GridBeyond®

Leading the charge Future proofing your fleet

Part of the Expert Explains series

In collaboration with

CONNECTED ENERGY Advanced Energy Storage Solutions

Lancaster University

About the Expert Behind this Edition of Experts Explain

Michael Phelan, Co-Founder and Chief Executive.

Michael has over 22 years management experience in sales, marketing and product development in electronic and software companies targeting the energy sector.

Prior to joining GridBeyond, Michael held positions at Philips, Microsol, PCAS and Duolog in automation and electronics. He was responsible for developing European, Asian and American markets and OEMs such as Invensys, Mitsubishi, Toshiba, and Alstom. In addition, he has facilitated several successful exits. Michael is a graduate of University College Dublin where he obtained an MBA in Business Administration, Management and Operations.

GridBeyond®

About GridBeyond

GridBeyond is a global leader in intelligent energy technology for industrial, commercial, institutional and utility partners. Energy users are provided the ability to manage and control demand response participation, energy performance, markets and costs via the multi-award-winning AI Point platform. GridBeyond's award winning technology can be found on the sites of some of the world's most well-recognised businesses.

The Point platform has enhanced their revenue earning potential with access to the fastest acting grid balancing programs, whilst stacking additional opportunities such as price peak avoidance, on-site efficiencies, energy trading and asset optimisation.

Transform energy into opportunity.

Transport is currently the largest emitting sector of the UK economy, responsible for 27% of total UK greenhouse gas emissions; within this, cars are responsible for 55% of transport emissions.

Falling costs, widening availability, and support from policy-makers, have spurred a recent rise in sales of electric vehicles (EVs). But as EVs become more common, electricity demand will inevitably rise. This will create new opportunities for commercial EV fleets. Ultimately, it could help turn what is currently a cost centre – refuelling – into a potential revenue stream through optimisation of electricity use.

In this paper, we examine the landscape for EV fleets and the opportunities for businesses to not only secure additional revenues but to further boost their green credentials by helping the grid to increase levels of renewables generation in the energy mix.

Greening up transport

Road transport contributes to air pollution in urban centres, adding a local health element to the national and international challenge of climate change. The adoption of EVs offers a sustainable way forward.

EV fleets are expanding at a fast pace in several of the world's largest vehicle markets. This is being driven by governments and automakers who are promoting electricity powered vehicles as a key technology to curb oil use, fight climate change and air pollution.

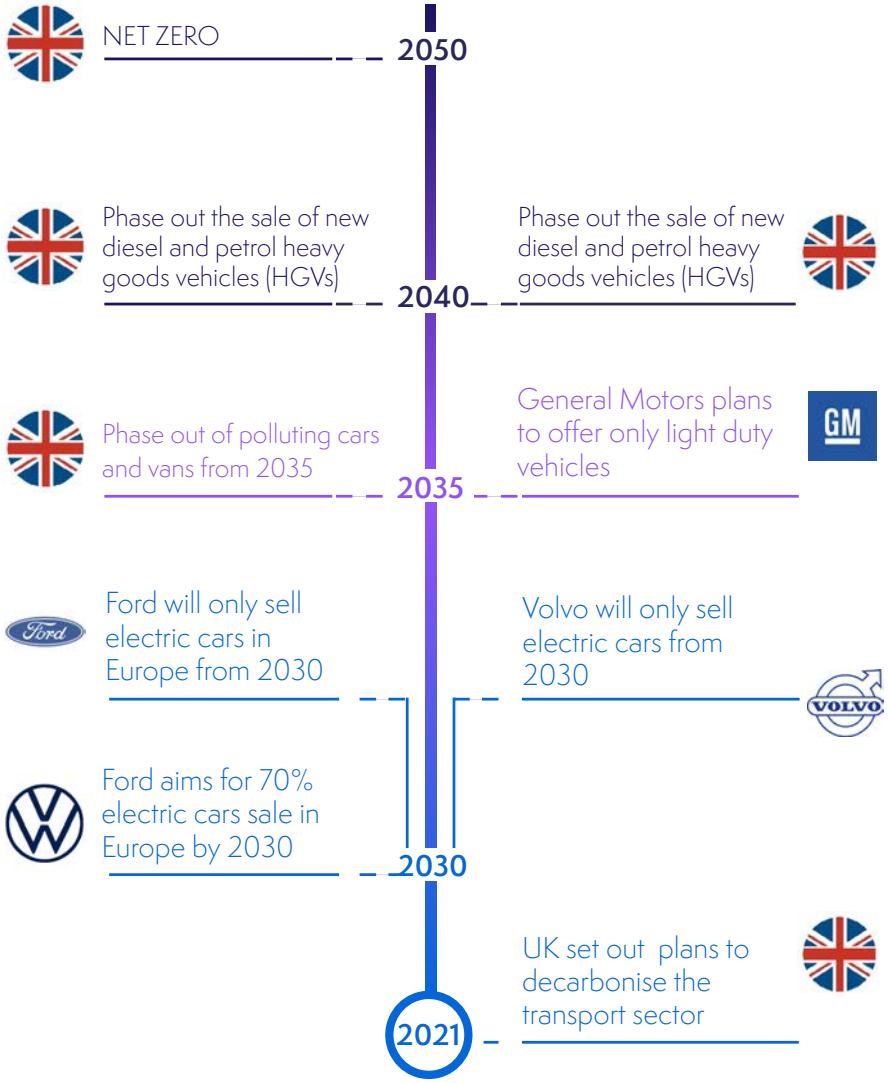
After a decade of rapid growth, in 2020 the global electric car stock hit the 10M mark, a 43% increase over 2019, and representing a 1% stock share. Battery electric vehicles (BEVs) accounted for two-thirds of new electric car registrations and two-thirds of the stock in 2020. This has been driven in part by the falling cost of batteries. According to the BNEF's yearly survey of battery prices, the weighted average cost of automotive batteries declined by 13% in 2020 from 2019.

Notably 18 of the 20 largest car manufacturers (in terms of vehicles sold in 2020), which combined accounted for almost 90% of all worldwide new car registrations in 2020, have announced intentions to increase the number of available EV models and boost the production of electric light duty vehicles (LDVs).

Several car producers have raised the bar to go beyond previous announcements related to EVs with an outlook beyond 2025. More than ten of the largest vehicle Original Equipment Manufacturers (OEMs) worldwide have declared electrification targets for 2030 and beyond.

Significantly, some OEMs plan to reconfigure their product lines to phase out fossil fuel vehicles and produce only EVs

But as electric cars and commercial vehicles go mainstream, they have faced a persistent question: Are they really as green as advertised?



Government ambitions

The UK government has set a net zero target to be achieved by 2050. Progress is being made to reduce emissions in certain segments (such as power generation). However, despite vehicles becoming more fuel-efficient, transport emissions have remained largely flat since 1990 as the gains from efficiency have been largely offset by road traffic increasing near 30% between 1990 and 2019.

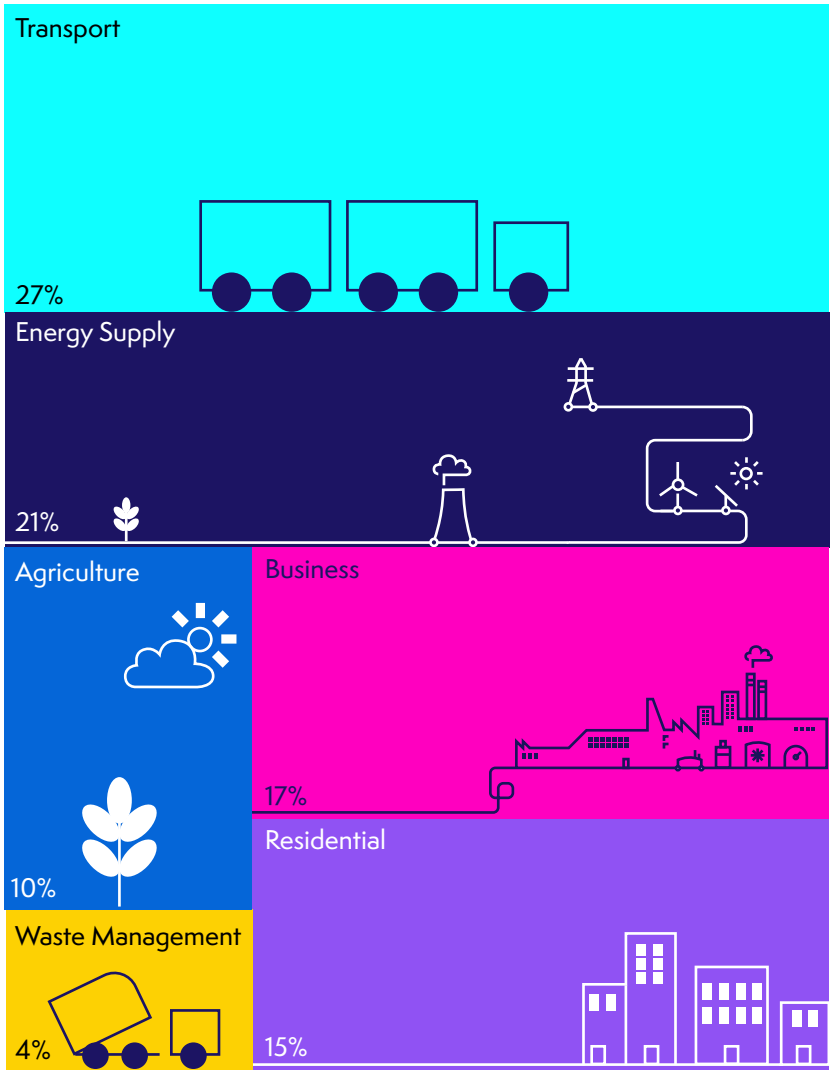
The latest data from the government shows that transport represents the largest share of total carbon emissions across all sectors of economy, 27% in 2019 - equating to 126 million tonnes of CO2 - with most of the emissions stemming from road transport.

The UK has set a goal of banning sales of conventional fossil fuel vehicle sales by 2030, and only allowing zero-emission vehicles from 2035 – five years earlier than it had originally been planned.

On 14 July 2021, the government set out a blueprint on decarbonisation of the domestic transport,, which includes plans to phase out the sale of new diesel and petrol heavy goods vehicles (HGVs) by 2040. Combined with the 2035 phase out date for polluting cars and vans, the government said this represents "a world-leading pledge to phase out all polluting road vehicles within the next two decades".

In July, the government also published its response to the electric vehicle smart charging consultation. It commits to laying legislation later in 2021 to ensure that all private EV charge points meet smart charging standards.

The transition to EVs is central to the government's net zero commitment, but it will also increase demand on the electricity system. Smart charging can help mitigate these impacts. This legislation will play an important role in driving the uptake of smart technology, which can save consumers money on their energy bills.



How green are EVs?

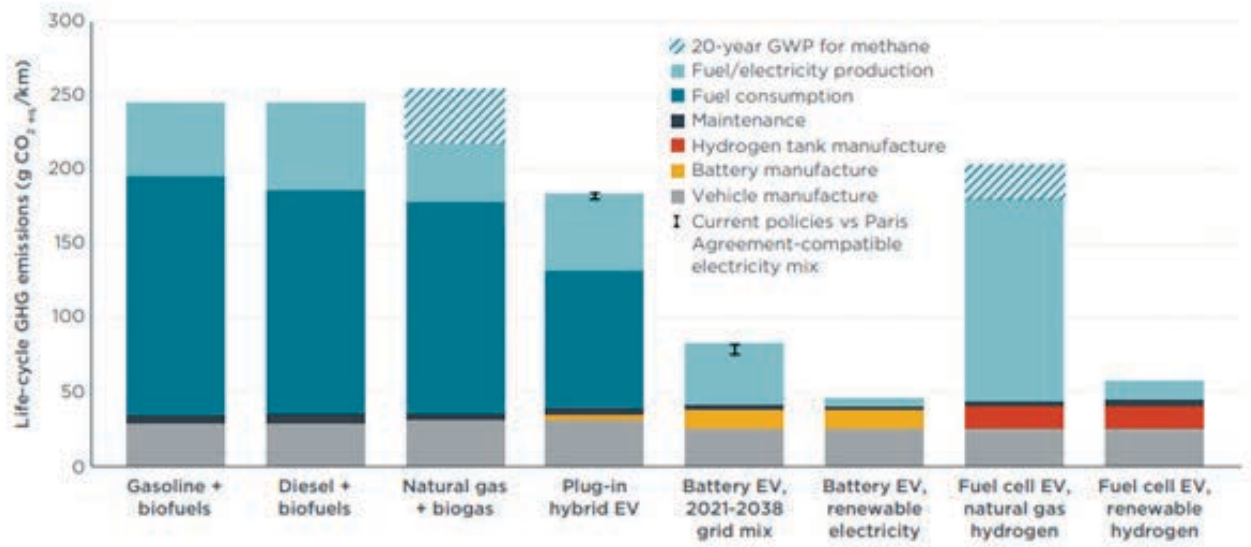
When it comes to answering the question on how green are EVs, a lot depends on how the energy used to charge up those plug-in vehicles is generated.

An argument often brought up against the transition to electric cars is the assertion that, all things considered, electric vehicles aren't much cleaner than internal combustion engines. One of the common beliefs is that once we account for battery production and electricity generation, the emissions savings of electric vehicles are minimal at best.

In response to those claims,, the International Council on Clean Transportation (ICCT) has published a white paper, comparing life-cycle greenhouse gas emissions of combustion engine and electric passenger cars.

Considering emissions associated with vehicle and battery manufacture, maintenance, fuel consumption and fuel/electricity production, the study finds that electric cars cut emissions significantly, even in countries where the transition to renewable energy in the electricity mix is still in the early stages.

The report found that emissions generated over the lifetime of a mid-sized electric passenger car are between 66%-69% lower than those of a car with a combustion engine.



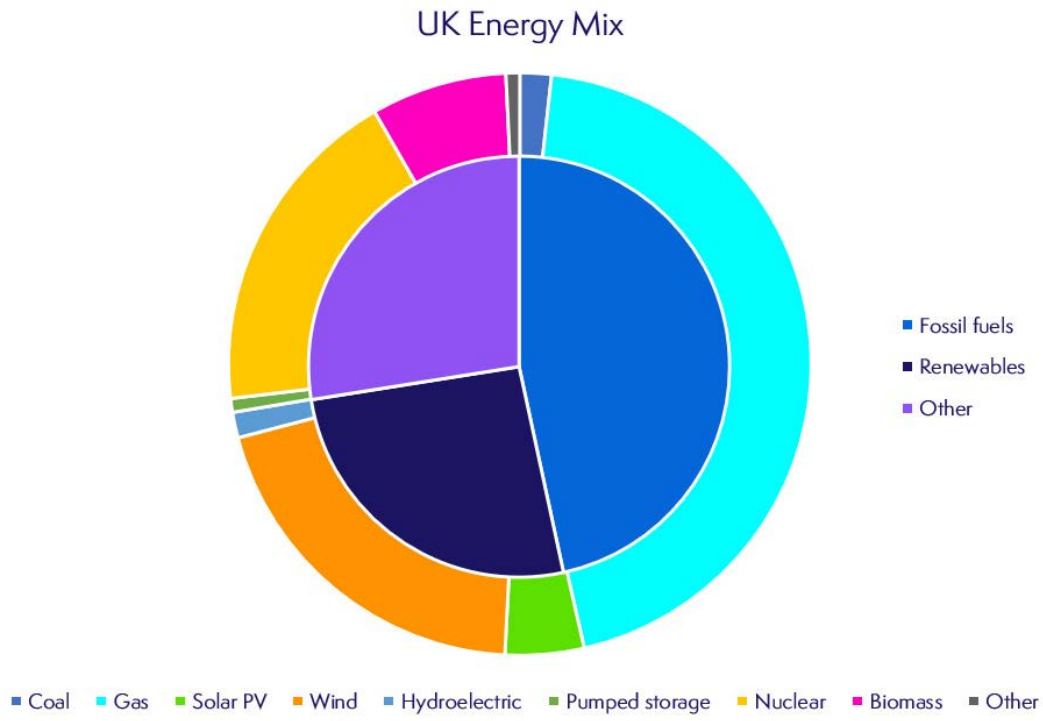
How green are EVs?

In the UK, the electricity mix remains dominated by gas (around 40% of total electricity productions). This highlights the importance of grid decarbonisation alongside vehicle electrification. Along with electrification of other sectors, such as heat, and increasing levels of renewables, EV adoption is an important part of the transition to a low-carbon energy future.

The life-cycle greenhouse gas emissions (GHG) performance of electric cars will improve as grids decarbonise as both manufacturing of components and the charging of the vehicles increasingly run on zero emissions power. Regulations that promote electrification are crucial to capturing the future benefits of renewable energy.

An increase in EV use will also result in lower carbon monoxide and air pollutant emissions from the road transport sector including sulphur dioxide, nitrogen oxides and particulate matter from the transport sector.

But rapid EV uptake will no doubt create challenges for the electricity grid. However, the EV itself may provide part of the solution.



Challenges for the grid

EV adoption is an important part of the transition to a low-carbon energy future, but rapid EV uptake will create challenges for the grid. However, the EV itself could provide part of the solution.

In its latest Future Energy Scenarios, National Grid expects some 37.4M EVs to be on Britain's roads by 2050. A study by the UK's Climate Change Committee predicts that the increased electrification of the country's economy, including the widespread adoption of EVs, could lead to a doubling of annual demand, from 300TWh in 2019 to 610TWh by 2050.

While many have argued that the power grid cannot cope with significant increases in EVs on the system, National Grid has estimated that even if there was an overnight switch to EVs, the increase in overall demand would only amount to 10%. The most pronounced effect will be the impact of EVs on the electricity load curve. But the EVs themselves offer a solution to this.

"The biggest challenges for the grid with the rise of EVs are around demand volume and time of charging.

"That amount of new added demand for electricity will by itself become a challenge for grids all around the world, and in particular for grids that are constrained. With charge timing, the challenge is when consumers will charge their vehicles. In most grids, the peak hours are the ones right when people are arriving home from work, so if business fleets finish operations at 5pm and immediately plug their EV fleet in to charge, that is going to be difficult for the grid operator. However, with challenge comes opportunity. Given EVs are essentially a battery on wheels, they can be utilised as an energy storage system.

"Price dynamics are already creating an opportunity for EV owners. We are helping some of our customers by finding the optimal tariffs to reduce their charging costs. By automating their systems to charge only when the electricity price has fallen to a given level, we are helping to reduce our customers' costs.

"By going beyond optimisation and enabling bi-directional vehicle to grid (V2G) charging, these customers could send electricity back to the grid at times of peak demand. This creates a new revenue stream, by providing flexibility services when the price is right."

- Michael Phelan, Co-Founder and Chief Executive, GridBeyond

Tariffs and markets

Organisations with large EV fleets are going look for the ways to charge them at the most optimal time. That will be when the price of electricity is at its lowest, which is typically overnight. But if millions of EVs are charging at the same time, electricity will become more expensive. A sharp rise and sustained level of demand could even change the traditional pattern of daytime peak/night-time off-peak power pricing.

Action is already being taken by the government to ensure that the rise of EVs benefits the grid.

In its July report the Transport Committee welcomed the government's commitment to mandate that all new private charge points should be equipped with smart functionality and to introduce the relevant legislation later in 2021. But it also urged the government to mandate industry to:

- use price as a lever to shift consumer behaviour away from conventional refuelling habits towards "a little but often" approach; and
- incentivise consumers to charge at times when there is less demand on the electricity grid.

"It is economic for businesses to make the transition to EV's now, provided they take action to optimise their fleet and energy purchasing strategy.

"If you're on a flat tariff like most people are today, it's probably marginally economic at best to install an EV fleet. But if you purchase through the wholesale market and put in a smart charging system, you will end up saving money, as well as helping with the transition to a zero carbon economy.

"Another solution for businesses would be to purchase electricity directly from off-grid generation facilities, through a Power Purchase Agreement (PPA) especially those powered by renewables, which could yield significant cost savings, thanks to the difference between retail and wholesale energy prices (without accounting for avoided demand charges).

However, for long term resiliance to rising prices and security of supply investment in on-site generation, such as solar power possibly co-located with a battery storage system could be a viable option for many EV fleets, provided that the assets are co-optimised to ensure full participation across energy markets while ensuring your EVs are charged and ready when you need them."

- Michael Phelan, Co-Founder and Chief Executive, GridBeyond

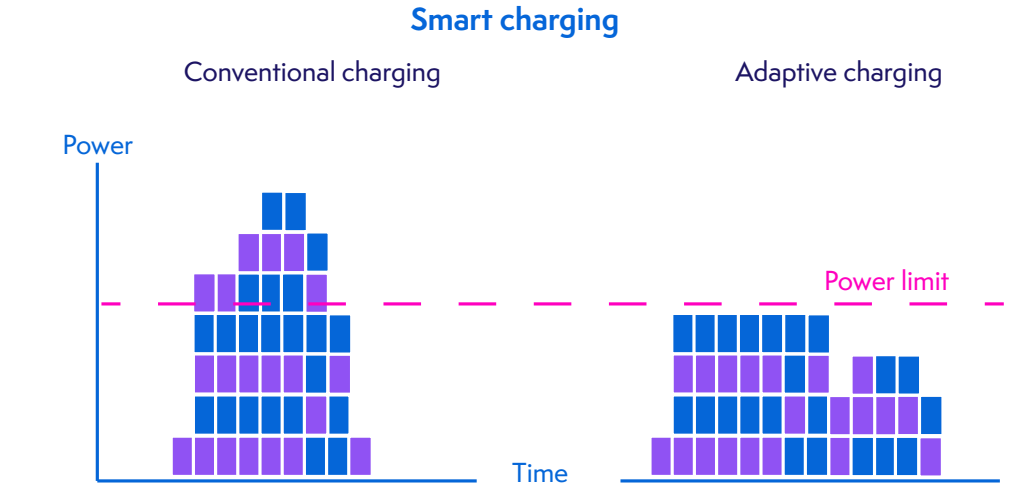
Smart solutions

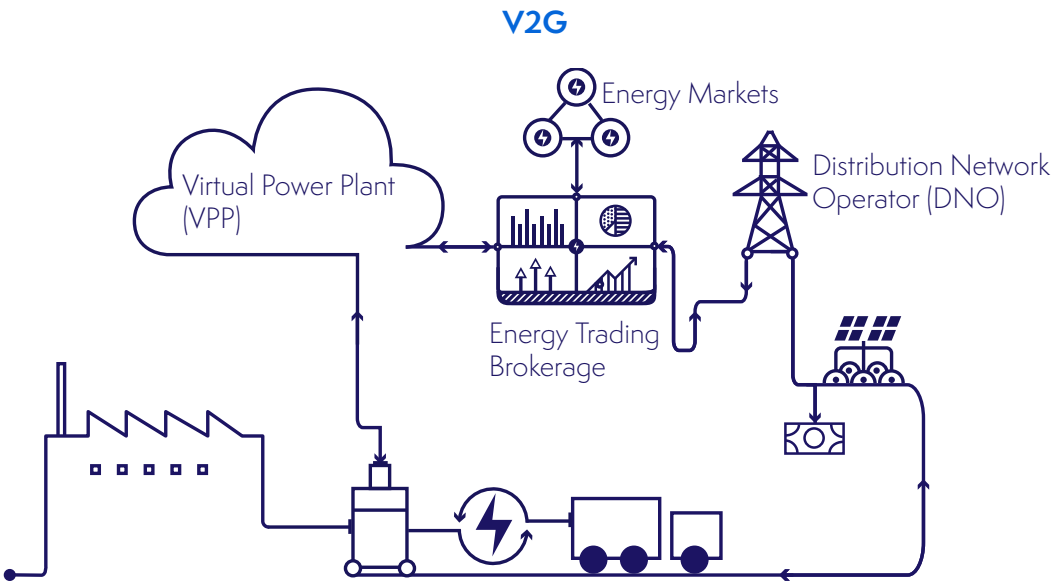
There are two main ways that EV can be used to support the grid. The first and simplest is through smart charging, but a better way is through Vehicle to Grid (V2G) optimisation.

Smart (also known as managed or intelligent) charging is where an EV is charged in a way that spreads the load across a specific timescale. This is made possible through a system where an EV and a charging device share a data connection with a charging operator. It essentially allows the charging station owner to monitor real-time data such as supply and demand on the local electricity network and to manage the use of their devices remotely to optimise energy consumption from the EV.

Consumers can benefit from cheaper power, and operators benefit from an easier to balance system and avoiding all cars being charged simultaneously. Smart meters have the potential to enable sending detailed information on consumption to energy suppliers, and more reactive use of power for customers. It could also allow EV fleet owners to access "time of use" tariffs in the future, with potential financial savings, or to use on-site energy storage to its maximum potential.

The concept of V2G (vehicle to grid) is an extension of smart charging. When supply is low and demand high, EVs connected to the grid to charge can instead release power back into the electricity network. Owners of the vehicles can then be paid for this balancing service in a similar way to the operators of energy storage units.





Incentives

There are currently a variety of financial incentives available to encourage businesses to electrify, mostly government initiatives.

Enhanced Capital Allowance Scheme

The Enhanced Capital Allowance scheme aims to encourage businesses to invest in efficient equipment, which includes new zero-emission goods vehicles. Electric cars qualify for first year allowances, which means you can deduct the full cost of the purchase from your profits before tax.

Super-deductions

In April 2021, the Chancellor announced a new capital allowance known as a "super-deduction", offering 130% first-year tax relief on certain green investments. Companies taking advantage of the super-deduction effectively get a tax cut of 25p for every pound they invest in new machinery, and the list of qualifying assets includes EV charging points and solar panels. The expenditure must be made before 31 March 2023.

Plug-in grant

The plug-in grant is a government subsidy intended to encourage sales of low-emission vehicles. To qualify for the grant, a vehicle must be on the government's approved list of cars, motorcycles, vans and trucks. The grant will cover 35% of the purchase price of a car on the approved list, up to a maximum of £2,500. The maximum for small vans is £3,000 and for large vans it is £6,000. But to be eligible for the grant, the purchase price of a car must be less than £35,000.

Workplace Charging Scheme (WCS)

This scheme helps businesses with the capital costs of buying and installing EV charge points. It covers up to 75% of the costs, capped at £350 per socket. Businesses can use the online form to apply, but they must first check that they meet the eligibility requirements and the terms and conditions. The scheme will pay for up to 40 EV charge points per business.

Local incentives

Funding may also be available at local level. For example, Birmingham's Heavy Duty Vehicle Fund offers up to £15,000 per vehicle to help businesses adapt to the demands of its new Clean Air Zone, while Bath is offering smaller businesses up to 35% of the costs of switching to a cleaner vehicle (capped at £4,500 for cars and vans). Other UK cities are likely to follow suit, both with implementing Clean Air Zones and in offering some form of support for businesses to adapt.

Low Benefit in Kind (BIK) rates

Employees who enjoy the use of company cars have to pay tax on this perk, which varies depending on the vehicle and its emissions. BIK tax can be a disincentive for employees to opt into company car schemes, because it is often more cost-effective just to claim the mileage on their own cars. The BIK rate for fully electric cars is now 1% and will rise to 2% in the financial year 2022-2023. The rate for plug-in hybrids has dropped too. These very low rates make the idea of driving an electric company car much more attractive.

Benefits for business

The shift to EVs bring numerous benefits and opportunities for businesses to optimise energy strategies while supporting the integration of renewable energy into the grid.

In addition to being a more sustainable option at a time when employees and supply chains are demanding action on the environment, EV fleets provide cost reductions over the lifetime of their ownership. With lower overall running costs, an increasing number of tax benefits, and grants from the government, the savings compared to traditional vehicles soon add up. With the raising number of Clean Air Zones coming into force in cities across the UK, there has never been a better time for businesses to consider switching to EVs.

In terms of running costs, an EV can be driven for as little as 1p per mile, compared with 8-10p per mile for even the most fuel-efficient petrol and diesel vehicles. They also have fewer moving parts than conventionally fuelled vehicles, providing long-term maintenance savings. Fleet and business vehicle operators could also save more than £17M a year in London Congestion Charge Zone payments by switching to electric or plug-in hybrid cars and vans, according to research by Citroën UK. Analysis of Transport for London data obtained via a Freedom of Information request has revealed that, despite a freeze in payments last year due to the Covid-19 pandemic – businesses still spent more than £1.4M per month to enter and operate in central London.

In addition to these day-to-day savings, switching to an EV fleet can save further money for businesses as they incur reduced national insurance contributions. Businesses looking to make an investment may also be able to benefit from funding and finance schemes currently available.

The environmental and economic benefits of EVs are clear. The improving vehicle ranges, an ever-growing charge point infrastructure, and an increasing number of models available are giving more businesses the confidence to switch. But in addition to these benefits there are revenues to be made through providing services to the grid. The specific characteristics of EVs mean that they have potential to provide balancing and demand response services.

Frequency response - the ability to rapidly (ideally sub-second) charge or discarge the EV battery for a few seconds up to 30 minutes (or more).

Fast reserve - the ability to charge or discharge the EV battery with two minutes' notice for up to 15 minutes.

Reactive power - the ability to configure EVs to adjust real or reactive power.

Voltage control - providing local network services to manage temporary voltage issues.

Demand turn-up/-down - the ability to charge or discharge the EV battery where (typically) local conditions mean an excess of (typically renewable) generation is one of the system.

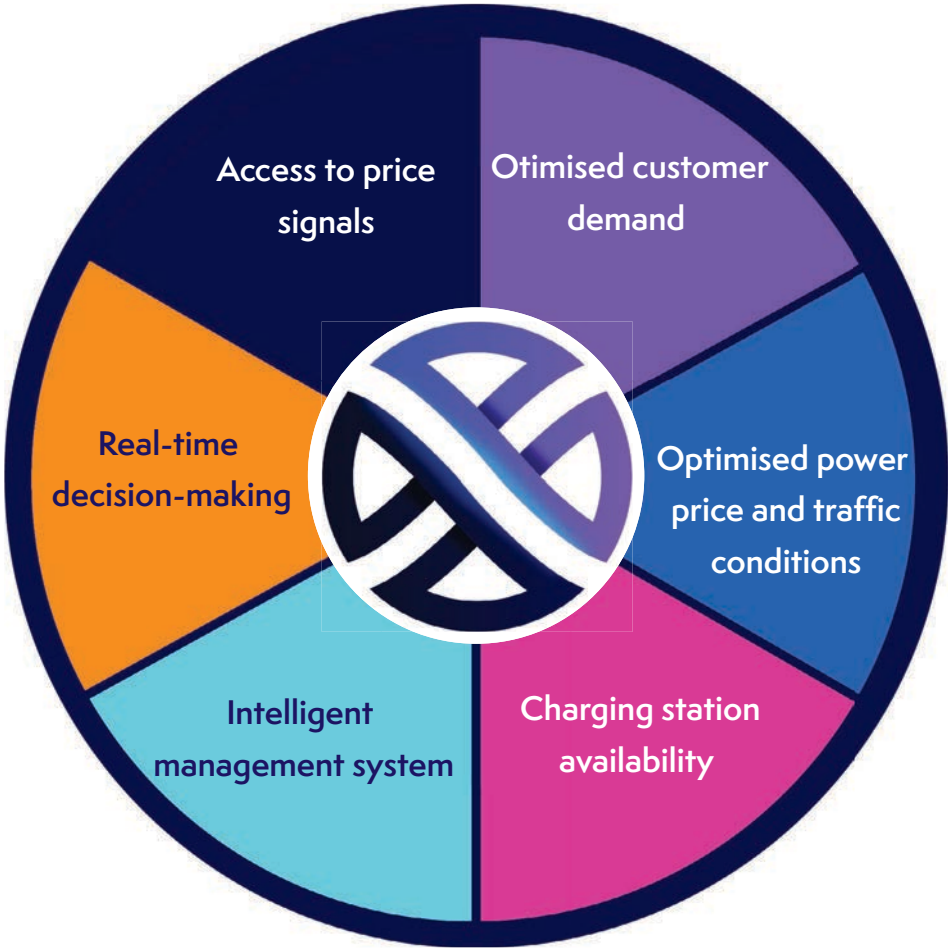
Capacity market - the ability to discharge the EV battery with four hours' notice of a system stress event.

Capture opportunities

Transitioning your fleet introduces a new set of challenges that go well beyond the vehicles.

To fully capture the opportunities in the EV fleet-charging market your business needs access to price signals from the energy market to enable real-time decision-making and an intelligent management system to optimise charging in alignment with customer demand, power prices, traffic conditions, and charging-station availability.

GridBeyond is helping businesses across the UK, US and Ireland make the switch to EVs. Our end-to-end service gives businesses a clear roadmap to cleaner fleets and lower emissions. If you are considering the switch to EVs, find out how we can help you on your journey.



Futureproofing your fleet

Moving to EVs is an excellent decision for many businesses, but even if you are set on making the switch, there are a series of considerations.

Smart energy purchasing

Traditional energy brokers will help you negotiate and select a fixed supply contract – and leave it there. While this approach gives you certainty over costs, you could be missing out on significant opportunities that arise when you take control of your energy procurement.

At GridBeyond we know that EV fleet owners have potential to reduce costs by taking advantage of short-term downward energy prices through hybrid and flexible tariffs available. We also understand that you need a partner to help you decide which direction to take.

Fleet management and benchmarking

Running an electrified fleet requires sophisticated energy monitoring and control technologies to manage your charging infrastructure remotely, monitor charging sessions, energy usage and diagnose issues early.

Our Point Ai. Thrive Services provides remote access control for individual EV stations and groups of stations to monitor performance and user access. Access historical charging activity and real-time monitoring to manage risk and monitor battery health, state of charge and predictive maintenance.

V2G optimisation

Choosing "smart" charge points will optimise energy consumption across your site, saving you money and reducing strain on the grid. But a better option is installing V2G technology, which will allow you to not only save money, but to make revenues.

Our AI-powered platform enables you to unlock additional revenue from traded energy markets, flexibility and balancing services. It allows you to buy energy at its cheapest and greenest, sell power back to the grid - supporting decarbonisation goals, your own sustainability strategy and unlocking new revenue and improve your return on investment.

On-site battery storage

By installing a battery or renewable generation on your site, such as solar PV, your business can decrease its electricity bill, while ensuring the fleet is charged with the greenest energy possible – boosting your sustainability credentials.

GridBeyond will, at no cost to your business, install a battery on your side of the meter. This can then be used to store electricity that either is produced from any on-site generation you may have or power drawn from the grid when electricity prices are low. This stored electricity can then be used to meet your charging requirement or site demand, boosting your resilience and ensuring you are fully optimising your solar assets.

Analysis and information

The ability to measure, monitor and reduce greenhouse gas (GHG) emissions is a critical component in making the shift to EVs and proving the return on investment for the assets.

GridBeyond can help you consolidate your energy management and GHG reporting in one place. We have the technology, tools and expertise in energy management required to simplify the process of capturing, monitoring and reporting on your energy and carbon use.

Industry insight

Nigel Dent

Head of Sales, Connected Energy

Two lives are better than one

The need for battery energy storage systems (BESS) made from second life vehicle batteries is clear. There are an estimated 5.2 million electric vehicles on the road at present, with a predicted 34.7 million by 2030, in less than ten years time. At the same time dramatic changes are required to the way we create and store energy to meet carbon reduction targets.

Second life BESS present an opportunity to solve the two key challenges facing the country:

- the huge demand for energy storage due to de-carbonising the grid and decommissioning traditional energy producers in the next ten years
- the immense influx in electric vehicle car sales over the next 10 years.

A key driver in meeting these challenges is embedding an understanding between e mobility, the energy sector and sustainability. Only by building strong relationships with the original equipment manufacturers (OEMs) will vehicle batteries be able to be taken directly from the vehicle and employed in energy storage units. This will ensure the R&D and millions the OEM has invested in the safety of the battery is maintained.

Embedded safety

In a BESS that employs second life batteries, advanced technology uses an inhouse power control module that talks directly to the EV management system (BMS) so that as far as the batteries in the BESS are concerned, they are in a car. This means all the safety and testing embedded in the batteries is intact, making the BESS as safe as the electric car you sit in every day.

A controller communicates with multiple batteries at the same time and in the same language as it would in the car. It also interfaces with a bi-directional battery charger, which converts the current from DC to AC and vice versa so it can connect to the grid. Intelligent algorithms run the inverters within the BESS and modulate them to increase their efficiency and life of the system, and can be auto scheduled to ensure optimal peak load avoidance.

A sophisticated maintenance monitoring system remotely adjusts settings to ensure optimal performance of the batteries and maximum use of renewable energy.

Industry insight

CONNECTED ENERGY Advanced Energy Storage Solutions

Circularity that makes sense

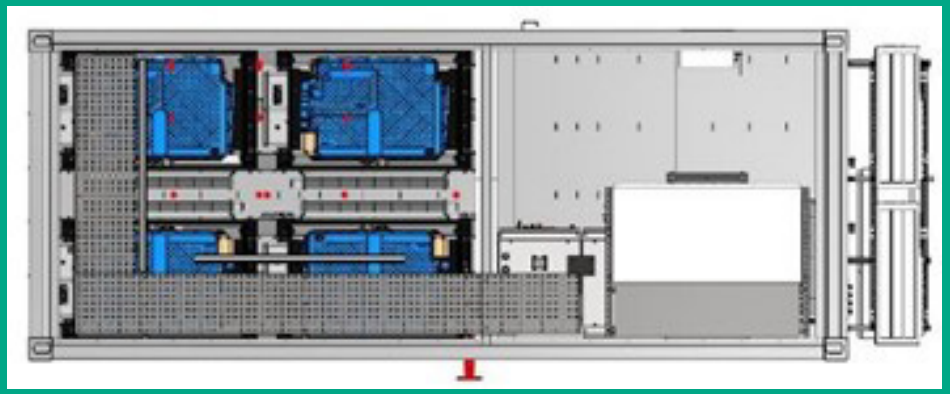
Where help is needed behind the meter to manage peaks in demand, store renewable energy, or just to manage energy costs, a BESS using second life vehicle batteries is a common sense, easily understood approach.

When, for example, a second life BESS, employing typically from six to 48 Renault Kangoo batteries, manages the electricity supply at EV charging stations, it is an especially effective example of the circular economy at work, but the solution can perform in a number of different applications.

Multifunctionality

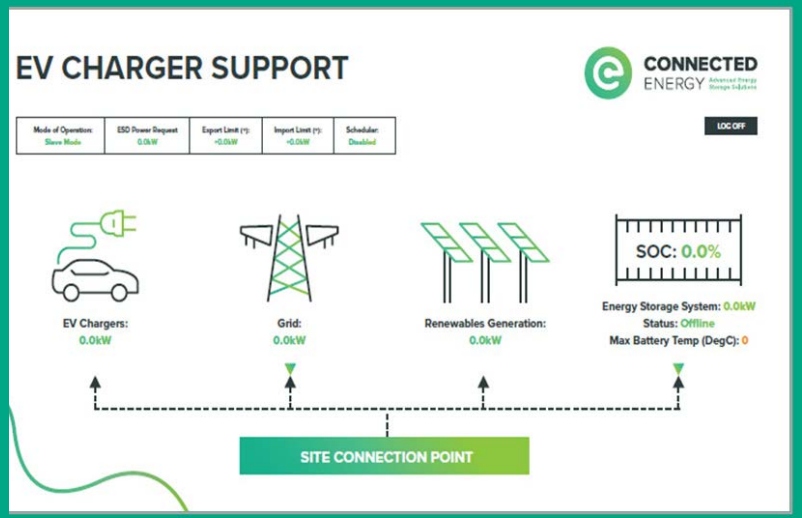
Thanks to its hardware interface, EV charging usage can be monitored, with solar generation or grid usage enabling the BESS site to perform as needed. The BESS can also be manually or auto scheduled to ensure optimal peak load avoidance. A sophisticated maintenance monitoring system remotely adjusts settings to ensure optimal performance of the batteries and maximum use of renewable energy.

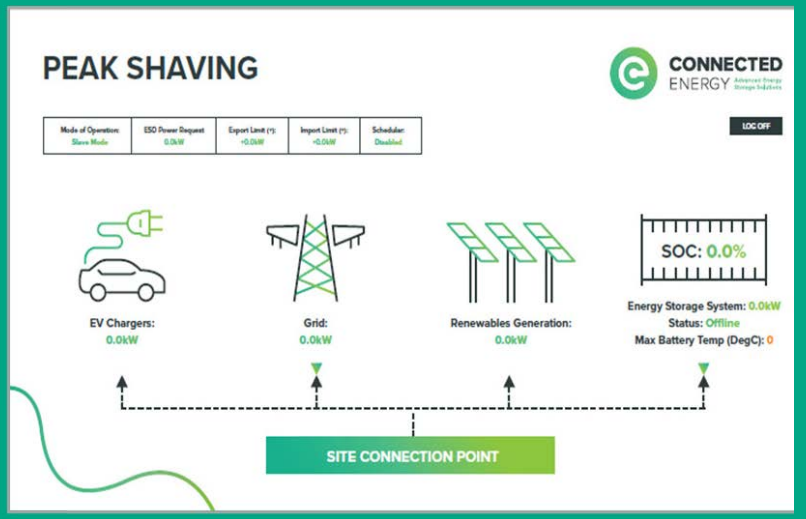
The technology and advanced electrical engineering solutions have been developed by Connected Energy. Passing all grid services response and approval tests, the system can be taken over by GridBeyond to ensure full grid service access and benefit.

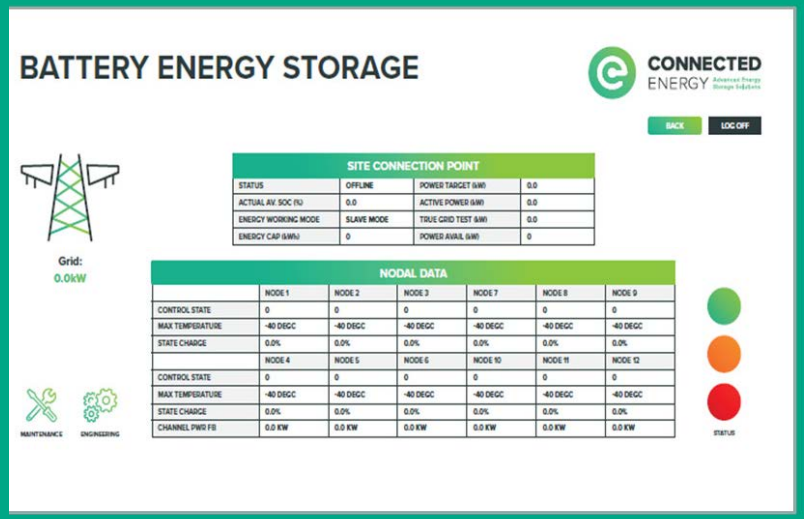


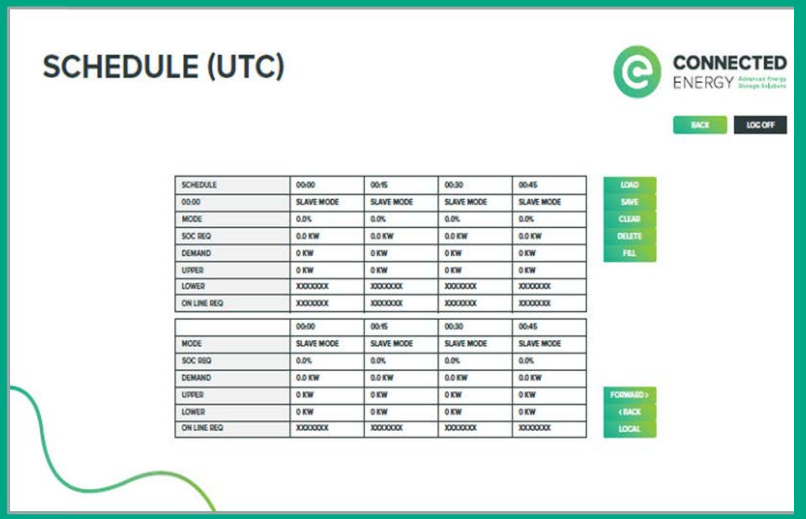
Industry insight

CONNECTED ENERGY Advanced Energy Storage Solutions









Industry Insight

CONNECTED ENERGY Advanced Energy Storage Solutions

Turnkey solutions

With full back-office support and R&D team, initial feasibility through to installation, commissioning and operation and maintenance is provided – a turnkey solution. This enables a circular economy approach and brings carbon reduction benefits quickly and efficiently.

There are two different types of systems – modular 20ft containers with 300kW or power and 360kWh of capacity. The modules are almost 'plug and play' and contain everything required for a battery storage system.

The multi MW system is classed as a split system where one container is filled with batteries and the other holds the inverters and power control. These are designed for bigger projects and provide battery type flexibility with an ability to switch-out containers filled with different types of batteries.

Looking further down the road

A group of companies have now joined forces on a project designed to create a new circular end-of-life supply chain for the electric vehicle industry.

Called RECOVAS, the project is a partnership between EMR; three major vehicle manufacturers: Bentley Motors, BMW and Jaguar Land Rover; plus the University of Warwick; the Health and Safety Executive; the UK Battery Industrialisation Centre; Autocraft Solutions Group; uRecycle, and Connected Energy.

The project aims to provide a standardised and reliable route for recycling and repurposing lithium-ion car batteries at a scale that can cope with the expected sales of electric vehicles in the UK. There is not a one size fits all solution at present and not all batteries will be suitable for use in every BESS. As such the RECOVAS project is developing a triage approach where batteries are graded and directed to the best route. If not suitable for a BESS, then other options are explored either to refurbish them with Autocraft or recycle to break them down and capture the precious metals with uRecycle.

About Connected Energy

We operate internationally to provide and enable second-life battery energy storage systems.

Our proven technology enables electric vehicle (EV) batteries to have a second life deployed in commercial scale stationary energy storage systems. These systems will have lower capital, cycle and environmental costs compared to first-life energy storage systems. Using our proprietary technology, we are also able to maximise the value of MWhs under our control.

Positioned at the intersection of the energy trilemma, the electrification of transport and the circular economy our team is focussed on positive impact.

Connected Energy, together with GridBeyond, provide a clear pathway to energy management using solutions which play an active part in the transition to a zero-carbon emission economy.

Contact Connected Energy

www.c-e-int.com

The Core, Bath Lane, Newcastle Helix, Newcastle upon Tyne NE4 5TF

Academic Insight

Carbon Impact Analysis of 2nd-Life Battery Storage

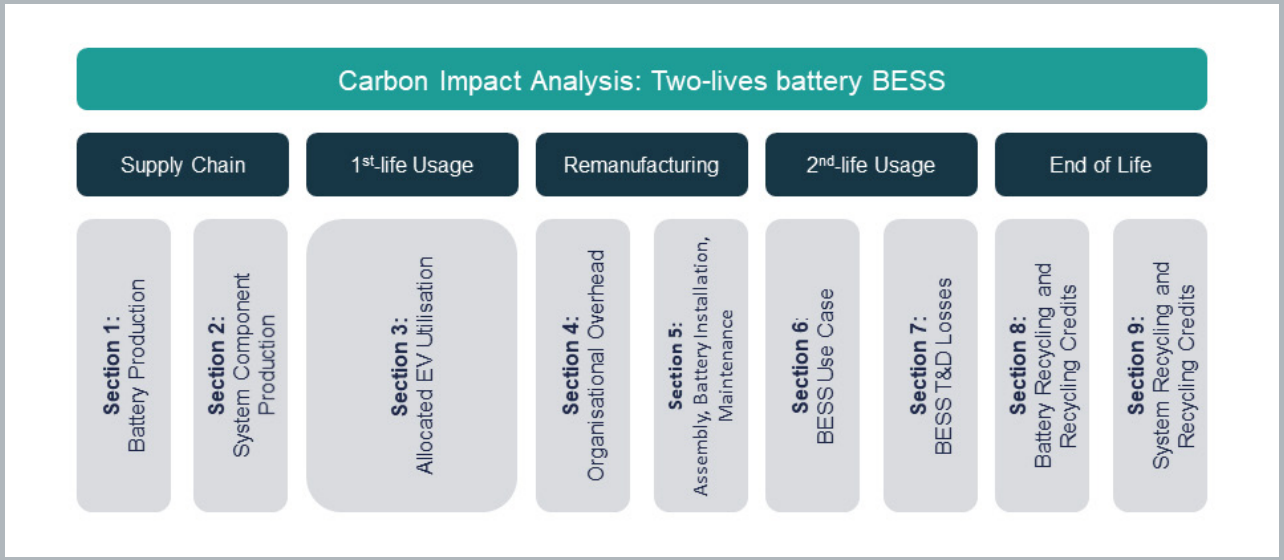
Many organisations need to be able to demonstrate the carbon savings that their investment in new energy systems or approaches will deliver.

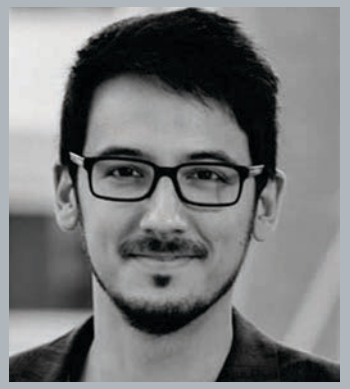
An ESRC-funded project between Lancaster University Management School's Thomas Jalili Tanha and Connected Energy has developed a carbon impact analysis tool to quantify the benefits and impacts of using battery storage systems.

It is based on calculating the difference in emissions comparing energy storage to major technologies used to provide grid balancing, such a gas peaker plants. Additionally, the tool provides a comparison between first and second life battery energy storage systems.

Each stage or section in the battery life is included in the model, shown in Figure 1. The processes and carbon emissions of each of the nine stages have been quantified.

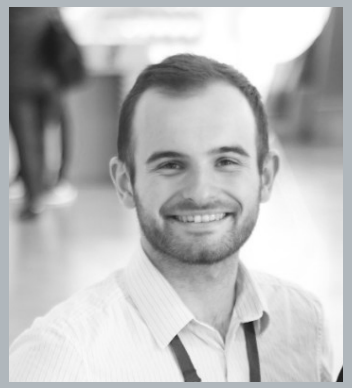
Figure 1. Breakdown of the modelling components





Thomas Jalili Tanha

Doctoral Researcher, Lancaster University



Frazer Wagg

Energy Storage Analyst, Connected Energy

Academic Insight

The Carbon Impact of Batteries in EVs

Figure 2 illustrates the carbon impact of three sets of battery packs.

Pack 1, created in 2013, is used for seven years as an electric vehicle (EV) battery at UK average mileage. Afterwards, it is recycled. A carbon credit for recycling is accounted for as future raw material mining and processing can be avoided. This original generation of battery packs was close to breaking even on their carbon impact.

Expected improvements of manufacturing, recycling and grid decarbonisation will mean that future packs have a significantly more positive impact on carbon emissions when compared to internal combustion engine (ICE) cars. Pack 2 and Pack 3 follow as seen in the chart below.

Over the three generations of battery packs that operate until 2036, a total of 3.5t CO2e would be saved compared to an ICE vehicle. The modelling has set the grid mix to follow the 'steady progression' scenario developed in UK's National Grid Future Energy Scenarios 2021.

First life batteries in a BESS

A battery energy storage system (BESS) can be modelled using first life batteries. Here we can see an initial carbon expenditure for the entire battery system which includes manufacturing the system and its electronics as well as the battery pack components required.

After ten years, it is expected that the first life batteries will need to be replaced. Figure 3 shows the carbon impact of a 300 kW system installed in 2021 to perform grid balancing (i.e. frequency response) and compared to alternatives, such as turning up and down gas peakers and turning down wind turbines.

Figure 2. Carbon impact analysis of electric vehicle packs

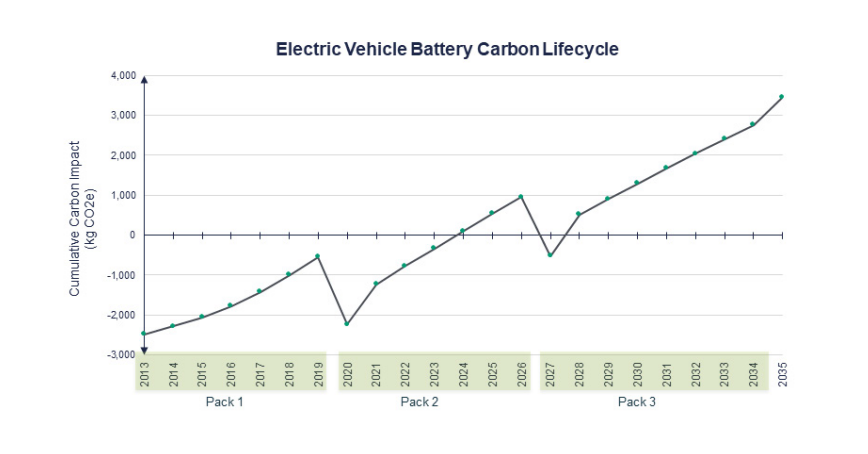
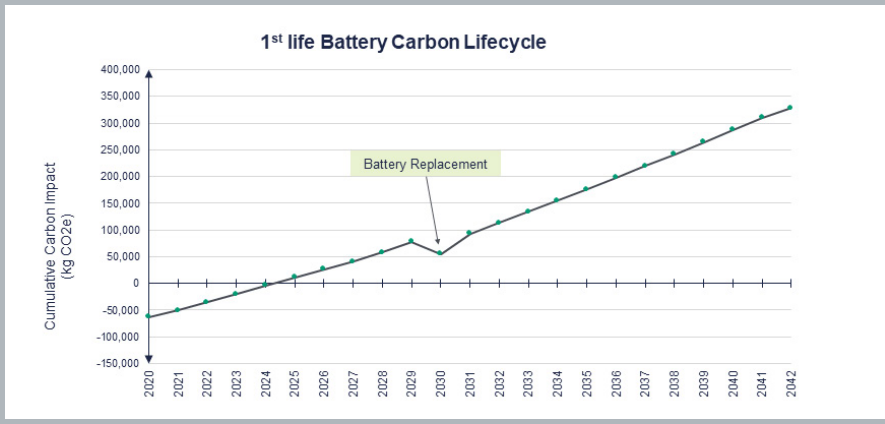


Figure 3. Carbon impact analysis of a 300 kW 1st life battery storage system



Academic Insight

Second life batteries in a BESS

By combining the analysis of batteries in EVs and the BESS use phase, a carbon impact analysis across two lives can be made.

In a second life BESS, the battery packs are expected to last seven years once installed, rather than ten as in the case of brand new batteries.

Assuming the BESS is installed to work until 2042 it will therefore need three sets of batteries over a 21-year timeframe.

Figure 4 visualises the two lives of the batteries in four stages.

- Stage 1: First set of EV packs created and driven.
- Stage 2: Battery storage system is manufactured and uses the first set of EV packs, meanwhile the 2nd set of EV packs are created and being used on the road in a vehicle.
- Stage 3: Similar to stage 2, the 2nd set of packs are installed in the system whilst the 3rd are created and are on the road. Additionally, the first set of packs are recycled.
- Stage 4: This stage sees the 3rd set of packs being installed into the system. Both the 2nd and 3rd set of packs are recycled once they exit the system. The remaining system becomes recycled.

Second life CO2e savings

There is a clear benefit to incorporating second life EV battery packs into energy storage systems despite requiring more pack replacements over the life of a system than using first life battery packs. In total, the first life BESS gives a benefit of 329t CO2e, whilst the second life BESS gives a benefit of 473t CO2e. The 2nd life system therefore saves an additional 144t CO2e.

Additional benefits are created by 1) extending the useable life of the EV packs and 2) moving the recycling point further forward in time, by which stage advances in recycling technologies will have made the process more efficient.

Contact the author or find more about the tool on Github.

Figure 4. Carbon impact analysis of a 300 kW second life battery storage system

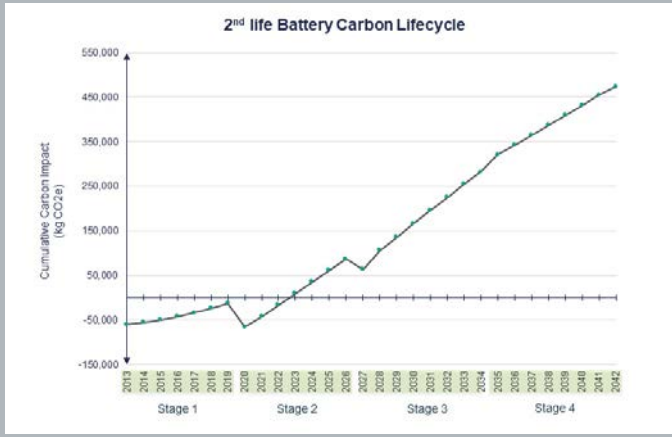
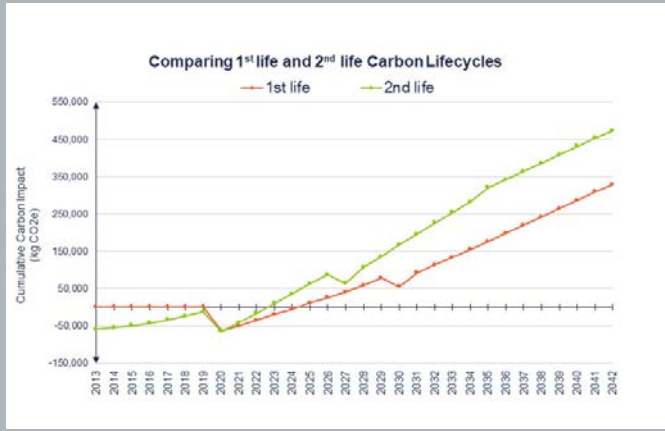


Figure 5. Comparison of carbon impact between a 1st and 2nd life 300 kW battery storage system



Moving resilience behind the meter

It's easy to take the reliability of our electricity supply for granted. But despite the resiliency measures embedded in the GB electricity system power cuts can and do happen.

Given that the grid is becoming increasingly intermittent as we move to an energy system progressively underpinned by renewables there is widespread recognition of the benefits of improving resilience by taking measures behind the meter.

From the widespread UK power cuts in August 2019 to rolling blackouts during the 2020 California heatwave and the impact of the recent Winter storms in Texas, grid resiliency is a key consideration for many businesses. As the UK continues to make the transition to a net-zero economy and renewables integration increases, the potential risks also rise.

At GridBeyond we use on-site assets and battery storage to provide a holistic solution that supports both grid and business resilience. In the event of a power failure or voltage dip either on your site or the local electricity network, the battery installation will supply reactive power, reducing the possibility of a brownout or blackout, eliminating downtime, and ensuring critical systems remain unaffected.

Our AI-powered platform, Point, ensures that full power resilience is delivered instantaneously, preventing disruption to even the most sensitive equipment. By supporting the effective running of connected assets, businesses can be confident that their operations will continue uninterrupted and running optimally, regardless of the cause for loss of power.

Boosting your green credentials

As electricity demand increases, more carbon intensive assets are brought into the generation mix. While during periods of low demand, renewables are dominant, meaning the carbon intensity of the grid is lower.

Batteries can help capture low-carbon energy and feed back to the grid during periods of high carbon intensity – helping to reduce the overall carbon emissions of the power sector. Battery storage also supports the integration of renewables by providing voltage and frequency support, as well as other services, for system operators that help to integrate higher shares of renewables generation into the grid.

As batteries do not produce any emissions while in operation so you can be safe in the knowledge that you are supporting global and country-wide emissions reductions, enhancing your environmental and sustainability credentials. By combining battery storage with any on-site generation or load assets you can further reduce your carbon footprint and help increase the volume of renewables in the energy mix. If your on-site generation exceeds your needs, batteries allow you to store surplus energy or export electricity to the grid.

Why GridBeyond?

GridBeyond gives business owners full control of their assets. We can even manage it on your behalf so you can focus on what your business does best.

Despite the range of tax breaks and other financial incentives available, many businesses are cautious about the upfront costs involved in switching their fleets to EV or investing in on-site stationary batteries. However, the investment made now will lock in long-term rewards in terms of customer retention and new income streams.

GridBeyond's experience spans across the whole grid network, from front-of-the meter assets through to industrial load and distribution network optimisation. This means we have a unique, holistic perspective of the network, as well as the unique capability to ensure your participation in the energy markets.

GridBeyond can support your business by installing a stationary battery on your side of the meter at no cost to your business.

The battery's installation and operation will be entirely managed by GridBeyond and will not interfere with your normal business operations, or require any capital expenditure

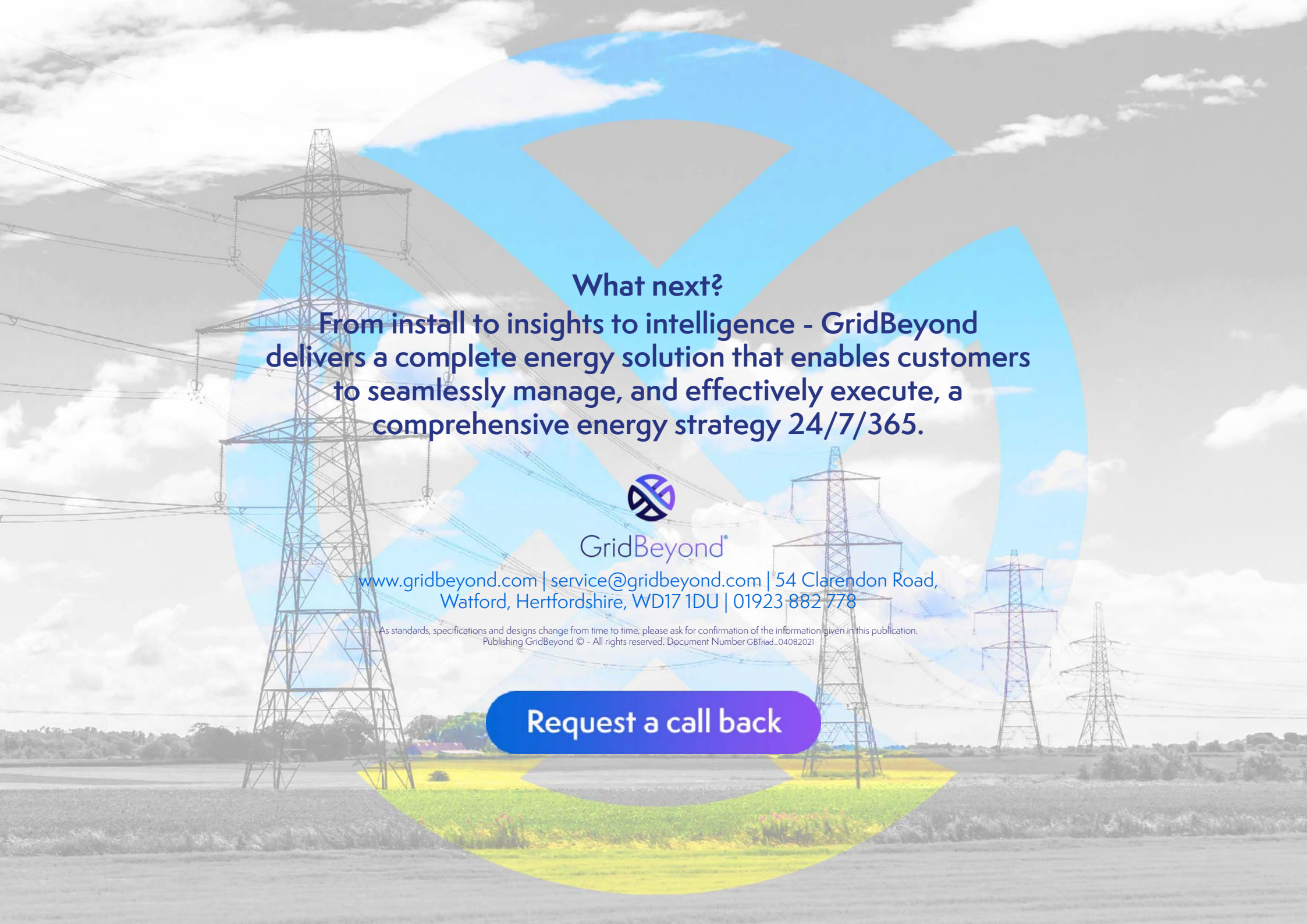
Using our expertise and AI-powered forecasting capabilities, GridBeyond will use the battery to store electricity that either is produced from any on-site generation you may have, or power drawn from the grid when electricity prices are low. This stored electricity can then be used to meet your site demand, boosting your resilience by providing a power source that can be deployed during power cuts or when energy prices are highest. GridBeyond will also predict when Triads, the periods of high DUoS charges, will take place and use the energy stored in your batteries to dramatically reduce your consumption during these events – cutting your annual power bill.

Our Point platform will provide you with the data needed to support your carbon reporting and the case for further investment in on-site generation, battery storage or energy efficiency measures.

The regular monthly revenue generated by the battery providing flexibility or demand response services throughout the entire useful life of the asset, will provide you with additional funding to further enhance your energy strategy.

Learn more about how GridBeyond can optimise opportunities for your EV fleet or stationary battery...

Request a call back



What next?

From install to insights to intelligence - GridBeyond delivers a complete energy solution that enables customers to seamlessly manage, and effectively execute, a comprehensive energy strategy 24/7/365.

GridBeyond®

www.gridbeyond.com | service@gridbeyond.com | 54 Clarendon Road, Watford, Hertfordshire, WD17 1DU | 01923 882 778

Request a call back