updated along with the building during a major renovation. In general, a building with a MEP engineering model is easier to manage and service than another building where only conventional construction plans are available.





# WHY OUTSOURCING MEP DESIGNS BENEFITS THE CONSTRUCTION INDUSTRY?

The construction industry is fast-paced whereby a single day's delay could incur exorbitant costs. Projects are deadline driven, and so the experts in this industry need to be alert and act proactively in a quest to complete the projects quickly. One of the driving forces of this industry is MEP design (Mechanical, Electrical and Plumbing). Should construction firms utilize in-house or outsource MEP designs?

MEP designs or models play a significant role in building design, construction, and maintenance. A basic layout of the building design would include fire protection systems, piping systems, electrical fixtures, HAC systems, water supply piping, and other akin building management systems. All these systems need unbeatable expertise and a wealth of experience to perfect from the design to the installation.

While companies may have their in-house MEP design personnel, their expertise may be second to a dedicated MEP engineering firm whose sole role is to provide unparalleled MEP designs using latest technologies such as BIM (Building Information Modeling). This therefore necessitates the need for outsourcing opportunities, which expose you to a complete control of your project while expert engineers maneuver your designs.

Outsourcing MEP designs presents a broad range of benefits for a fast-paced, deadline-driven, and cost-sensitive construction industry. Some of these benefits are highlighted hereunder.

## THE BENEFITS OF OUTSOURCING MEP DESIGNS FOR THE CONSTRUCTION INDUSTRY

**Time saving:** An outsourcing company would ideally take care of your MEP designs while you focus on other important tasks. As a result, your in-house team has adequate time to excel in other roles while another firm fine-tunes your designs. In a complex building, MEP designs could be demanding and you might waste recruiting or upskilling your existing staff in order to excel in MEP designs. Why not save time by outsourcing?

**Cost effective:** depending on the scale of your projects, you may have to spend more money to get MEP designs. This includes investing in the latest technologies and hiring talented staff in MEP. Modern engineers are no longer using the conventional 2D drawings to craft MEP designs. Instead, they have adopted BIM technology, which not every firm is yet competent in using. By carefully handpicking the best engineering firm to outsource the designs to, you can rest assured that you will save associated costs.

The use of BIM, for instance, brings loads and lots of benefits to your design and construction. It gives accurate cost estimations, collaborative 3D models, clash detection and resolution, shop drawing, project scheduling, minimum change orders, and many more benefits. Traditionally, you would organize a countless number of meetings for project teams and use costly stationery for that. Outsourcing to a BIM specialist engineering firm saves you a lot of money.

**Guaranteed data security:** a single mistake in data leakage could mess up your company's reputation and even hamper its progress. Outsourcing companies, off-shore companies in particular, are bound by data security laws, which comes with hefty penalties. In spite of these data laws, outsourcing companies strive to maintain long-term relationships and integrity by securing your data and never sharing it with the third party.

**Great project control and management:** project managers are oftentimes inundated with a heap of tasks to fulfil for their projects. Large-scale projects become even more overwhelming. Among others, MEP designs are the most complex, and the best way is to outsource them so that you can have a complete control and management while an outsourcing company takes care of your designs. With the help of BIM services, all project stakeholders can now collaborate and engage in a digital model and make changes instantly.

## WRAP UP

**MEP designs** play a pivotal role in the construction industry and they are inevitable. They are, however, demanding from the design execution and installation. Most importantly, MEP designs require a highly skilled team of engineers. In-house engineers are not always well-rounded since they are oftentimes overloaded with insurmountable tasks to complete.

Outsourcing remains the most cost-effective and viable solution for project owners. As highlighted above, outsourcing brings loads of benefits. New York Engineers has been in the industry for decades helping project owners excel in their constructions. We have an unmatched team of MEP professionals with expertise and experience in MEP BIM solutions.

# HOW DEVELOPERS BENEFIT FROM WORKING WITH A MEP ENGINEERING FIRM



When developers start a new construction project, a common practice is hiring separate engineering companies to design mechanical, electrical and plumbing installations. However, this approach creates a considerable management challenge, since the developer must coordinate design teams in separate companies, ensuring that all building systems interact properly.

There are also equipment providers that offer design services, but the system configurations available are limited to the product offering of that specific provider. The end goal of suppliers is to sell their own equipment, and developers don't have a chance to consider other solutions that may be a better match for the project.

A simpler and smarter approach is working with a MEP engineering firm, which covers many areas of expertise. This way, developers can delegate not only the technical aspect of design, but also team management. Building systems cannot be designed in isolation, since they share physical spaces and they have components that interact directly - for instance, many types of HVAC equipment are powered by electricity.

## MEP Design Is Not Only a Technical Challenge

MEP design seems like a straightforward process, where the goal is to specify equipment and devices that meet the needs of the building. However, there are many challenges that go beyond the functional aspects.

**Code compliance:** Even if a building system accomplishes its intended function, it may miss code requirements. For example, some codes specify additional safety measures or a minimum level of energy efficiency.



**Permits and other paperwork:** A code-compliant design is required for project approval, but the construction plans and specifications must also follow specific formats. Projects must be documented properly for approval.

**Meeting deadlines:** Construction cannot start unless the project is approved, and in turn the approval process requires a completed design. Since a delayed project causes inconvenience and financial losses for the developer, completing the design on time is very important - effective team management is key.

**Cost optimization:** Ideally, a project design should meet codes and owner requirements at the lowest cost possible. There is a common misconception that savings are only possible at the expense of performance, but this is not the case.

When building systems are designed in isolation, the project often becomes more expensive and the design process takes more time. Errors are also more likely, and there may be equipment location conflicts and compatibility issues. The simplest way to avoid these issues is by working with a MEP engineering company that delivers an integrated design.

Building codes and permitting formats represent an ongoing challenge, since they are reviewed and updated by authorities at regular intervals. However, a qualified MEP engineering firm is highly familiarized with codes, documentation, and their latest requirements.

## Enhancing the Design Process with Technology

Construction drawings were once drafted by hand, a process that required a high input of man-hours. Drafting was greatly simplified with the development of computed-aided design, allowing two-dimensional drawings in just a fraction of the time.

Modern design software is based on building information modeling, or BIM, where engineers can create a three-dimensional model of the project with material and equipment properties. This allows enhanced visualization and planning of construction, and bills of materials can be calculated with automatic tools.

Advanced building models continue to be useful even after the project is completed, since they can be used as a basis for building modifications and maintenance activities. The BIM file can be updated constantly to track the condition of equipment and components, scheduling replacements well in advance.



# CHECKLIST FOR CHOOSING A MEP ENGINEER



Mechanical, electrical, and plumbing (MEP) systems represent most of the construction budget in many renovations and infrastructure upgrades. Choosing the right MEP engineering firm for your project is very important, since this will guarantee project success and high-performance systems within your technical and financial objectives. MEP engineers offer a wide range of services - to obtain the highest possible value, you must understand the service level you need.

Scheduling an interview with your MEP consulting firm is recommended to discuss your project and needs. This article provides a checklist you can consider during the interview, to make sure your project is assigned to the right MEP engineer.

## Talk With Both MEP Designers and Project Managers

Meet the design and management team that will be working on the project, learn about the tasks they will perform, and how each of them will be involved throughout the project. Usually, your first contact will be with executives or marketing staff, and you will then be referred to the corresponding Lead Engineer or Project Manager.

If a Project Manager is also a Lead Engineer for one of the trades, they can provide better leadership since they will be more familiarized with project details. At the end, this will improve the project outcome.

## Discuss the Quality Management Process

Companies usually claim they have a quality management program, but many of them fall short. Quality management should begin with the proposal, and be considered during every step from project design to construction.

When in doubt, you can ask for a list of quality control procedures for each position. When you are dealing with MEP engineers who take quality seriously, these documents are frequently reviewed and updated.

## Ask for Contractor Feedback

Having unbiased and positive comments from multiple contractors and developers speaks well about MEP engineers. Actually, a qualified engineering firm can help you manage the contractor relationship better, since all drawings and documentation are clearly understood.

You can also ask for a list of trade subcontractors who have worked with your MEP consultants and call them for reference. Coordination among trades is much easier when a project is designed and specified by professionals.

## Ask About Previous MEP Design Work with Frequent Clients

Having frequent clients is a clear indication of work ethic and performance, and you can call those clients for reference. An even better sign is when your MEP consultants have clients who work exclusively with them, especially if there is a long-term contract involved.

An ongoing business relationship can help you manage your buildings better, since the MEP engineers will become very familiarized with your installations and procedures. Hiring a different firm for every MEP project is less efficient, since each new engineer must dedicate time to inspect your building systems.

## If Your Project is a Renovation, Ask for an Inspection

MEP engineers should always check the present condition of MEP systems even if as-built documents are available. Existing documents could have inaccuracies, requiring a more extensive field verification should take place.

Engineers must verify that the MEP conditions indicated in drawings are accurate, in order to prevent future problems. An engineer from each trade should visit the site to review the corresponding system, since they are the ones who will create a solution.

## Discuss Construction Administration Services After MEP Design

Construction administration services are essential for a successful project. When the MEP engineers in charge of design also provide this service, communication between the design team and the contractor is greatly improved. Hiring different firms for MEP design and construction administration is possible, but communication will become less efficient, possibly leading to project delays and extra costs.

Ask MEP engineers how they proceed when a contractor has not followed the drawings or specifications. The engineer should clarify the design, listen to the contractor's input, and build consensus. This will be beneficial for the project, while creating a good working relationship between both parties.

A MEP engineering firm should be capable of responding quickly to phone calls, emails, contractor requests for information (RFI), and submittal reviews. Slow communication can delay an entire project.

# HOW TO CHOOSE A MEP ENGINEERING FIRM



Working with the right MEP engineering firm can greatly improve your building performance. Mechanical, electrical and plumbing systems create a suitable indoor environment for humans, but they can also consume plenty of water and energy. Ideally, MEP systems should accomplish their function with the lowest operating cost possible.

MEP engineering is the science and art of planning, designing, and managing the mechanical, electrical and plumbing systems of a building. MEP design companies specialize in those skills, and they play a key role during all stages of construction. Some of their roles during a project include decision making, cost estimation, construction administration, and building management.

## WHY YOU SHOULD INCLUDE A MEP ENGINEERING FIRM IN YOUR PROJECT?

MEP engineers can maximize the performance of a new construction or renovation project, while minimizing costs and providing long-term value. MEP firms analyze individual building systems within the overall context of the project. By doing so, they can determine the systems that best integrate with the building architecture. MEP engineering companies can help you with the following technical challenges:

- Improving aspects like lighting, heating, cooling, and environmental performance - while keeping design integrity and aesthetics.
- Reducing operation and maintenance costs for the entire service life of the building.
- Minimizing construction and energy costs.
- Meeting environmental requirements, while promoting water and energy conservation.
- Solving plumbing issues and wastewater management.



There are many services that fit in the category of MEP design and engineering. Plenty of engineering firms provide MEP services, but only a few have the expertise to cover all areas. The following table summarizes the main MEP services required for a building project.

MEP Engineering Category	Examples
Mechanical Engineering (including HVAC)	Air-Handling Systems Hot Water Systems Chiller and Boiler Plants Direct Digital Control Systems Exhaust Systems
Electrical Engineering	Electrical Wiring and Conduit On-site Power Generation Lighting Systems and Protections Fire Alarm Systems Arc Fault Services
Plumbing Engineering	Domestic Cold and Hot Water Systems Storm Water Systems Water Conservation Systems Domestic Waste and Vent Systems Automatic Sprinkler Systems

The benefits of MEP consulting are many, and extend beyond those who are directly involved in construction. Building occupants and the community in general benefit from improved safety, comfort, aesthetics, value, and reliability.





# CHOOSING A MEP ENGINEERING FIRM

The services of a MEP consulting firm have a long-term impact on a project. The planning and design decisions that take place during the early stage of a project can make the difference between success and failure. Like in any business partnership, choosing the right firm will improve the chance of success, and here are some elements to consider:

- Innovation and creativity level that the design firm brings to the project. Innovation and creativity can be left aside because of standard detailing and traditional design thinking. Also, some designs are rushed in order to start construction ASAP, or they are only viewed as a necessary step for project approval. As a client, make sure to select a firm that exceeds the minimum performance in building codes, while integrating creative alternatives. Learn about the quality of work provided, and ask about previous projects, and get opinions from previous clients.
- Communication skills that the company offers to the project. Written documentation and the ability to verbalize concepts are key for a successful project. The company reputation plays an important role, so make sure you ask for references. Project communication is an often overlooked aspect, but the Project Management Body of Knowledge dedicates a whole chapter to the topic.
- The ability to design within budget, while adding value to the project. From the client perspective, a successful project offers value that is greater than cost incurred. This may be the result of increased productivity, energy efficiency, higher employee morale, etc. Remember that design and construction are only a fraction of the project lifetime cost, but additional investments upfront can achieve much greater savings over time. As mentioned before, make sure to look at the firm's project portfolio, and ask about professional credentials such as LEED.
- Collaboration between the design team and the client's team. It is important to meet with the design team, to determine how they would work with you. Schedule all the necessary meetings to ensure that project requirements are clear and to address any concerns. Establish direct communication with senior engineers in the MEP firm to address any major concerns.
- Being capable of delivering quality within the project schedule. Regardless of the size of the firm, the designated team determines the project delivery on time and on budget. Evaluate the design management approach, collaboration approach, and the company's design leadership over time.

Projects with strong management and design leadership can usually manage costs and schedules better. Also, learn about the MEP firm's project record, so you can feel comfortable and trust them with your building design.



# THE ROLE OF MEP ENGINEERING IN THE NYC GREEN NEW DEAL



The NYC Green New Deal establishes the ambitious target of cutting building emissions by 40% by 2030. Such a goal will require major upgrades in existing buildings, and these will come at a high cost for owners. The NYC Urban Green Council estimates that the necessary investment during the next decade will be around \$20 billion.

The official name of the NYC Green New Deal is the Climate Mobilization Act. It includes Local Law 97, which mandates two emission cuts for buildings: 40% by 2030 and 80% by 2050.

- The resulting cost for building owners over the next 10 years will range from \$16.6 billion to \$24.3 billion, according to a study by the Urban Green Council.
- Considering the scale and amount of building upgrades required, LL97 could create around 141,000 jobs.

Energy consumption in buildings can be attributed mostly to mechanical, electrical and plumbing systems. These installations must be upgraded to reduce energy consumption and emissions, and only experienced MEP engineers can design the most effective solutions.

## WHAT IS THE SCALE OF THE CLIMATE MOBILIZATION ACT?

The emissions reduction target will affect around 50,000 buildings in NYC, and numerous retrofits can be expected each year. Consider that only \$235 million were spent on energy efficiency upgrades in 2018, while the projected investment to meet LL97 is around \$20 billion over 10 years.

There are numerous possibilities when upgrading a building, and the effectiveness of a specific measure varies in each case. The best starting point is an energy audit, since it provides a list of efficiency measures, with a technical and financial feasibility analysis. The following measures tend to achieve good results in many types of buildings:

ENERGY EFFICIENCY MEASURE	BENEFITS
New facades and windows	Buildings lose heat through their envelope during winter, and they gain heat during summer. This increases the workload on heating and air conditioning systems. Any measures that reduce heat gain and heat loss can improve energy efficiency.
Efficient air conditioning	Air conditioning is the largest load during summer. While it does not produce emissions at the point of use, the resulting emissions at power plants are significant. As of 2018, New York still gets around 70% of its electricity from fossil fuels. As a result, each kWh used has a high carbon footprint.
Efficient boilers and water heaters	Air conditioning is the largest electrical load, but heating represents the largest fraction of total energy consumption in NYC buildings. Many old buildings have oversized steam heating systems that are very inefficient.
LED lighting	<p>The dollar savings that can be achieved with LED lighting are much less than those possible with heating and cooling efficiency. However, LED lighting is an excellent investment in terms of cost and benefit, and a payback period of less than one year is possible in some buildings.</p> <p>LED lighting works best when upgrading fixtures with long operating schedules. Some examples are office lighting, outdoor lighting, and the common area lighting in multifamily buildings.</p>
Building management systems (BMS)	Upgrading to efficient building systems is a major step to save energy. However, MEP systems must also be configured efficiently. A BMS can control parameters such as lighting schedules and thermostat settings.

Since every building is unique, the effort required to cut emissions will be different in each property. Old and inefficient buildings require significant upgrades, especially those with oversized steam boilers. However, glass skyscrapers will also be subject to demanding requirements, since their heating and cooling costs are high.

Low income housing faces a unique challenge, since there are less funds available to reinvest in buildings. This can be addressed by applying less stringent requirements in the affordable housing sector, or by applying prescriptive and low-cost measures.

Carbon trading can help meet the requirements of the Climate Mobilization Act. Some buildings may have conditions that allow a drastic reduction of emissions with modest investment, while others may require significant investment just to reach the goal. With a carbon trading program, building owners can “purchase” part of their emissions reduction target from other properties.

Local Law 33 of 2018 will provide an additional incentive to upgrade buildings in NYC. It covers all buildings that are subject to energy benchmarking, requiring the disclosure of an energy grade from A to F, as well as the ENERGY STAR score. Tenants will know exactly how buildings are performing before renting, and efficient buildings will be in high demand.

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