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PLANNING GUIDE FOR NYC ENERGY STORAGE SYSTEMS (ESS): **PROJECT CONSIDERATIONS**

This document was developed with support from the NYC Interagency Solar & Storage Coordination Initiative.

The City of New York is committed to a renewable energy transition that includes a shift away from fossil fuel dependency; enhances grid reliability, modernization, and resilience; and is centered on equity. The expansion of energy storage deployments within the five boroughs is necessary for the City to meet these goals.

The NYC Interagency Solar & Storage Initiative, coordinated by Sustainable CUNY in partnership with the NYC Mayor's Office of Climate & Environmental Justice, convenes more than 30 New York City agencies on a bi-annual basis to align policy, permitting, and implementation efforts for solar and energy storage deployment.

This *Project Considerations Guide* provides an introductory level overview of key decision-making elements involved in ESS project planning, for stakeholders interested in exploring the potential for an ESS installation at a site/building/facility in NYC. It is intended to help users understand key factors involved in ESS project scoping and how these may impact project feasibility and influence project design.[1]

This document aims primarily to support more informed communications between end users and service providers. It is not a comprehensive design or compliance guide. Design and compliance for ESS installations is highly variable and subject to New York City's code requirements as well as site specific factors. Always consult a qualified professional when evaluating, scoping, designing, and permitting an ESS project.

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[1] An accompanying decision-support tool, the *Planning Guide for NYC Energy Storage Systems: Site Considerations*, addresses physical site elements pertaining to ESS project planning.

ESS and the Utility Grid

One key factor of planning an energy storage installation is its interaction with the utility grid, which is less of a factor in traditional renewable energy systems like solar PV. This arises from the unique capabilities of storage to provide bi-directional energy flow to and from the grid, and controllable dispatch, which solar and other renewables lack.

ESS & Utility Grid Interconnection: Meter Configuration

ESS connect to the power grid in one of two ways: "Behind the Meter" (BTM) or "Front of Meter" (FTM). This configuration is a fundamental element of project planning, as it sets the parameters for the system's function(s) and financial/monetization profile.

Front of the Meter (FTM):

- Installed on the grid-facing side of a site's utility connection and are not tied to a specific building.
- Charges from the grid (can also charge from on-site generation e.g. solar but not generally practical in NYC).
- Can discharge only to the grid – **not directly to a building** – so cannot support building-level energy management or resilience.
- Maximum size capacity for FTM ESS is 5 MW per site; there is no technical minimum kW/kWh limit for FTM ESS, but in practice these are typically large multi-MW systems.

Behind the Meter (BTM):

- Located on the customer side of a site's utility meter and are designed to serve specific buildings or sites, focusing on energy management and/or backup power and resilience.
- Usually charge from the grid; charging from on-site generation is allowable though not generally practical in NYC.
- Can provide power to the building and export power to the grid; but in practice BTM ESS typically serves on-site loads rather than export.
- Sizing of BTM ESS is largely driven by the building's energy usage profile, energy management goals, and the system's intended use.
- Can provide backup/emergency power if electrical system integration is configured to do so.

ESS & Utility Interconnection Upgrades

An interconnection upgrade will be required for both FTM and BTM ESS if the existing utility infrastructure cannot support the planned ESS charging and discharging loads. Key planning considerations include:

- Costs, complexity, and timelines for interconnection upgrades vary significantly. Larger ESS requires more extensive work. In some cases, interconnection upgrades can be cost-prohibitive.
- Systems up to 50 kW qualify for the simplified interconnection process as outlined in the *NYS Standardized Interconnection Requirements (SIR)*. For smaller projects, no interconnection upgrades may be needed.

- Systems over 50 kW usually require a full interconnection review which includes the *Coordinated Electrical Service Interconnection Review* (CESIR). This is a detailed engineering analysis that determines the scope, extent, and design of the utility interconnection work.
- There is no fixed ESS size that automatically triggers the need for utility upgrades; rather this depends on site-specific factors as well as the existing utility infrastructure.
  - "Network" areas (underground utility infrastructure) typically involve more complex and costly interconnections.
  - "Non-network" areas (overhead infrastructure) are generally simpler and less expensive to interconnect.

ESS Financial Dynamics

ESS can serve multiple uses/functions including grid support, renewable/cleantech augmentation, building-level load management, and backup power/resilience. However, these uses can be mutually exclusive, may not be feasible for a given site, and have differing financial implications. The intended use of the ESS is another fundamental decision-making point of planning an ESS project and can influence other subsequent project decisions. Planning an ESS project requires an evaluation of desired use priorities and associated trade-offs including financial and siting feasibility.

Financial dynamics – FTM & BTM side-by-side comparison

FTM ESS	BTM ESS
• FTM ESS are typically large multi-MW systems designed to maximize revenue generation through participation in grid-supporting utility and/or wholesale ("NYISO") market programs (e.g. arbitrage, Demand Response, ancillary services, capacity markets). • Cannot provide building-level demand reduction (e.g. peak shaving, load shifting) or backup power, as they are not connected to a specific building or load. • For a site or building owner, financial arrangements with a third-party ESS owner/operator will vary and may include revenue sharing, lease payments, or other options. • While smaller systems can be installed FTM, some market programs require a minimum capacity threshold to participate. Smaller projects may qualify to participate via a third-party aggregator.	• BTM ESS can generate savings primarily through demand charge reductions via peak shaving, for sites that have significant demand charges. • Other utility rate options may also provide additional savings such as time-of-use (TOU) rates. • Backup/emergency power does not provide direct revenue or bill savings but may offer critical non-monetary benefits. • May be able to participate in some utility and wholesale market programs, although access and feasibility is typically more limited compared to larger FTM systems. • Participation in Demand Response programs may not always be feasible in conjunction with daily peak shaving for demand charge reduction.

Financial dynamics – incentives & LL97 compliance

ESS projects in NYC can qualify for a range of incentives which may vary depending on the type of project, but most are able to obtain:

- Federal tax credit
- State (NYSERDA) incentive
- NYC Property Tax Abatement (PTA)

Additionally, a recent and significant development in the NYC ESS market is the use of ESS to support LL97 compliance. A building that is subject to LL97 compliance can use an ESS to reduce its annual emissions, earning both “host” as well as “offtaker” deductions that reduce or eliminate LL97 penalties. This is applicable to both FTM and BTM ESS.

Ownership & operational structures

ESS technology is more complex to use, operate, and maintain as compared to other types of clean energy installations due to several key factors:

1- NYC codes require ESS to have a designated “Certificate of Fitness” (COF) holder as well as 24/7 remote monitoring, in addition to standard routine maintenance and inspections;
2- ESS – especially larger installations – typically rely on ongoing remote operational control in order to be operated effectively, maintain battery conditions, respond to market signals, etc.

Therefore, there is not a universal ownership and operational structure that will work for every ESS installation. ESS can be under full ownership and operations by the building/site owner, some sites may host a fully third-party owned and operated system (more typical of FTM systems), and some may be under a hybrid revenue-sharing structure.

ESS Equipment Considerations

Choosing the right energy storage equipment for an installation in NYC depends on several key parameters described below.

FDNY Certificate of Approval (COA) for ESS products

No battery ESS can be installed in NYC unless it has obtained a Certificate of Approval (COA) from FDNY – this is the first consideration for equipment selection for an ESS project in NYC. The COA, typically obtained by the product manufacturer, determines certain installation criteria specific to the product, such as spacing/separation distances and fire protection measures.

FDNY's published list of approved ESS equipment provides the inventory of available product options and is updated 1-2 times per year. A product that has not obtained a COA can be used in an ESS project, but this would necessitate additional equipment approval, adding considerable time and complexity to a project.

Energy Storage Technology Types

Below are general details on energy storage types that are currently available on the market:

- **Lithium-Ion:** are dominant in the market due to their high energy density and long cycle life that allows for frequent cycling over many (10+) years. Current options for indoor installation are limited by both COA availability of indoor-approved products as well as stringent code requirements for indoor spaces housing li-ion ESS.
- **Lead-Acid (LA) and Nickel-based (NiMH, Ni-Cad):** are widely used in Uninterruptible Power Supplies (UPS) for backup applications. These batteries have shorter cycle lives and are designed for infrequent use (e.g. a few times per year). Historically the lowest-cost option, though li-ion has narrowed the gap. Lower flammability risk allows for indoor installation.
- **Flow batteries:** can provide significantly longer duration, but with less energy density than Li-ion, thus requiring more space per kWh. Flow batteries also generally have low flammability risk which may allow for indoor installation.
- **Thermal batteries:** are a distinct category of batteries that provide heat or cooling, not electricity. These are primarily for HVAC-associated applications and may be well suited where cooling loads are significant, and possibly where waste heat is significant or process heat needs are high.

Regulatory & Compliance Dynamics Based on ESS Technologies

Fire, safety, and other compliance requirements differ by battery chemistry, which can also impact project planning decisions. Some examples are noted below, but a full understanding of compliance requirements as established by NYC regulations would be needed if an ESS project planner was looking to evaluate between technology types:

- Lead acid systems require ventilation for normal operations, and flow batteries require spill containment, neither of which apply to li-ion ESS.

- For indoor installations, lead acid ESS have greater location flexibility for siting – e.g. they are permitted in a broader range of building types and locations, including non-sprinklered buildings and below-grade spaces, where li-ion ESS are generally restricted from.
- Additionally, smaller indoor lead-acid installations are subject to less extensive construction compliance requirements as compared to indoor li-ion systems.

Regulatory & Compliance Dynamics Based on ESS Size

ESS "size" typically refers to the power (kW) and energy capacity (kWh). Most regulatory and compliance requirements scale up with size, which can make this a key factor in project planning. Some of these factors include:

- **FDNY Rule 608-01:** categorizes outdoor ESS as Small, Medium, and Large based on kWh and battery chemistry. Small differences in ESS size can therefore trigger a more complex approval tier (e.g. a 250 kWh li-ion ESS is "Medium" while 300 kWh is "Large").
- **Utility Interconnection:** ESS under 50 kW qualify for a simplified interconnection review process, while systems over 50 kW face more extensive utility review and typically more costly interconnection.
- **Zoning Requirements:** Most ESS must comply with basic zoning provisions such as screening, but provisions are minimal for small systems (units <18” depth from a wall) while large ESS with a physical footprint over 10,000 ft^2 sited in Residential districts trigger a discretionary public review and approval by the NYC Board of Standards & Appeals.
- **Other:** In addition to electrical capacity size, physical parameters such as system footprint and weight may also be important factors in project scoping.

ESS Projects - Sizing and Equipment Types General Notes

- **FTM ESS for Utility Market Participation:** Projects aiming to participate in utility or wholesale markets typically seek to maximize capacity on a site, with typical size between 3 to 5 MW. However, this is driven largely by economics and is not a technical or regulatory requirement.
- **BTM ESS:** System sizing and technology choice for BTM applications will be influenced by a wider range of variables. Often BTM ESS will be sized to the building's load profile and energy management needs, but monetization goals, space availability, interconnection parameters, etc. may also influence decision-making. These installations are usually smaller than FTM systems and can range from a few kW up to a MW or more.
- **Backup/Resilience Applications:** For infrequent backup use, lead-acid battery equipment may be more cost effective – both in equipment and compliance requirements – than li-ion, though costs of li-ion have come down in recent years. A battery for purely backup use will have limited applicability and financial feasibility in NYC, as leveraging more of the uses/capabilities of a battery will typically make a project more cost effective. However, for some niche sites purely backup use may be the preferred option.[2]

Other Design & Planning Considerations

Several additional factors as detailed below may also significantly influence ESS planning and feasibility.

Siting/Location

ESS planning will need to consider the differing physical characteristics of a site or building to determine best available space, and a building or site's ability to accommodate compliance requirements will impact a project's feasibility. Regulatory requirements differ in some significant ways for outdoor vs. indoor installations and also by different ESS chemistry types.

- **Indoor siting:** entails significant fire safety compliance requirements, which are stricter for li-ion ESS as compared to lead-acid and nickel-based UPS products.
- **Rooftop installations:** must account for certain roof-specific factors including weight loading, electrical access, fire department access, and water supply.
- **Chemistry-dependent siting flexibility:** lead-acid UPS equipment can be installed in more varied locations than li-ion ESS, including below grade and non-sprinklered buildings.

Standalone vs. Paired

ESS can be installed alone or in conjunction with other types of clean energy technology such as solar PV or EV chargers. An ESS that is co-located with solar PV or EV chargers may also impact decision-making, regarding aspects such as tie-ins between the equipment, battery sizing, etc.

- **ESS+PV:** An ESS that is co-located with solar can support a wider set of functions than a standalone ESS, such as a microgrid or extended back-up/resilience, although feasibility of this will typically be limited to certain sites or applications, such as emergency shelters.[2] In NYC, it will not typically be cost-effective for the ESS to charge solely from on-site PV.
- **ESS+EV Chargers:** An ESS co-located with EV chargers (or PV+EV chargers) can help manage increased loads from EV chargers, especially during peak periods to prevent demand spikes.

Space needs

Some general considerations for space needs for ESS projects include:

- All space planning must consider compliance regulations for setbacks, unit spacing, separation distances, and room volume (for indoor installations) – especially the 10' minimum clearance between the ESS and surrounding exposures that is required for most projects, including smaller ESS unless exceptions are otherwise granted.
- Larger ESS projects generally need a footprint area of approximately 2,500-3,000 ft^2 per MW, but utility interconnection equipment must also be accommodated. Utility equipment needs can be significant especially for larger projects; for every approximately 2 MW ESS, additional feeder, transformer, and/or other utility interconnection equipment may be needed.
- Commercial FTM ESS project developers generally look for sites that have a minimum of 10,000 ft^2 area.
- Smaller projects will need less space, with rooftops and garages being potential locations for siting aside from ground level yards and other open spaces.

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[2] See the CUNY Smart DG Hub's Resilient Solar Project *"Solar for Sandy"* Case Study

Zoning Considerations

Zoning changes in NYC adopted via the *2023 City of Yes for Carbon Neutrality* amendment has expanded siting options for ESS. However, several zoning factors can still impact project design, as well as project permitting.

Zoning Factors & Impacts on Project Permitting

While zoning considerations are not likely to have a significant impact on project feasibility, some key zoning-based factors may influence project decision-making:

- **Zoning District Type:** Zoning requirements such as screening, height limits, and setbacks vary based on whether the site is in a Residential (R), Commercial (C), or Manufacturing (M) district. R-districts are the most restrictive.
- **Accessory vs. Non-Accessory Classification:** denotes whether an ESS is considered to be the primary use on a site or not. It is based on a formula that compares the kWh of the ESS to the total electrical consumption of the lot. It is *not* dependent on a BTM vs. FTM metering configuration.
    - Accessory use denotes ESS that are not the principal use on a site. To be considered accessory, the aggregate kWh of installed ESS must be less than 24x the building's maximum electrical consumption. Accessory classification can be applicable even to Large (250+ kWh) FTM ESS since it is determined relative to the building's electrical consumption.
    - Non-Accessory use denotes ESS that are the principal use on a site (e.g. on a vacant lot or when aggregate capacity exceeds the 24x threshold). These projects typically require filing a new or amended Certificate of Occupancy (CO), triggering a more complex and time-consuming permitting process including potential street and sidewalk improvements.

Generally**,** zoning-based design requirements are similar for both accessory and non-accessory ESS including screening, setbacks, height limits, etc.[3]

Special BSA approval in R-districts

M-districts or C-districts primarily allow any ESS type as-of-right, with no additional approvals needed. R-districts also allow ESS as-of-right up to a physical footprint size of 10,000 ft^2. Above this size, ESS projects will require special approval from the Board of Standards and Appeals (BSA) which can add significant time and cost to a project.

[3] For additional reference see the CUNY Smart DG Hub's *NYC ESS Zoning Guide*.

City Environmental Quality Review (CEQR)

CEQR will be applicable to any ESS project that is publicly supported via any of the following:

1). Directly managed by a city agency
2). Funded by a city agency
3). Requires discretionary approval from a city agency (e.g. BSA)

CEQR is a disclosure process by which NYC agencies determine what potential environmental effects could stem from a discretionary action they approve. Completion of the CEQR is not by itself an approval step; rather it is intended to support other decisions made by agencies such as approvals of rezoning or variance applications, funding, or issuance of discretionary permits.