





Assessing the impact of neighborhood batteries

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Smart cities are transforming urban landscapes with technology and sustainable practices, fostering economic growth and social inclusivity. As urban areas become more complex, technology plays a crucial role in optimizing these operations. The integration of battery storage technologies into urban energy systems has the potential to revolutionize the way cities manage and utilize electricity. This article explores the opportunities and benefits of neighborhood batteries and how they compare to home storage solutions.

Smart cities are urban areas that focus on long-lasting economic, social, and environmental well-being, providing answers to the demands of all stakeholders. The World Smart Sustainable Cities Organisation (WeGO) helps cities become smart and sustainable by using digital technology, working with city leaders and communities, and bringing together different sectors. Founded in 2010 by 50 cities worldwide, WeGO aims to improve residents' quality of life, enhance public services, and boost regional competitiveness.

As urban areas become more complex, technology plays a crucial role in optimising

these operations. The integration of battery storage technologies into urban energy systems, for example, has the potential to revolutionise the way cities manage and utilise electricity, covering important aspects, such as:

- Energy management
- Grid stability and resilience
- Peak load shaving
- Integration of renewable energy
- Transport electrification

In this article, we compare the impact of 2 different battery storage models, i.e. neighborhood and home storage batteries, on urban energy systems, considering factors such as cost effectiveness, scalability, grid integration, and overall system efficiency. We analyse the potential benefits and challenges associated with each approach, considering the varying needs and preferences of residents, utilities and policymakers.

By examining the implications of these two structures, we will provide insights into how cities can use different storage strategies to optimise energy management, enhance grid reliability, and accelerate the transition to a sustainable energy future, to become smart.

Neighborhood batteries in comparison with home storage batteries

Two emerging trends in battery storage deployment are neighborhood batteries, which serve multiple households or buildings, and home storage batteries, installed in individual homes. Understanding the impact of these two approaches is crucial for optimising energy systems, enhancing grid resilience, and promoting sustainable urban development.

Neighborhood batteries: offering centralised storage capacity for multiple users

Neighborhood batteries have a centralised storage capacity that can be shared among multiple users. This means a delicate balance of supply and demand within a local area. By aggregating storage within the neighborhood, these batteries can help reduce peak demand, increase grid stability, and facilitate the integration of renewable energy sources.

In contrast, home storage batteries provide consumers with greater control over their energy usage, allowing them to store excess energy generated from rooftop solar panels or charge during off-peak hours to reduce electricity costs.

Home storage batteries, in particular, have grown in popularity. They play a crucial role in achieving energy resilience and reducing reliance on the grid. When the grid experiences an outage, many of the hybrid converters can seamlessly switch from grid power to battery backup without interruption.

These systems can be charged either by electricity from the grid or by solar power. When coupled with solar panels, the battery can support power usage until the grid is restored. Events, like public safety shutoffs, have increased demand for home batteries. Consumers are recognising the need for reliable backup power during outages.

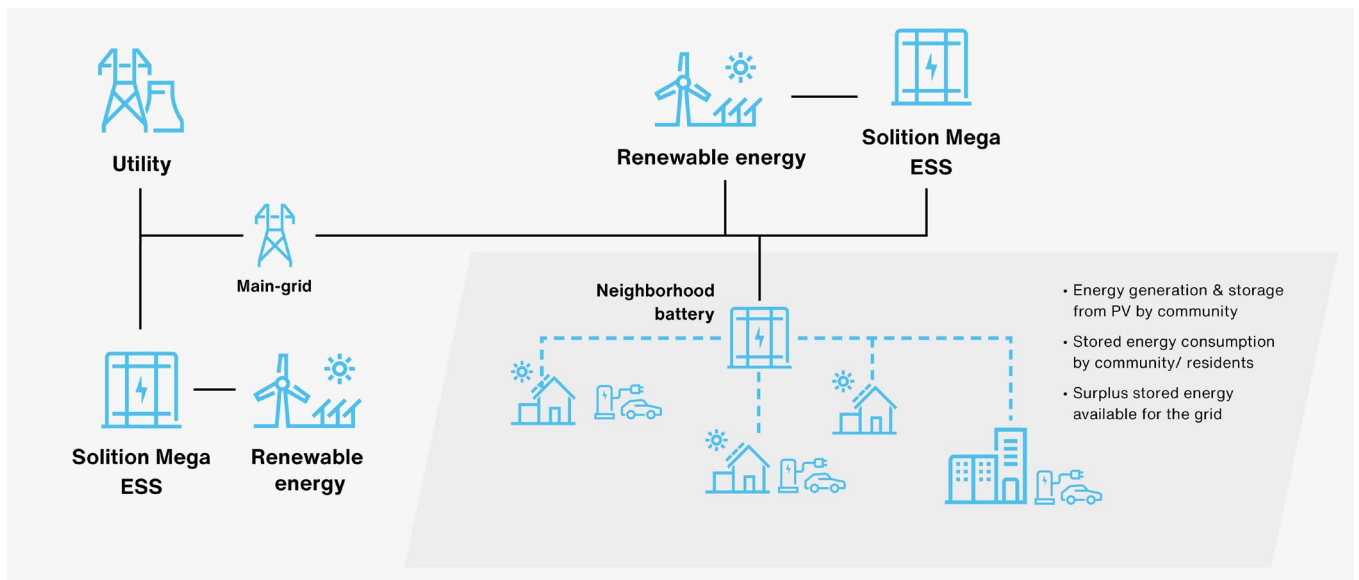
Location of the batteries

Appropriate placement ensures efficient operation. For home storage batteries, the ideal location plays a crucial role in their effectiveness and safety. The best place for a home storage battery is inside the house, close to the consumer unit, where the electrical circuits originate.

As batteries work best at temperatures similar to those preferred by us, indoor placement ensures optimal conditions; however, if an indoor installation is not possible, a home storage battery could also be placed in the garage, in a utility closet, or on an exterior wall, ensuring it is at least 3ft away from doors or windows. Before installing a home storage battery, it is essential to consult local regulations and safety guidelines.

Battery energy storage opportunities for urban areas

- Energy management: battery storage captures and stores surplus renewable energy produced during peak times, like sunny days or windy periods. Stored energy can then be used during high-demand periods or when renewable energy generation is low. This reduces the need for fossil fuels and balances supply and demand.
- Grid stability and resilience: battery storage systems enhance grid resilience by providing backup power during outages and stabilizing the grid by responding to demand or supply fluctuations. This improves reliability.
- Peak load shaving: by storing excess energy during off-peak hours and releasing it during high-demand periods, battery storage systems reduce peak electricity loads. This cuts costs for consumers and relieves strain on the grid.
- Integration of renewable energy: battery storage supports the integration of intermittent renewable energy sources into the grid by storing excess energy and releasing it when needed.
- Transport electrification: battery storage can facilitate the electrification of transportation by providing charging infrastructure for electric vehicles (EVs). This promotes clean transportation and reduces air pollution and greenhouse gas emissions.



Neighborhood batteries, meanwhile, will be installed in the public domain, directly connected to a transformer that powers the area. They are usually in the form of a small container. In neighborhoods where individual houses have a single-phase connection, these batteries can help maintain the correct voltage window, so that PV converters will not trip due to excessive voltage.

Technical constraints

Many neighborhoods built before 1990 use a single-phase 16A or 25A connection; adjacent houses are connected interchangeably to the three-phase grid cable. Many of these neighborhoods have been built and in recent years have been sold by project developers, the municipality, or governments to their tenants.

In many instances, this prompts homeowners to expand their living areas, upgrade their kitchens, and invest in PV systems to cut energy expenses. Nevertheless, being linked to a single phase comes with the drawback of grid voltage being a critical factor.

As more homeowners feed energy back into the grid on a single phase, the voltage rises, causing the PV converter to shut down. One remedy involves integrating a battery system that charges during the morning to offset the energy consumed during the evening and night, thereby maintaining grid connection stability without voltage spikes.

However, this setup might not align with the needs of industries starting their

operations in the morning, which could efficiently utilise the surplus PV energy. Hence, while beneficial for homeowners, it may pose challenges for industries and the broader community.

Adding to the challenge, once the battery reaches full capacity, the problem persists: the excess energy cannot be fed back into the grid due to high voltage, exacerbating the situation. For typical family homes without EVs, a battery capacity ranging from 5 to 10 kWh proves ample to sustain energy needs through the night.

Economic consequences

Initially, most grid operators allowed the exchange of electricity so that any kWh fed back into the grid could be withdrawn again at no cost. Now, increasingly, operators either charge for feeding-in or, worse, no longer allow it.

Previously, PV converters lacked the capability to integrate with batteries, necessitating homeowners to invest in both a new, upgraded hybrid converter and batteries, which represents a significant financial commitment.

In addition to the economic considerations, installing a battery presents logistical challenges. Ideally, it should be situated near the PV converter, often located in the attic; however, this poses several issues: space constraints, limited visibility for system monitoring, potential temperature regulation challenges, and, critically, safety concerns associated with battery installation.

Safety aspects

Safety is a high priority for manufacturers of home storage batteries. But it does not stop there. Proper storage and operation techniques not only ensure safety but also help maintain battery performance over time. Choosing the right storage container, avoiding extreme temperatures, installing the battery in a cool, dry environment, and avoiding direct sunlight is paramount.

It is important to have home energy storage systems installed and connected by a qualified electrician, to check regularly for damages, and to closely follow the manufacturer's guidelines for installation and use.

In comparison, neighborhood batteries are, in most cases, installed within a cube of 3x3m that can provide services in the area. By charging through all three phases, the local grid voltage can be maintained within its operational window, so the single-phase PV converters remain functional. Energy can be distributed to the wider grid when needed in adjacent or remote locations. Once the morning energy usage peak is over, the neighborhood battery can be charged with power that suits the situation.

The grid operator maintains complete control over the system through a communication channel, which is a safer approach compared to managing numerous PV converters at individual homes. The control of many home storage batteries also presents challenges for those responsible for ensuring the safety of Information and



Energy can be distributed to the wider grid when needed in adjacent or remote locations. Once the morning energy usage peak is over, the neighborhood battery can be charged with power that suits the situation.

Communication Technologies within the public grid. Each connection represents a potential security breach, posing a significant concern for those overseeing grid safety.

The introduction of a neighborhood battery simplifies the provision of power to local EV charging stations dispersed throughout the neighborhood grid. This setup enables peak shaving, addressing issues like voltage and frequency stabilisation, which are crucial for grid operators.

From a capital expenditure perspective, the costs associated with multiple hybrid PV converters, diverse communication interfaces, and individual agreements with homeowners are significantly higher compared to a centralised solution. The price per kWh for home storage is up to three times higher than that of a neighborhood battery whereby a single converter and communication interface in combination with a large battery offer much better economics.

Moreover, on the operational expenditure side, neighborhood batteries are more advantageous. Gaining controlled access to private PV converters entails monetary compensation for the PV owner.

Furthermore, in case of errors or premature wear and tear leading to the replacement of the battery or PV converter of the home storage system, resolving such issues become tricky and may result in prolonged discussions between the grid company and asset owners. This would complicate matters further. Identifying the root cause of these issues adds another layer of complexity, potentially leading to protracted deliberations.

Why is Europe not yet equipped with more neighborhood batteries?

Legislation in many countries restricts grid operators from storing energy in batteries, confining their role to transporting electric energy from generation points to users. Conversely, this limitation inhibits opportunities for energy storage, trading, and other forms of energy flow manipulation. Implementing in-front-of-the-meter applications, like neighborhood batteries, holds the potential to significantly reduce investments in additional cabling, strengthen the grid, and hasten the energy transition. While new laws are under discussion in various countries, their implementation often takes considerable time.

The technology for such advancements is there! Costs are decreasing, and progress can be accelerated by consulting industry specialists. This can effectively curb CO₂ emissions and enhance living conditions for residents.

Exide Technologies' Customized Energy Systems BV has successfully implemented several neighborhood battery projects, beginning as early as 2016 in Leimuiden, near Amsterdam. These have addressed issues arising from the growing number of PV installations, providing relief to homeowners experiencing local congestion and diminished PV functionality.

About the company

Exide Technologies is a leading provider of innovative and sustainable battery storage solutions for automotive and industrial applications.

With 135 years of experience, it has developed and globally marketed innovative batteries and systems, contributing to the energy transition, and driving a cleaner future.

Exide's comprehensive range of lead-acid and lithium-ion solutions serves various applications, including 12V batteries for combustion and electric vehicles, traction batteries for material handling and robotics, stationary batteries for uninterruptible power supply, telecommunication, utility in-front-of and behind-the-meter energy storage and propulsion batteries for submarines and more.

The company's culture and strategy are centered around recycling, sustainability, and environmental responsibility, reflecting the commitment to being a responsible corporate citizen.

The company has 10 manufacturing and three recycling facilities across Europe, ensuring resilience and a low CO₂ footprint with a local supply chain.

Exide Technologies is committed to superior engineering and manufacturing.

With a team of 5,000 employees, the company provides €1.6bn of energy storage solutions and services to customers worldwide, every year.

www.exidegroup.com

Another notable example is the installation of a system at the former industrial site 'Strijp-S' in Eindhoven, serving as a valuable case study in a pan-European comparison conducted by the main contractor and grid operator Enexis. This initiative yielded invaluable insights into the various operating modes of neighborhood batteries across different European cities.



About the author

Jos Theuns, Senior Director Innovations and Partnerships at Exide Technologies, is a highly accomplished electrical engineer with a wealth of experience in the IT and battery industries.

He started his career in the technical computer business before transitioning to the battery industry in 1993.

Having previously held management positions at renowned companies such as Rockwell Automation and General Electric, Jos is a true expert in his field.

In 2014, he founded his own company, which is now part of Exide Technologies, operating under Customized Energy Systems.

In recent years, Jos has spearheaded the design and engineering of cutting-edge lithium-ion based energy storage solutions (ESS) that are revolutionising a wide range of applications.

Jos lives in Helmond, the Netherlands.

In his spare time he is involved in the cultural heritage of historic vehicles.