Beyond battery grid parity:

How replacing diesel generators with batteries has reduced energy costs by 30% for one of London's residential tower construction sites (… and also reduce carbon emissions)

Lessons learned from a 6+ months deployment of an innovative energy storage system at in London.

The challenge

The demands of construction, with heavy machinery and tools requiring substantial energy, often surpass the capacity of the local grid. This is especially true in dense urban environments, such as the center of London. The grid is almost always the cheapest and most sustainable source of power, however, obtaining a grid upgrade can be both costly and time-consuming, disrupting project timelines and budgets.

As a result of this, builders often need to rely on diesel generators to meet their power needs during the construction phase. Although energy costs represent a small fraction of the overall construction budget, the use of diesel generators creates additional challenges for the construction project management team: risks of exceeding budgets as fuel costs are variable, not meeting stringent fine particle emissions in urban environments as well as meeting CO2 emission regulation.

Batteries to the rescue

Lithium-ion batteries have come a long way since the early days when Tesla launched its Tesla Roadster in 2008. Electric vehicles which are powered by batteries are growing at a staggering pace as new registration increased by 55% in 2022 relative to 2021 according to the IEA[1].

The applications of batteries now extend beyond the automotive segment and have reached mission critical applications such as underground mining vehicles. It is thus clear that batteries can enable decarbonization for additional segments.

The innovative approach

In tackling such challenges, not all construction companies are at common stages, some companies are ahead of the curve and adopt the technology ahead of the market. A London based construction company has been at the forefront of such deployments, and this can be demonstrated by the innovative work done with Northvolt at one of their sites in London.

[1] https://www.iea.org/reports/global-ev-outlook-2023/trends-in-batteries

The situation at site before the start of the project

- A Grid connection was available; however it was not sufficient to power the key power consumers: the welfare (office space, canteens etc.) and 2 tower cranes (cranes 1 and 2).
- The site was powered- using 3 generators:
    - Generators 1 and 2: Each operating a tower crane during the full work day: 8 to 10 hours 5 to 6 days a week
    - Generator 3: running 24/7 for powering the welfare and auxiliary systems.

Figure 1: Construction site powered by diesel generators (left); construction site powered by a Voltpack Mobile (right)

The Voltpack Mobile System:

- The Voltpack Mobile System (VMS) is a mobile and scalable energy storage system designed to provide clean, reliable energy storage to locations that don't get enough power from the grid.
- The VMS consists of:
    - Hub: which houses the power conversion system rated at 225 kVA and the intelligence of the system, this is the equivalent to the generator of an internal combustion engine;
    - Pack: which houses 281 kWh of installed battery capacity, this is the equivalent of the fuel tank of an internal combustion engine. Multiple Packs can be connected to the same Hub to provide a larger energy buffer.

The situation at site with a VMS:

- One Hub and one Pack were deployed. The Hub is connected from one side to the existing 100A grid connection and to the other side to the welfare and the two cranes.
- During the working hours:
    - The power demand from the welfare, and the two cranes exceeded the available grid connection.
    - This was when the battery was deployed to inject power on top of the grid connection limit to provide enough power to run the site.

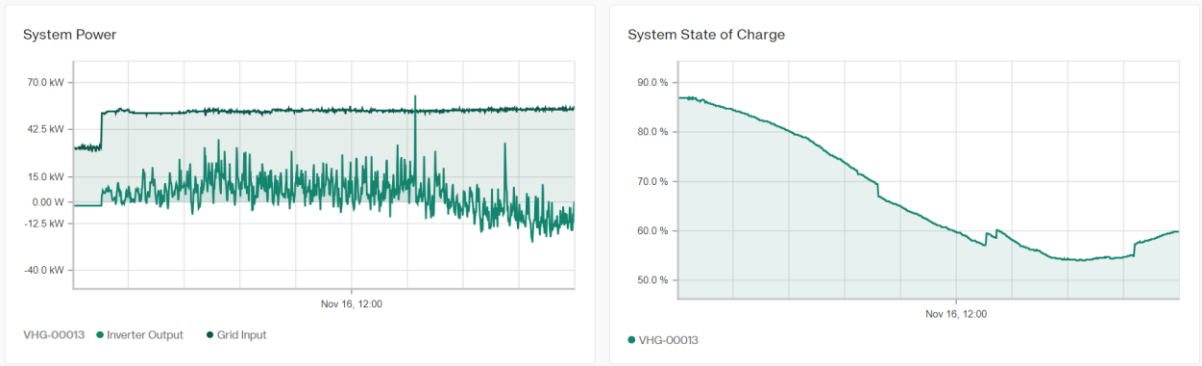


Figure 2: When the grid power limit is reached (grid input), the power conversion system (inverter output) injects power to complement the grid power thus discharging the battery.

During the day, the Hub limited the quantity power to the setpoint required and all the additional energy was provided by the Hub power conversion system therefore discharging the battery.

- After the construction site stopped for the day:
    - The power demand dropped and only the auxiliary systems were operating on site.
    - The battery was then allowed to recharge while remaining within the grid limit to be full and ready for the next day.

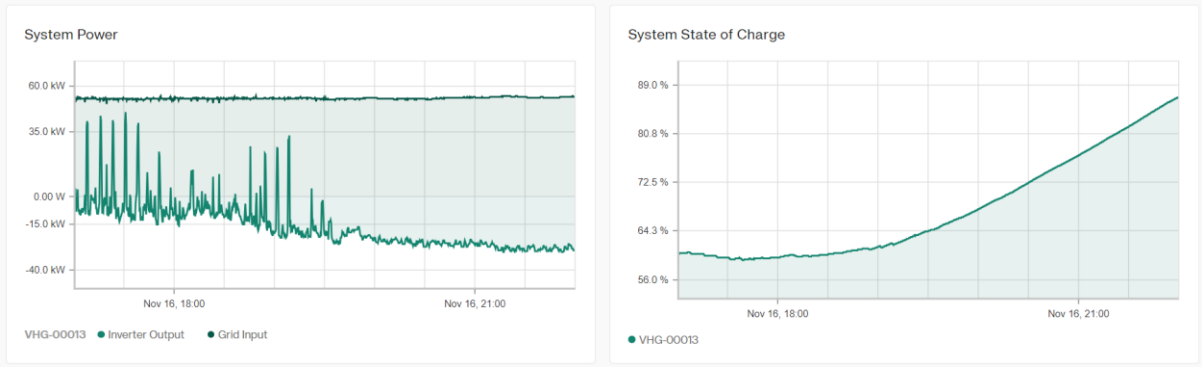


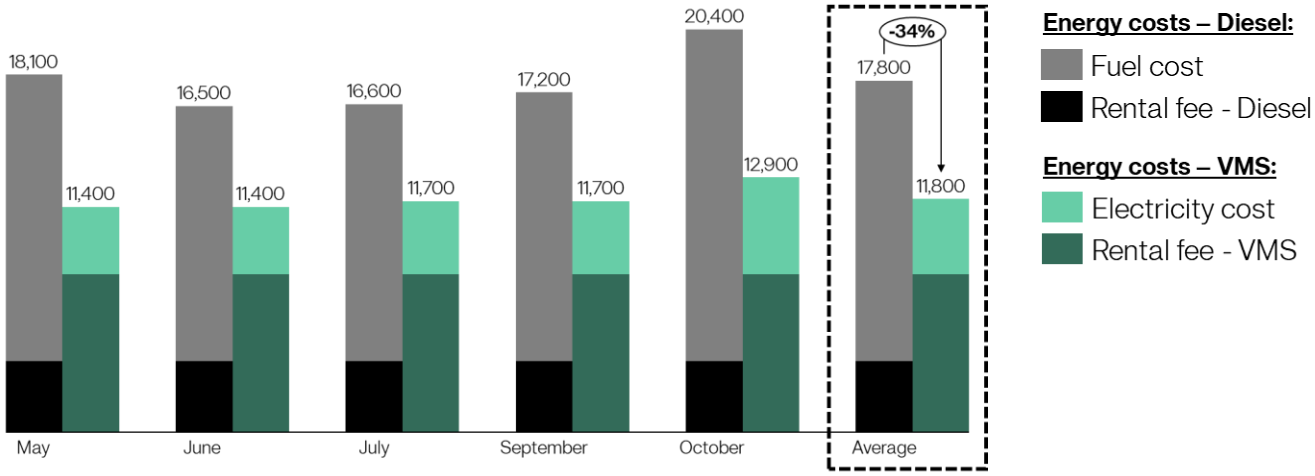
Figure 3: When the site power demand falls, the power conversion system (inverter output) makes use of grid power(grid input) to recharge the battery.

Main findings:

The 6+ months trial resulted in some remarkable findings, some of which are shared below:

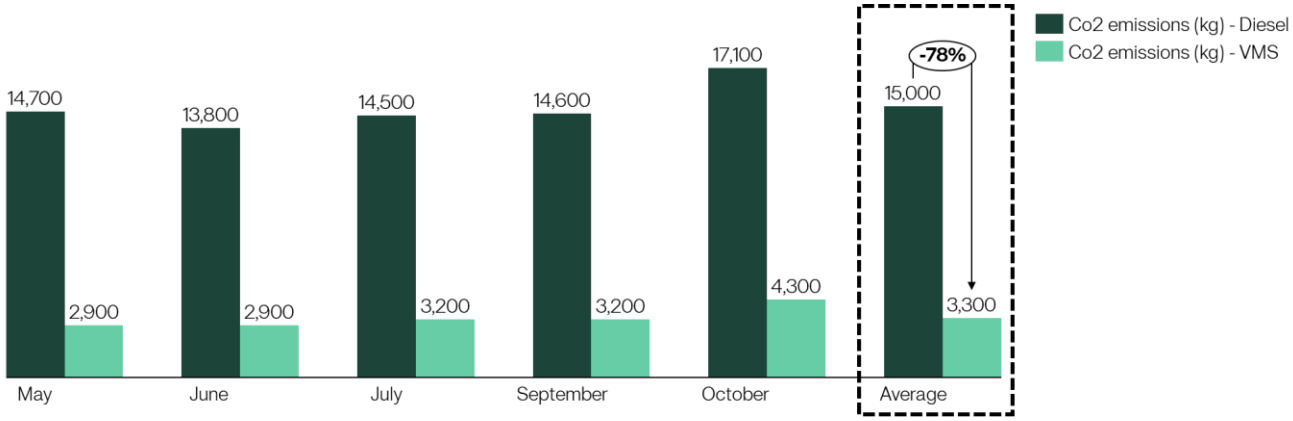
Energy costs:

- Deploying a VMS saved the construction site an average of 34% of their energy spending over the deployment period. That represents savings of more than 20 kGBP per year for every diesel generator replaced.
- The more energy was consumed at site, the higher the savings with Voltpack Mobile. This can be explained by the increased utilisation rate of the Voltpack mobile for the same fixed cost.
- The combined energy costs with Voltpack Mobile were less prone to fluctuations as the variable portion: electricity costs, represent a smaller fraction of the total running costs when compared to diesel (30% with the Voltpack vs. 50% with the diesels).



CO2 savings:

- Deploying a Voltpack Mobile enabled the construction site to reduce its carbon emissions by almost 80% over the period of the deployment. That represents more than 45 tons of avoided C02 emissions per year for every diesel generator replaced.
- Further savings could be achieved by selecting an electricity supplier which provides electricity from renewable sources only.



Field deployment:

- The technology was easy to deploy and did not face resistance on site from the operators.
- Good remote support is important for construction teams locally.

Occupational safety and health:

- Switching to the Voltpack Mobile resulted in a quieter work environment as reported by the workers at site, which was an additional side benefit especially when offices in the welfare were located next to a generator.
- Not having diesel fumes at site was also noticed by the construction workers.

Closing remarks and looking ahead:

- Early adopters:
    - The trial has resulted in important learnings for the construction company on how to operate mobile energy storage on their sites.
    - Such learnings will be used in future projects to incorporate batteries into the planning stage thus giving Northvolt's customers a cost advantage and a better chance of meeting emissions standards and upcoming regulations.

- Technology development:
    - The journey of lithium-ion batteries has just started, and the technology is in constant development, and achieving year on year improvements in levelized costs of operation.
    - An asset that can cost effectively replace diesel generators will make it easier for all stakeholders in the construction segment to comply with ever stricter restrictions on the emission of fine particles, CO2 reduction targets and noise pollution control.