cenex

Lowering your emissions through innovation in transport and energy infrastructure

Transport

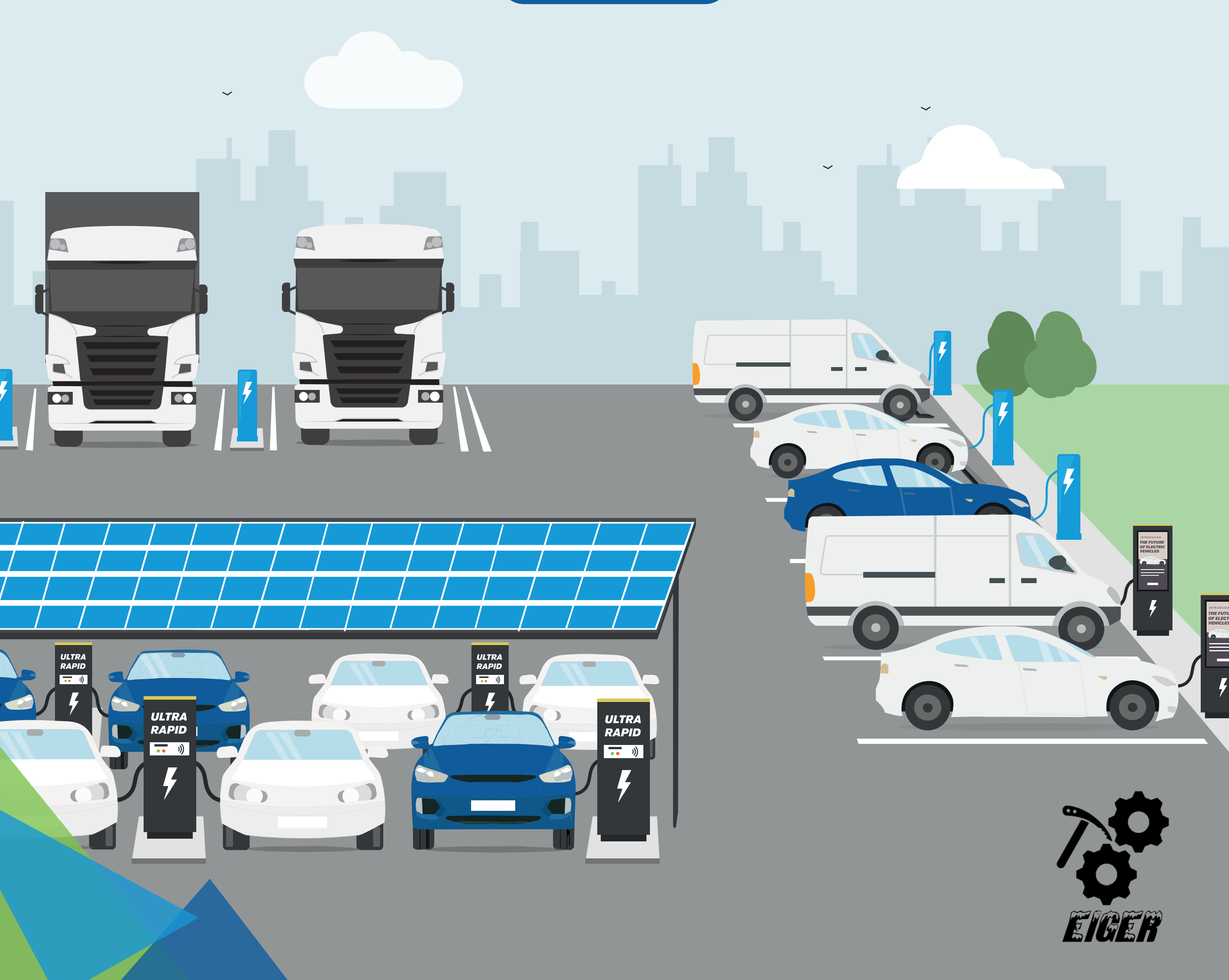
Energy Infrastructure

Knowledge & Enterprise

Depot Charging and Optimisation Assessment

An EIGER Model Case Study

Aug 2022



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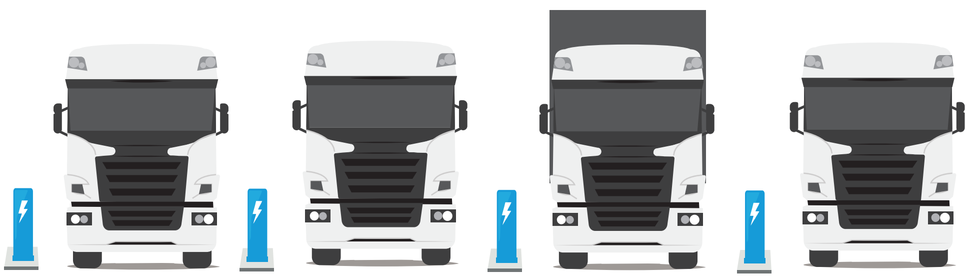


Introduction to Cenex

Cenex was established as the UK's first Centre of Excellence for Low Carbon and Fuel Cell technologies in 2005.

Today, Cenex focuses on low emission transport & associated energy infrastructure and operates as an independent, not-for-profit research technology organisation (RTO) and consultancy, specialising in the project delivery, innovation support and market development.

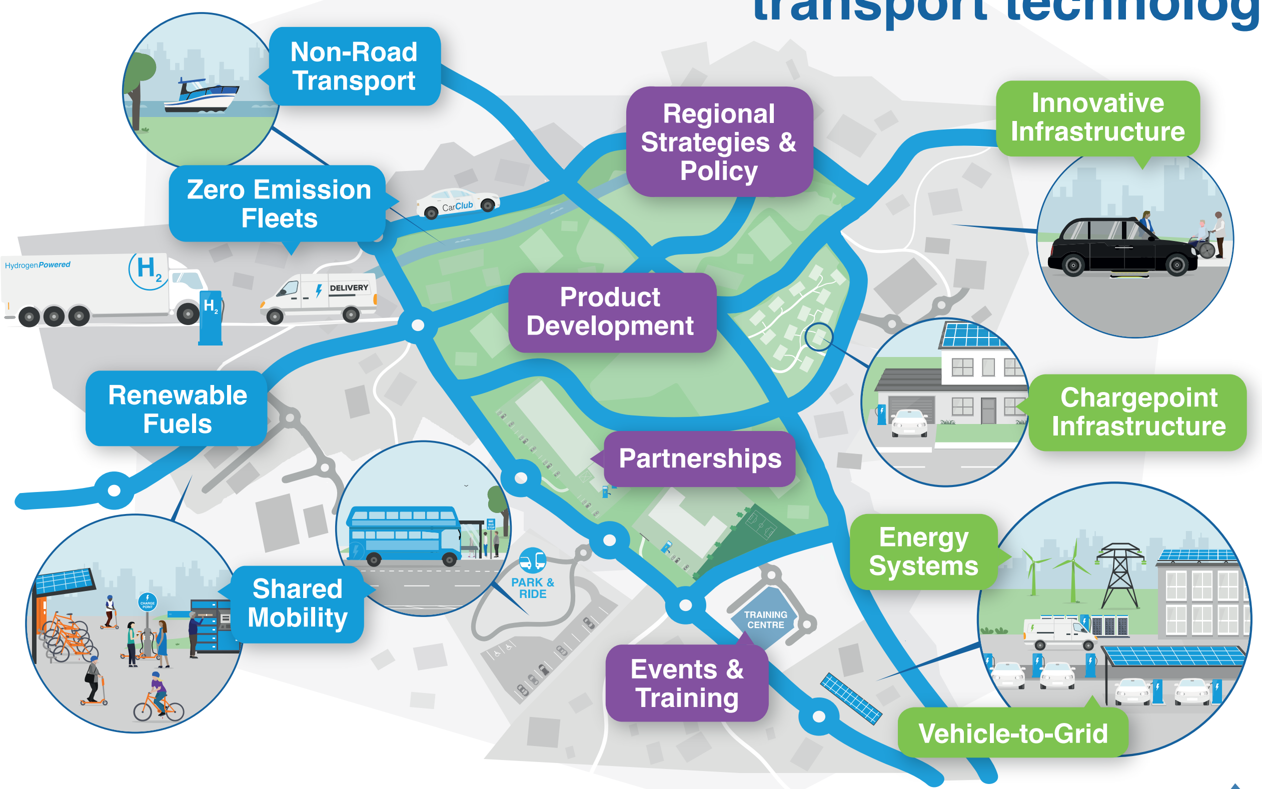
We also organise Cenex-LCV, the UK's premier low carbon vehicle event, to showcase the latest technology and innovation in the industry.

Our independence ensures impartial, trustworthy advice, and, as a not-for-profit, we are driven by the outcomes that are right for you, your industry and your environment, not by the work which pays the most or favours one technology.

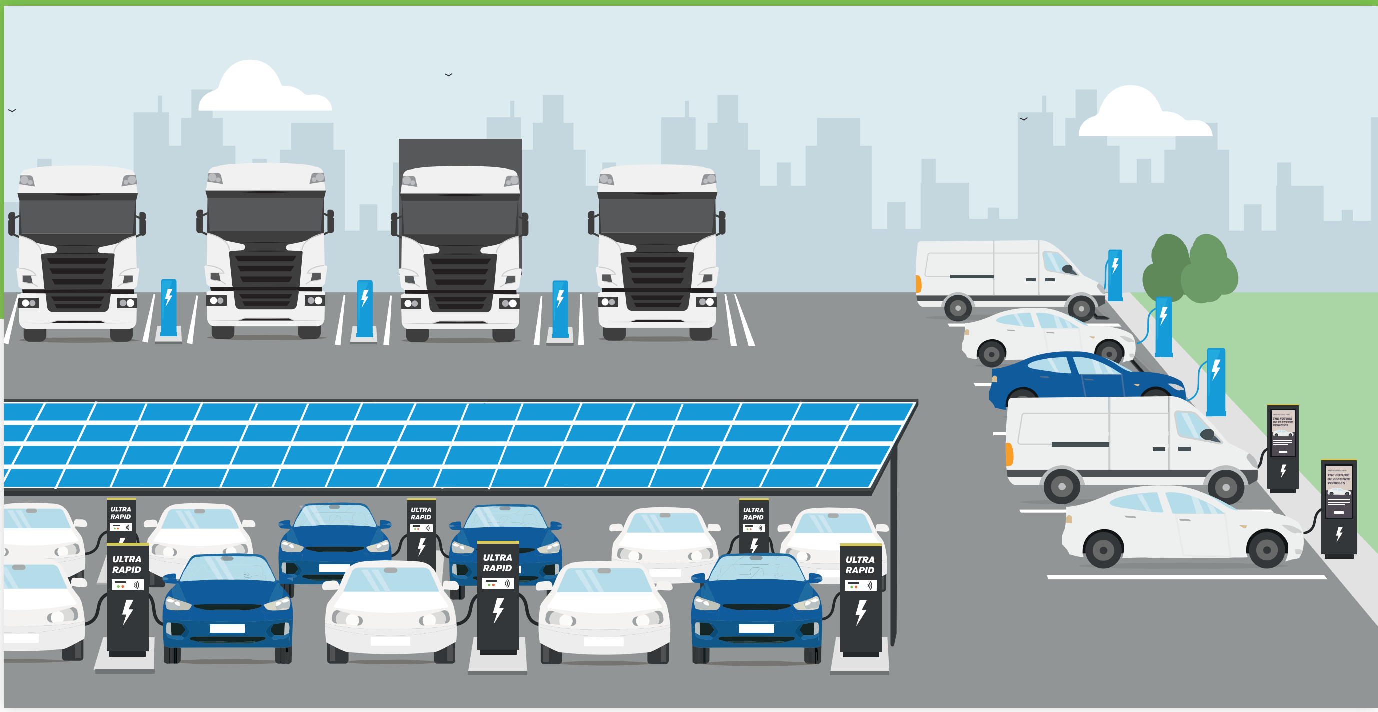
Finally, as trusted advisors with expert knowledge, we are the go-to source of guidance and support for public and private sector organisations along their transition to a zero-carbon future and will always provide you with the insights and solutions that reduce pollution, increase efficiency and lower costs.

To find out more about us and the work that we do, visit our website: **www.cenex.co.uk**

Map your route to zero emission transport technologies



Executive Summary



Within our engagement with industry, Cenex has seen a need for a way to quickly assess the need for Electric Vehicle Infrastructure for depot-based fleets, and the impacts that the transition to EVs may have on the existing electricity demand. In response to this Cenex has developed the EIGER (Energy Import or GEneration and Reserve) model.

The EIGER model provides bespoke assessments based on:

- A site's current fleet vehicles and usage patterns
- A plan for electrification of the fleet
- Existing on-site electricity demand
- Current electricity import constraints

This paper demonstrates the capability of the EIGER model, and how it could be used to assist in planning the transition to EVs for depot-based fleets. We use a fictional site – Nottsborough Depot as a case study for illustration.

Electric Vehicles and Environmental Policy

The UK has a legally-binding commitment to reach net-zero carbon emissions by 2050 and Electric Vehicles (EVs) are a key part of the plan to achieve this.

On 18th November 2020 the UK Government published a 10-point action plan for a "Green Industrial Revolution". In the accompanying documentation, the UK confirmed it would end the sale of new petrol and diesel cars and vans by 2030, ten years earlier than the UK's previous Industrial Strategy as laid-out in the Road to Zero publication. Furthermore, the sale of hybrid cars and vans that can drive a significant distance with no carbon dioxide coming from the tailpipe would be prevented from 2035 onwards.

This action is being implemented to tackle two environmental issues:

1. Environment and Climate Change

The UK's ten warmest years all occurred since 2002[1], reflecting a global heating which is considered "extremely likely" to have been caused by the increasing levels of carbon dioxide (CO_2) being emitted into the atmosphere[2]. The latest Committee on Climate Change report shows that transportation is now the worst-performing sector in the country and emissions have risen in four of the five most recent years[3]. According to the *Decarbonising Transport* report, "there is no plausible path to net-zero without major transport emissions reductions".

2. Society and Public Health

Poor air quality is now the largest environmental risk to UK public health[4]. The enquiry into the death of Ella Kissi Debrah listed air pollution as an official cause of death for the first time in the UK[5] and a recent study highlighted that a child living within 50m of a major road could have their lung growth stunted by up to 8% due to air pollution[6]. The transition to electric vehicles is key to improving air quality in urban areas and avoiding all of the direct and indirect health issues it can cause.

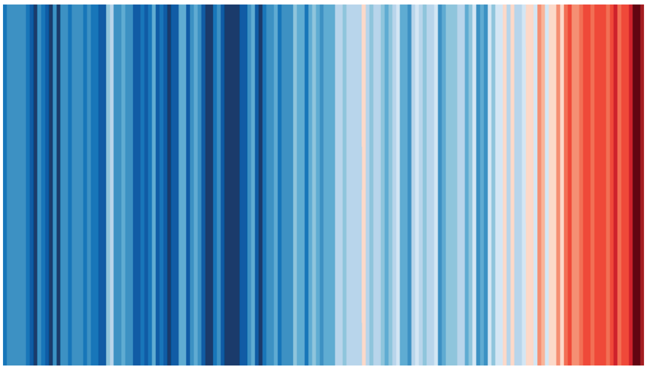


Figure 1: Warming Stripes, annual global temperatures from 1850-2017 [7]

[1] https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2019/state-of-the-uk-climate-2018, accessed 10th December 2020.
[2] https://www.ipcc.ch/site/assets/uploads/2018/02/ar5_syr_headlines_en.pdf, accessed 10th December 2020.
[3] https://www.theccc.org.uk/publication/reducing-uk-emissions-2019-progress-report-to-parliament/, accessed 10th December 2020.
[4] https://www.gov.uk/government/publications/health-matters-air-pollution/health-matters-air-pollution, accessed 10th December 2020.
[5] https://www.bbc.co.uk/news/uk-england-london-55146639, accessed 10th December 2020.
[6] https://www.kcl.ac.uk/news/living-near-a-busy-road-can-stunt-childrens-lung-growth accessed 9th December 2019
[7] Warming stripes I Climate Lab Book (climate-lab-book.ac.uk)

Fleet Depot Charging Assessment

With the these factors in mind, fleets across the UK are set to transition to zero emission over the coming years. Electric vehicles are going to provide the solution in most cases (with hydrogen potentially providing answers in some applications that are hard to electrify).

Some of the key questions that Cenex get asked are:

- Which vehicles in my fleet could be electrified now, and when could I electrify others?
- How many chargepoints and what types will I need?
- How many chargepoints can I install within my existing electricity import capacity agreement?
- Will installing PV on the roof of our site help at all?
- How much will all this cost?

To answer these questions requires specialist knowledge, and the answers are dependent upon the individual characteristics of the fleet and depot in question. One size does not fit all, and the best recommendations can come from understanding the specific requirements at the site in question.

Introducing the EIGER Model

The EIGER model, developed by Cenex, provides a relatively simple way to assess the impact on a depot of transitioning their fleet to electric vehicles.

The EIGER model produces outputs and insights for a site, which include:

- How many chargepoints are required, of what type, and the approximate cost
- An understanding of the peak import capacity required, when this occurs and under what conditions
- Energy profiles for each typical day for chargepoint type (and other assets such as PV and battery storage)
- Approximate annual energy costs and hardware capital costs
- Optimal sizes for additional assets (PV and battery storage) in order to reduce energy cost or import capacity

The model provides these outputs by analysing the behaviour of the assets (i.e. vehicles, chargepoints, demand, generation etc.) on each of the typical days types entered into the model. ***Figure 2*** shows the inputs used to enable this calculation.

One particularly important element of the inputs is the vehicle fleet data. The more accurate the data on when vehicles are on site and how many miles they do in a day, the better. However, a high level view is often sufficient to give useful results.

The model includes a database of electric vehicle equivalents to many internal combustion engine vehicles, so selecting an electric equivalent to the vehicles in a current fleet is easy.

The model produces charts and data sets to enable easy analysis of the results.

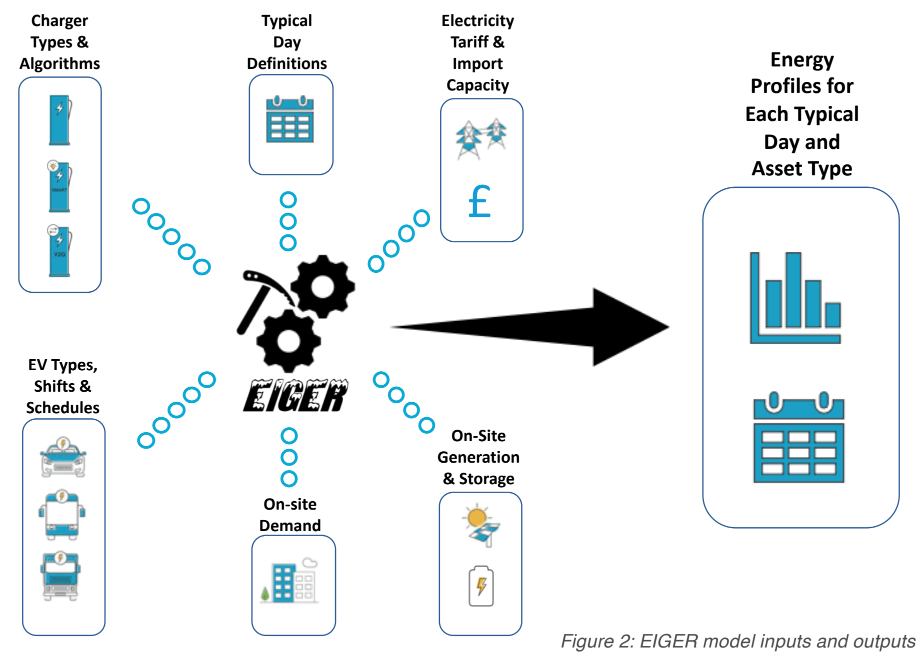


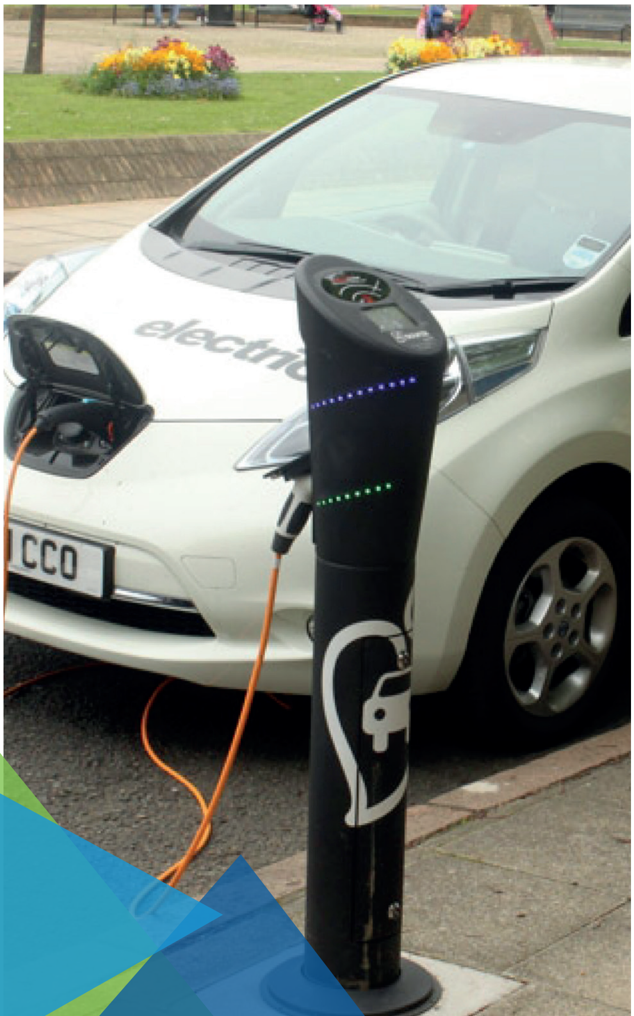
Figure 2: EIGER model inputs and outputs

Our Example Site

For our case study we consider a fictional site: Nottsborough Depot.

The depot is the base for almost 200 vehicles, including pool cars, vans and a rigid truck. The vehicles are used in a combination of early and late shifts, and are returned to the depot at the end of the day.

The depot has a current import capacity of 105 kW (i.e. 52.5 kWh per half hour). The site owner is looking to transition its entire fleet to electric vehicles over the coming years. They want to know if they will need to upgrade their network connection, and if the PV array they are considering will help reduce demand.



	Approximate Daily Mileage	Quantity
Small Car	15	5
Medium Car	15	8
4x4 Pickup	12	5
Minibus	26	1
Short Wheelbase Van (early shift)	46	12
Short Wheelbase Van (late shift)	39	12
Rigid Truck 2 Axles	46	1

Table 1: Vehicles based at Nottsborough depot

Analysis of Nottsborough Depot

What chargepoints are needed?

Once we assign all the vehicle on the site to electric equivalents, we find that 12 x Fast chargers (CP Group 1) and 2 x 50 kW DC chargers (CP Group 2) are sufficient to ensure each vehicle can plug in at the frequency it needs to meet its daily mileage. Given the daily mileage, only the rigid truck will need to plug in every day. The chargepoint utilisation for the peak day is shown in ***Figure 3***.

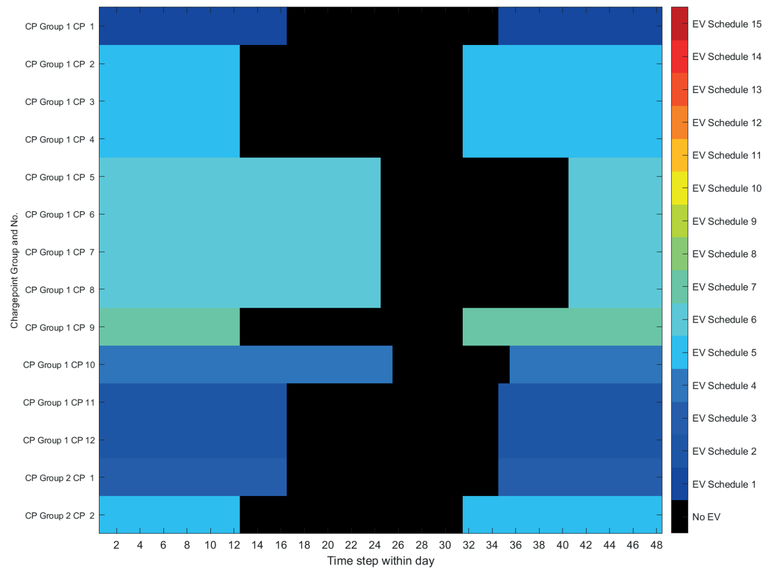


Figure 3: Chargepoint Utilisation for Peak day

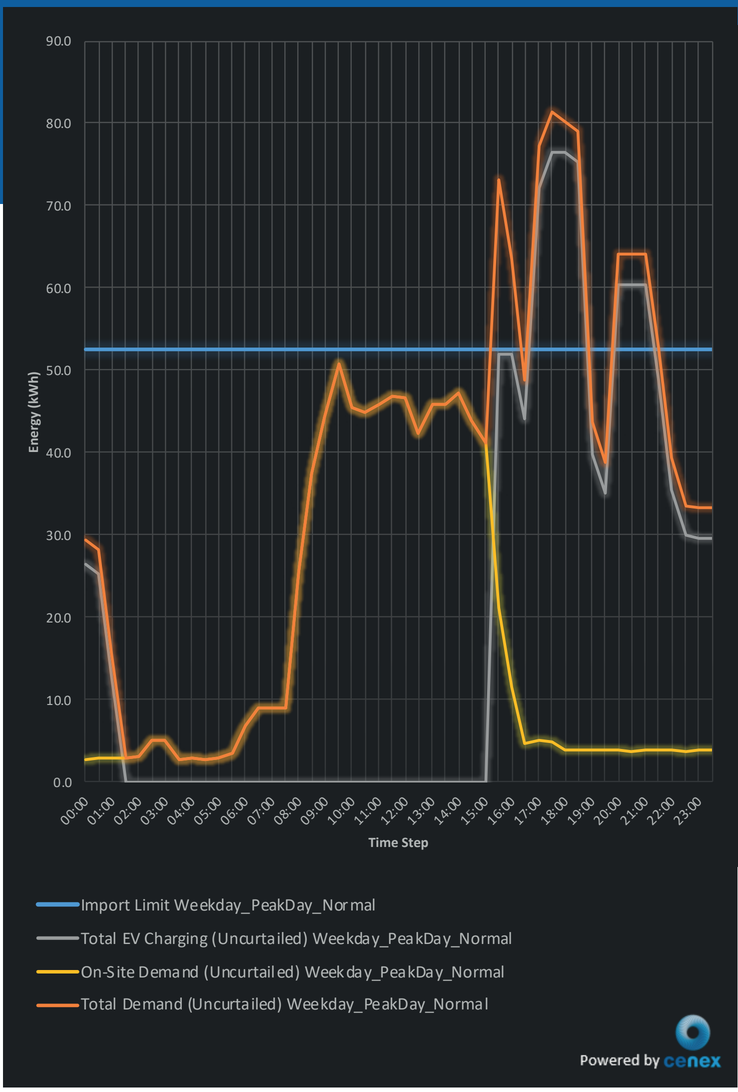


Figure 4: Unmanaged Charging on Peak Day

Does the import capacity need to be increased?

An analysis of the energy consumption on the Peak day ***(Figure 4)*** reveals that the import limit is breached by the unmanaged EV charging.

(Note that the charts show energy (not power) in kWh for each half hour of the day.)

Analysis of Nottsborough Depot

This can be compared with the results of applying a Smart algorithm to the charging, moving charging to periods of greatest import capacity headroom. ***Figure 5*** shows that with Smart charging we can stay below the import limit. Utilising smart charging at this site would therefore avoid a distribution network connection upgrade.

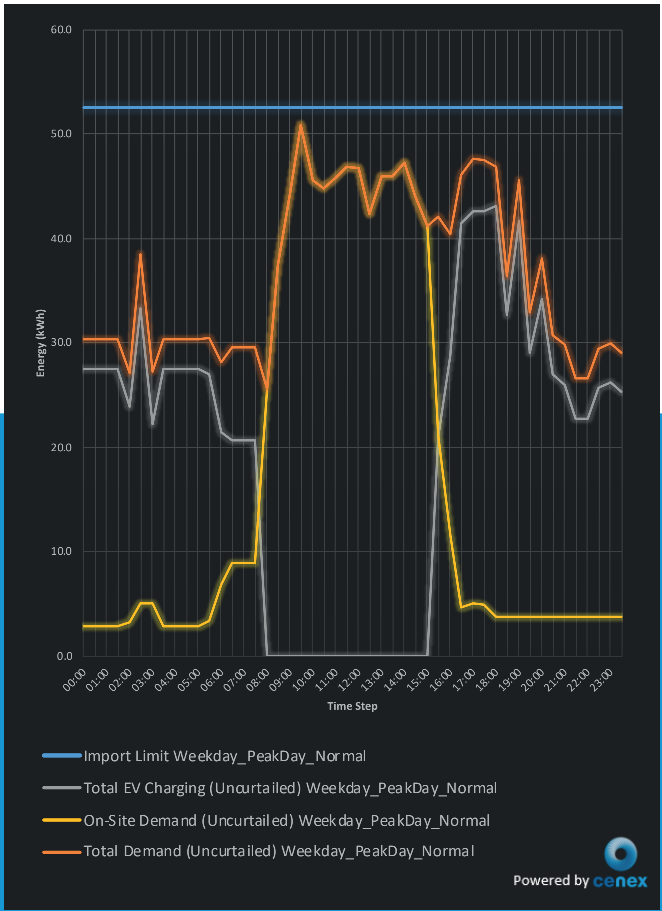


Figure 5: Smart Charging on Peak Day

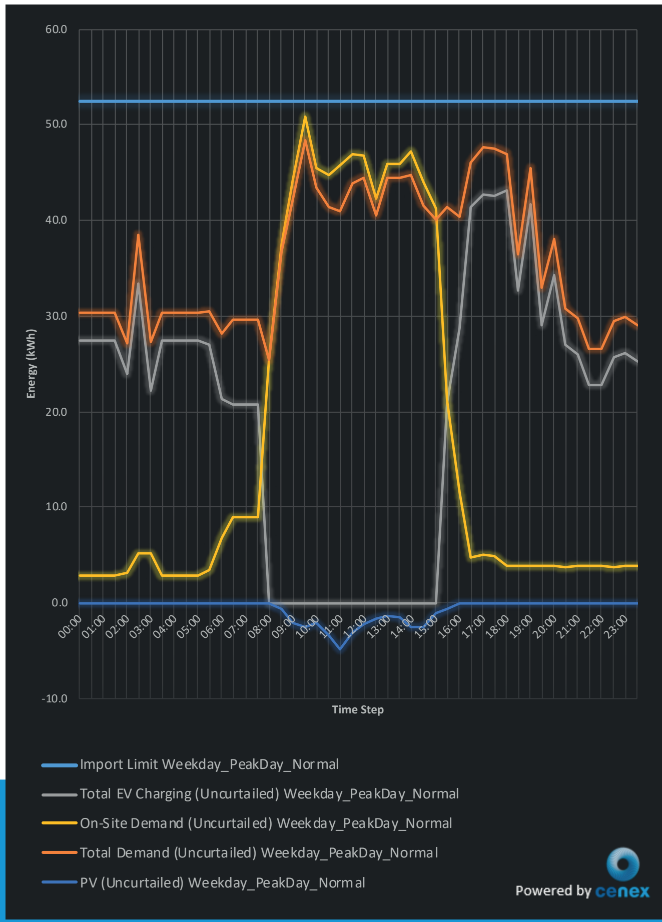


Figure 6: Smart Charging with PV on Peak Day

Will a Solar PV array help?

The site is also considering installing a 20 kW PV array on the roofs of the depot. We can put this into EIGER and see the impact on both the peak demand day (which occurs in the winter) and an average summer day.

Figure 6 and Figure 7 show that the PV reduces the peak demand only very slightly. Since the PV generation and the times when EVs need to be charge do not overlap, it does little to reduce electricity demand of EV charging.

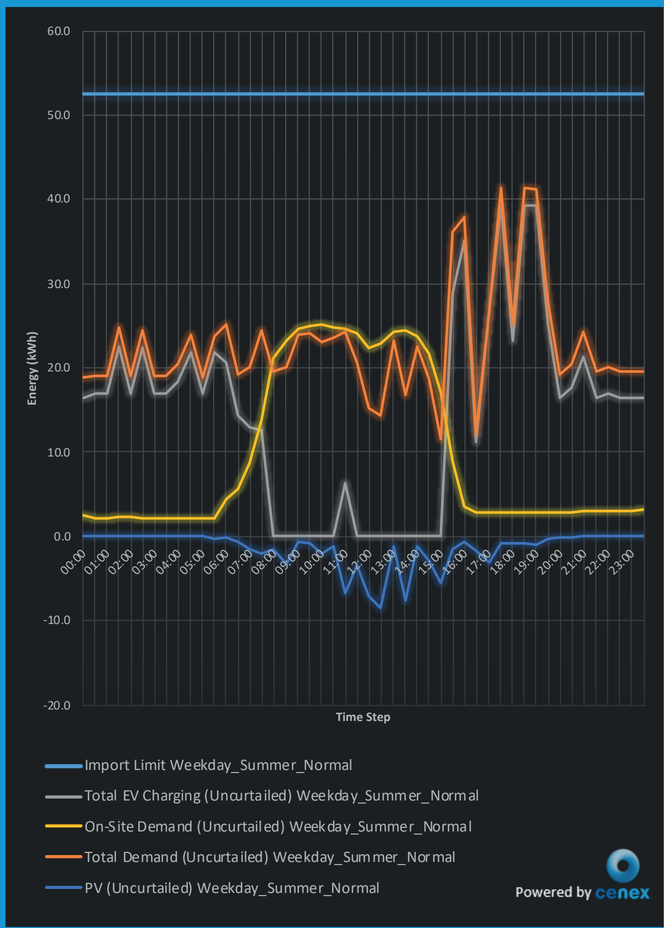


Figure 7: Smart Charging with PV on Summer Weekday

Analysis of Nottsborough Depot

Figure 8: Capital and Annual Energy Costs

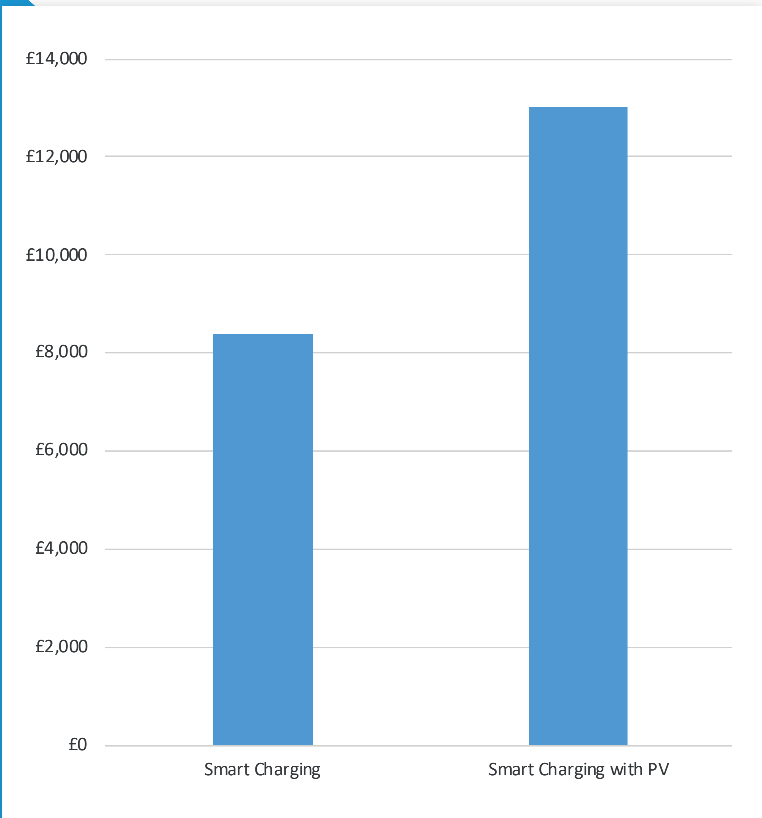


Figure 9: Approximate Annual Energy Cost Savings Versus Unconstrained Charging

What will it all cost?

But what about the costs of these measures? We can see in ***Figure 8*** the capital cost plotted with the reduction in the annual energy costs for each scenario. This shows a significant cost reduction through the implementation of Smart charging.

And in ***Figure 9*** we can see the approximate annual energy cost savings in each case. Smart charging returns around £8k with very little capital outlay, whilst the PV array will save a further £4,600 per year, which would equate to a payback period of just under 5 years.

Summary

Whilst this has been a fictional example, the inputs and assumptions used are realistic. The simple outputs presented can provide a clear direction for the site owners in order to further plan their transition to a zero-emission fleet.

How We Can Help You

Cenex is available to provide consultancy services using our EIGER model to provide a rapid analysis of the dynamics of your site.

Alternatively, you may wish purchase a licenced copy of the model to perform your own analysis if you have many sites to assess. However, the assessment of on-site charging needs is only one part of the services that Cenex offer. There are many other aspects of the transition to electric mobility that Cenex as a not-for-profit organisation can offer expert, independent advice, and assistance for.

Fleet Support

Helping clients to assess the suitability of low emission vehicles within their fleet.

- Fleet Review – identify the most cost effective and operationally suitable low emission vehicles for your fleet with a low emission fleet replacement strategy.
- Fleet Advice Scheme – aimed at SMEs with commercial vehicle fleets, one of our experts will provide long term strategic support and advice through a structured programme in your transition to low emission.
- Vehicle Trial Support – independently verifies alternatively fuelled vehicle trials to enable large scale implementation and ensure fuel, emission and energy savings
- Zero Emission Vehicle Training – prepare your organisation to plan for the low emission road ahead.

Infrastructure Strategy

Higher level strategy work for public private and third sector organisations to understand their current transport systems, the challenges faced and a roadmap for change:

- Vehicle and infrastructure baselining for both fleet and private vehicles.
- Review of existing and upcoming national policies and the impact on transport.
- Benefits of the transition to Electric Vehicles including emissions and air quality.
- Stakeholder engagement and creation of a local vision and roadmap.
- Market review of the available charging hardware and solutions.
- High level business case for chargepoint networks.
- Valuation of other mobility solutions and how this integrates with EV charging.

How We Can Help You

Implementation

Planning and support with implementation of strategy:

- Deployment planning for different types of charging infrastructure and locations -such as hubs, Park & Ride, destination, and workplace charging – alongside on-street residential charging to meet different user needs.
- Chargepoint ownership model analysis.
- Distribution Network Operator (DNO) engagement and grid connection evaluation.
- On-street charging site selection and depot site surveys.
- Project public communications management.

Procurement Support

- Industry engagement and events.
- Bid writing for Research & Development (R&D) grant funding opportunities for innovative charging technologies.
- Authoring of technical specifications for public procurement.
- Supplier scoring scheme creation, bid evaluation and supplier interviews.
- Installation design review and technical auditing.

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