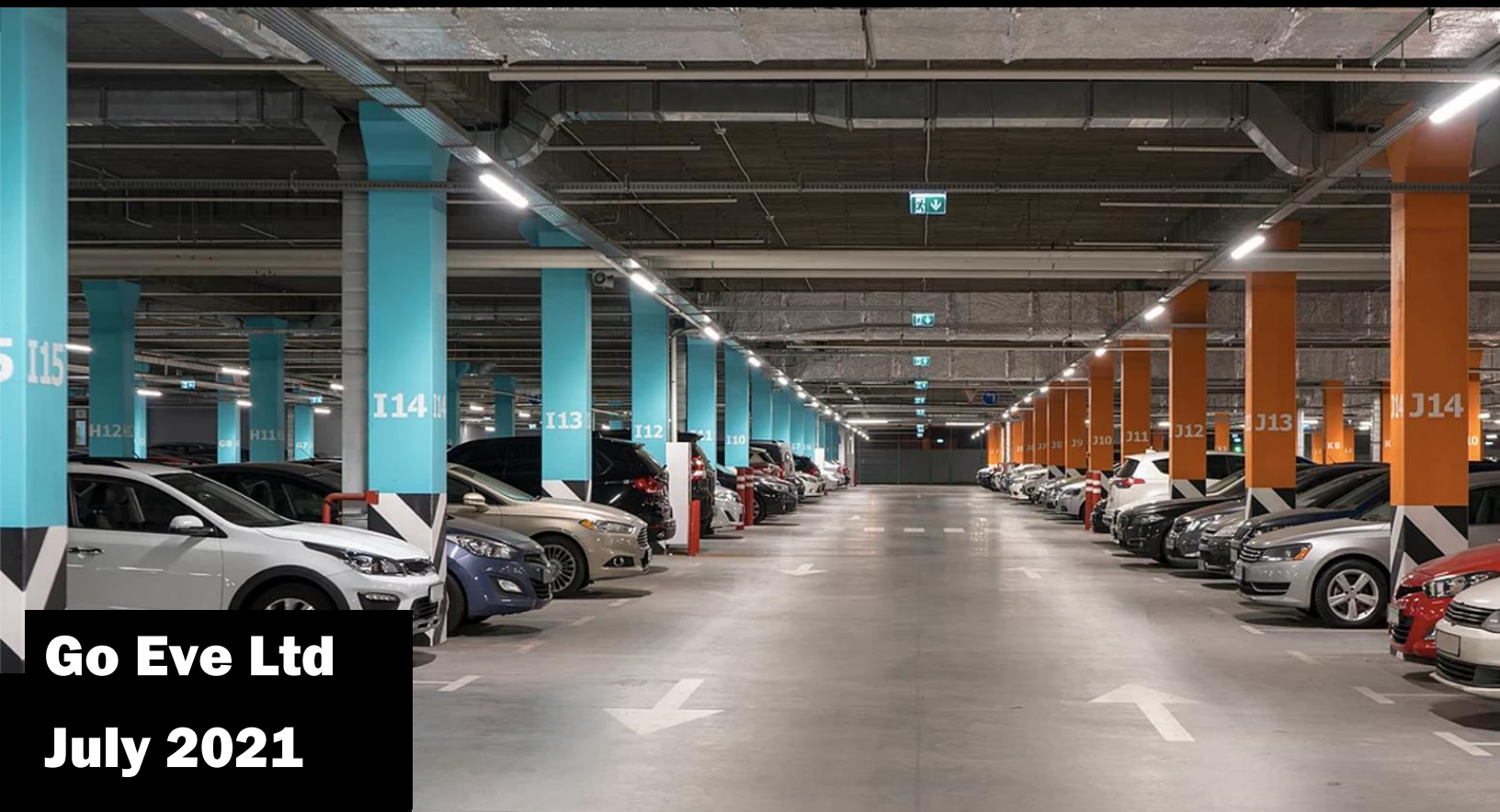


# DockChain

## Scaling EV charging



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# DockChain

Scaling EV Charging

The EV transition is happening.  
By 2025 or 2030 or sooner, petrol and diesel are done.  
It is clear what individuals can do, but what if you are a fleet operator? Charging a hundred or ten thousand cars is different!

01

**Market Trends - Cars**

## Market Trends - Cars

The market share of EVs is increasing. Especially in markets like Norway where they now represent a majority of new car acquisition. But even in countries like the UK, the sales of electric cars tripled from 2019 to 2020<sup>(SMMT)</sup>. Apart from national bans on new ICE sales after 2025 or 2030, cities are increasingly restricting access for petrol and especially diesel cars. These restrictions are certain to increase, putting many cities off-limits. (See [here](#)) This is an inconvenience for an individual car-owner, but easy enough to solve. It is a huge issue for fleet operators.

02

**Market Trends - Charging**

## Market Trends - Charging

While it has been lagging in some countries, the charging market in most European countries is catching up with places like the Netherlands. Again, the range of solutions for individual car owners is increasing quickly. Domestic charging is generally easy unless you live in an apartment or terrace. The occasional charge at a commercial charger won't break the bank and [both the EU](#) and now the UK are investing in charging infrastructure so you won't get stranded. But the needs of fleet operators are different. Tens or thousands of cars?

03

**Market Trends - Electricity**

## Market Trends - Electricity

Time of day pricing and price volatility have long been a feature of commercial and industrial electricity markets. And that is set to increase. Domestic users can take advantage of low nighttime or even low lunchtime rates for their single car and its predictable use pattern easily. But what if you are charging 500 cars, or 50,000 cars? What if you need to keep costs down but operational flexibility up?

---

*A fleet of electric cars is very different to a fleet of petrol cars. You can fill a petrol car quickly. An electric car too, nowadays. But you can also fill an electric car slowly. Or fill it when no-one is there. And you can fill it at home. And you can re-sell the electricity.*

*DockChain solves the problems of charging large electric fleets.*

---

DockChain is an innovation of University College Dublin and Imperial College London, working with Go Eve Ltd. DockChain is based on decades of experience in the car fleet market (rental, sharing), in the wholesale electricity market, and in the operation of large-scale IT systems.

# DockChain

Scaling EV Charging

## 04 Fleet Charging - Operations

### Fleet Charging - Operations

Charging a large fleet of electric cars in a cost-effective way is a challenge.

If you are far from home base, then getting a good price from a large charging point operator is key. Shell, BP, are all in the market now and provide corporate cards. You can get them through us too. But it is much more cost effective to charge at your own price and your own pace.

And if you work with DockChain you can do that without having expensive and inflexible infrastructure, without having to keep moving cars to get to the available charge points. And with the ability to charge – or not – depending on the cost of electricity.

## 05 Fleet Charging – Site Infrastructure

### Fleet Charging – Site Infrastructure

Whether small local lot, airport, or large office park, charging lots of cars can be a real problem.

## 06 Fleet Charging – Buying Power

DockChain allows provision of a charger for every parking slot without breaking the bank, with full control of charge status for each car, and with all the security you need.

### Fleet Charging – Buying Power

From getting large amounts of power onto your site in the most cost-effective way, to integrating intelligence on power prices with your vehicle operations, DockChain and Go Eve bring it all.

Long inside knowledge on fleet operations, wholesale electricity, and data systems at scale – combined with a patented charging system. Focused on fleet operators.

---

*Fleet operators must consider the operational challenges and opportunities of the EV transition. There are significant challenges, but there are opportunities too. DockChain's origins are in fleet charging and in providing multi-car charging infrastructure at low cost.*

---

# DockChain – The Innovation

The idea behind DockChain is simple – to make EV charging infrastructure flexible and cheap – right up to being extensible in an ad-hoc manner.

If you need another EV charging point, just plug in another DockChain unit. As simple as that.

This benefit applies for all sorts of situations.

- 1** Houses with more than one car, where the DockChain gives you the ability to charge all the household's cars from one charge point.
- 2** Apartment buildings, where installing a charge point for every parking place would be hugely expensive and where you want to be able to charge for the electricity used.
- 3** Office parking lots, where you want to offer the ability to charge a car in every parking place and to have control over who can charge, who can charge for free, etc.
- 4** Rental car fleet parking lots, where you need to be able to charge cars without causing multiple car movements, where you want to be able to ensure that electricity only goes into your cars, where you want to prioritize particular cars based on bookings, etc.

There is a competing possibility for all these situations.

Install a full charge point and power cable for every car or parking place. That is the right approach if you are building a dedicated charging location – like BP or Shell- where cars come and go and the whole purpose of the location is to charge cars quickly.

It is an overly expensive approach everywhere else.

DockChain's patent-pending innovation is to allow one cable and a series of small and cheap daisy-chained boxes to charge multiple cars. If you want to charge several cars over time, that is easy. If you need to charge one car as a priority, that is easy. If you want to charge all the cars in turn, that is easy.

DockChain boxes communicate with each other in a local network so that they charge the cars according to whatever priority you decide. They also communicate with the back office to ensure only authorized vehicles can charge, or to override the charging priority, or to respond to periods of high or low energy costs.

While the optimal setup depends on the specific location, there are some 'typical' situations.

# Domestic

It is a luxury if you have your own house and driveway, and even more if you have multiple EV in the driveway.

But how do you charge them all without having to install more chargers or having to move the cars all the time. Dinnertime conversation should not be dominated by who has to move their car so that someone else can charge.

DockChain is the solution.

Connect a DockChain unit to the house's charging point and you can charge two or even three cars off one charge point.

And if you want you can get a summary of who charged and how much, which could be useful in a house-share or if you want to allow your neighbor to charge too.

You can also enable the box for other people and charge them for the electricity they use while you are – say – away at work.



Figure 1 One house, multiple cars

If you are in a house with more cars, just daisy-chain another box. Ultimately you are limited by the power of the house's charge point and AC circuit, but unless you are trying to charge multiple cars from empty to full every night that is not a problem. And you can always prioritize a particular car if you need to.

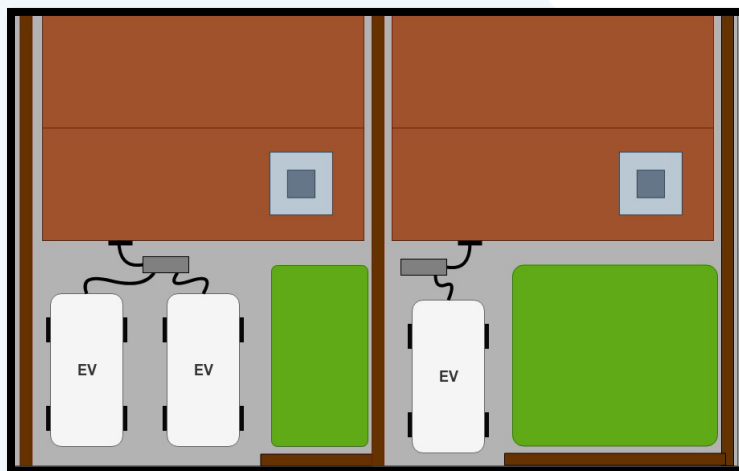


Table 1 DockChain at private house

One DockChain unit can be used for one house or along several houses.



# Apartment Building

Apartment building owners are increasingly faced with a problem.

Their tenants are going to have electric cars. And people want to charge their cars at home.

Existing tenants are already asking for solutions. Worse, the value of apartments is negatively affected in the future if there is no charging for EVs.

Not every space needs a charger yet. They will eventually, but not yet.

Worse, installing a cable and charging point for every parking place is expensive. And while giving free electricity to one or two cars might be ok, supplying everyone with free power could get expensive – particularly if they charge at peak times.

DockChain is the solution.

Most apartment buildings already have moderate levels of 3-phase power, but they are usually not wired up in the same way as a large commercial car park.

With DockChain you can install a small cheap box for every space that you want provision with power, and you can add additional boxes easily over time. Each box connects to the others, so cars can charge in sequence, or a particular car can be prioritized.

The number of parking bays you can effectively enable even off one 42 kW AC chain is – typically – 10 to 20 in the apartment context. Most cars are parked at home most of the time. That is a big saving for a building with 20 spaces. It is a really big saving for a building with 200 spaces. And – as the building owner – you can have full control of billing, or you can let Go Eve do it all.

And if you need more power or more cars on one chain, we can look at the DC chains. Perfectly possible with a generic AC/DC transformer and often suitable for larger buildings.



Figure 2 Underground Car Park - Apartment Building

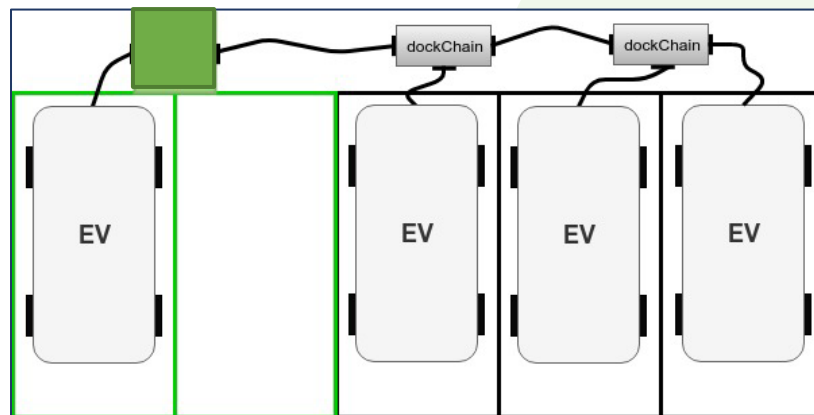


Figure 3 DockChain extending charging to selected apartment parking bays

# Office Car Park

Office car park owners have a similar issue to apartment building owners. Lots of spaces, lots of people with electric cars - usually parking all day - and a need to support electrification without spending lots of money.

DockChain is the solution.

With car parks, the flexible approach is to enable a few bays at a time. So, blocks of 10 or 20 parking spaces. Cars generally charge for the whole day.

And if one specific car needs to be prioritized, that is easy too.

One electrical connection and 20 economical DockChain units and you are sorted. And when you need more, you install more.

Again, most office parks already have moderate 3-phase power so this can be done in a cost-effective and phased way. And if/when more power is needed on the site as-a-whole, DockChain's expertise helps there too.

Most of the initial installations at these locations are AC, but we increasingly encourage office parks to go straight for DC.

One of the critical aspects in these retrofit applications is the small size of the DockChain units and the reduction in the cabling compared to provisioning of normal charge points.

Less construction cost, less obstruction of walkways, etc.



Figure 4 Office Car Park

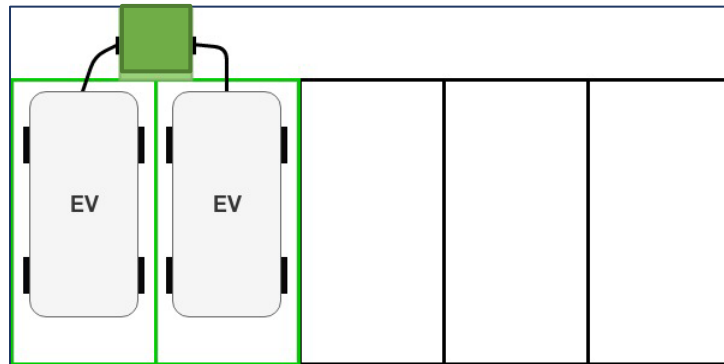


Figure 5 Typical charge point installation - most bays unserved

For most car park operators, they imagine that the only way to extend charging functionality to multiple bays is to install multiple independent charging points.

That is only true if you are setting up a charging facility, which most locations are not. The requirement is that cars can charge while they are parked.



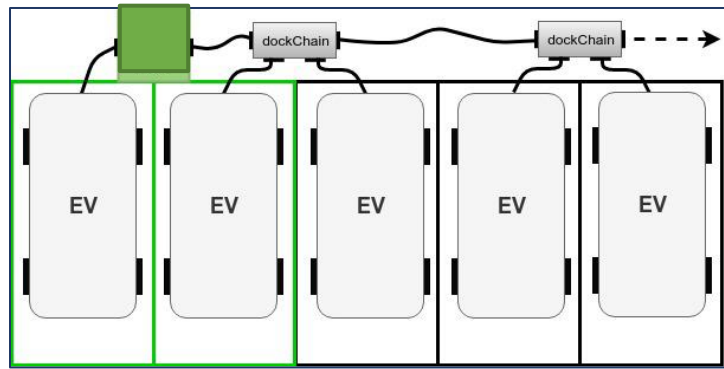


Figure 6 DockChain enables cost-effective charging at all bays.

A chain of DockChain units can enable charging in many more bays without installation of additional charging points or multiple additional cables.

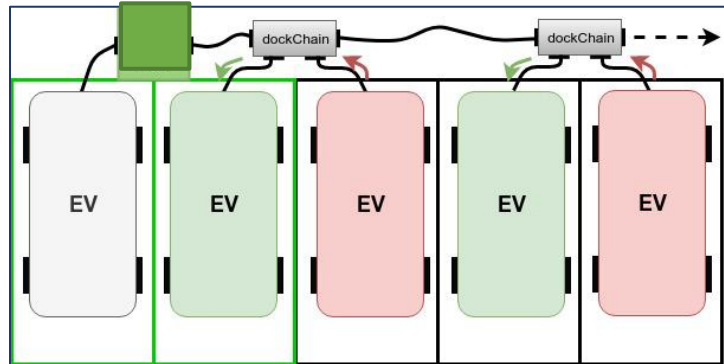


Figure 7 DockChain future proofs the system by supporting V2G from the beginning.

The chain can be extended in either direction from the power source. Only one cable lay is required and in many contexts it can be laid under a cable protector or along adjacent side walls.

## Fleet – Particularly Rental Fleet

Many corporate fleet owners' needs are adequately addressed by the office car park solution outlined above. Their cars typically travel during the day and can park and charge at their own locations overnight. Some even park at the driver's own home.

But even if they park at the office, the number of cars in their fleet is typically small compared to the number of parking spaces that are needed at the office during the day, so it is already a good solution.

If they do not own their own car park, all it takes is a quick discussion with the building or car park owner on cost sharing and they are sorted.

Or, again, they can both agree to let Go Eve handle it all for them.

Rental fleet owners are different.

Rental fleet owners operate lots of cars.

Large rental fleet companies can have thousands or tens of thousands of cars in countries like the UK or Germany – and have hundreds of thousands globally.

They also operate from dedicated locations that are packed as full of cars as is operationally practicable. Cost efficiency and operational flexibility are key. Managing power purchase and managing power efficiently can be critical to end-of-year financial results too.

DockChain is the solution.

Whether an urban location where access to moderate 3-phase power is easy, or an airport location where very high-power circuits are accessible, DockChain's patent-pending solution is the way to go.

Additionally, as mentioned above, the DockChain units support V2G from the beginning. This may be important for large fleet operators, since their overall power draw and potential supply could be extremely valuable in volatile energy markets.

Depending on the site size, rental fleet operators may want to use an AC chain or a DC chain on a site, or both, depending on the availability of site power and the operational needs.

We are also investigating the option of a dual-mode AC/DC chain<sup>1</sup>.



*Figure 8 Rental Fleet Locations - Charging*

---

<sup>1</sup> This option is still in R&D as it requires changes to the cable spec.

# Chain Solutions

In any application, the fundamental innovation and product remains the same. That is a chain of networked and intelligent but electrically very simple DockChain units. That electrical simplicity is what makes the boxes cheap and robust and is the core of the patent-pending technology.

That electrical simplicity really is the core of the innovation. Each unit tells the upstream unit that it is a car and tells each downstream unit that it is a charge point. As a result, standards compliance is maintained along the chain, and all the established car charging standards and protocols are used to maintain safety.

Each unit negotiates with the other units in the chain to decide which one is charging a car, and the correct power is delivered from the upstream unit.

That is the patent-pending innovation in both AC and in DC chains.

Only in the AC/DC chain (under development) do we build in a little more complexity, with the AC in one set of conducting lines and the DC simultaneously in the others.

## AC Chain

With an AC chain, you can connect as many cars as you like – each to a box - and charge each in turn up to the maximum AC speed of the cars. Additionally, if there are cars with very low battery levels, you can charge up to three at a time at 7kW. Then, when the battery is slightly charged go back to full power on each car in turn.

While many cars are still limited to 11kW on AC, that is improving, with cars capable of 22kW on AC coming on to the market in 2021 and 2022. In any case, DC is a better solution for most applications.

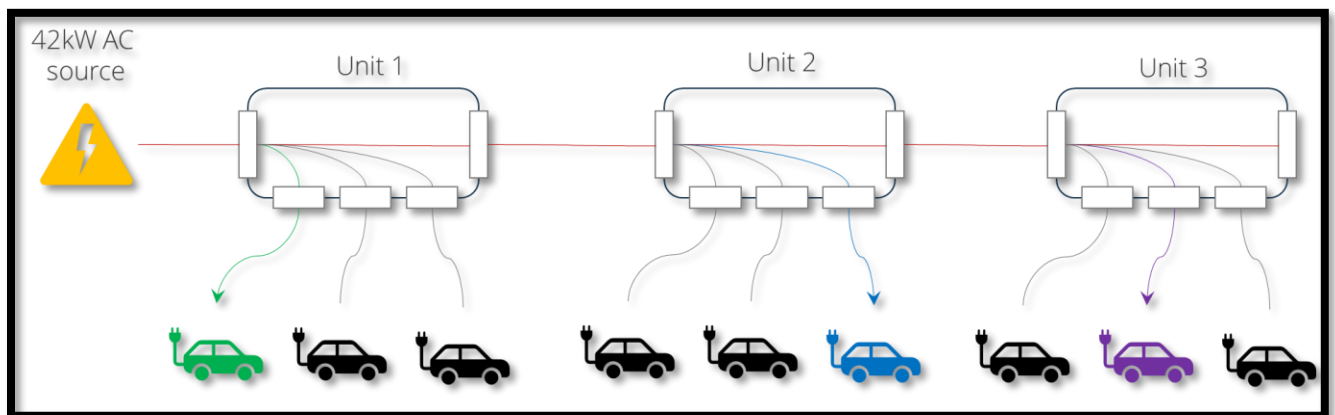


Figure 9 AC Chain - 9 cars active

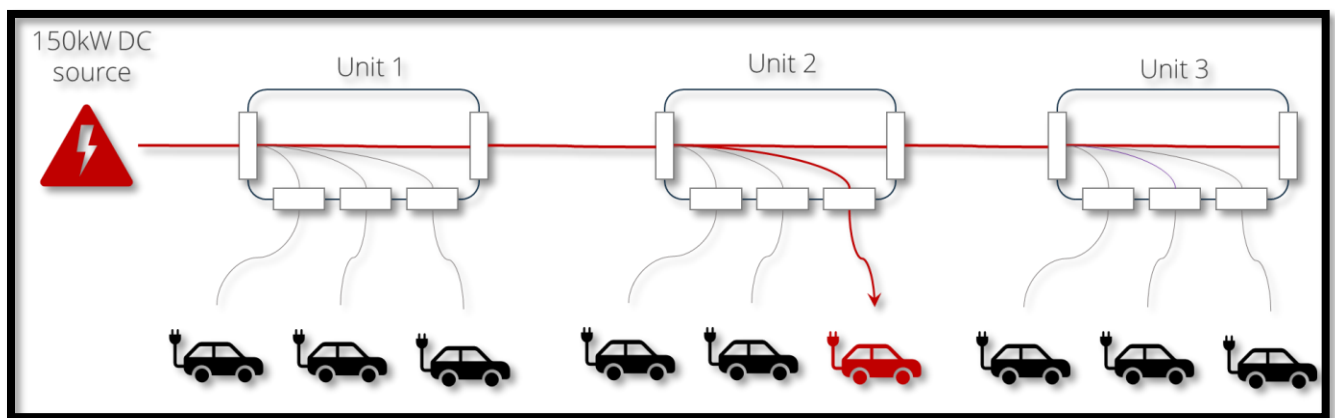
In the above scenario, any of the 9 cars can charge at their peak AC speed, which is increasing with each generation of cars. Alternatively, if slow speed charging is required, any three can charge at 7kW. Additional units and cars can be connected, depending on the situation. Nine are shown simply as an illustration.

## DC Chain

Similarly, with a DC chain, you can connect as many cars as you like and charge each in turn up to the limit of the car. While there are still cars with DC charging speeds of 50kW, it is increasingly 80-100kW or more, so most cars can charge in approximately 30 minutes. And that time is improving with each generation of cars.

Overnight, that lets you charge ~20 cars on a single 100-150kW DC chain running from 10pm to 8am. And if the cars return to base with residual charge, it can be feasible to have a single DC line and 40 cars docked and operationally available.

Additionally, as operational requirements change, it is possible to run additional power through a chain or to any point on an existing chain to speed charging or to extend the chain further.



*Figure 10 DC Chain - tens of cars can be effectively connected*

With the DC line, faster charging is possible – again dependent on the site power. The maximum DC charging speed is considerably faster than with AC, enabling many more cars to be charged in operationally meaningful windows. For instance, with cars charging at 100kW DC, 20 cars could charge 50kWh each between 10pm and 8am.

That is enough to bring most cars on the market from “operationally empty” to “operationally full”. All unattended. And the prioritization of charging can be set based on the morning’s bookings.

With DC installations, we recommend looking at the use of generic AC/DC transformers on site. These are considerably cheaper than integrated AC/DC car units, and likely to have longer useful lifespans.

Additionally, when a site’s overall power is adjusted, these units are easy to re-use on other locations or – since they are standard industrial units – to sell on.

# Web interface

Whether at the level of an individual household or at a large rental facility, most users will want to be able to control their DockChain unit remotely.

This can be done via a mobile app to authorize or administer a single unit, but for multiple units the web interface is needed.

This allows fleet and multi-site users to carry out the following functions, as they need.

- Monitoring of charge status for all connected vehicles
  - o Charge level & time to complete charging.
  - o Place in queue
  - o All at both single site and higher level
- Analytics/Reporting of charge and cost
  - o By site, by car, by vehicle class, by time-of-day, Etc.
- Setting priority for individual vehicle charging
  - o Drag and drop or simple selection button.
- Monitoring/alerting on local electricity prices
  - o Default actions can be set depending on price, e.g., “all off”.
- If the fleet telematics system is available, we can also enable “double entry accounting” for all charging sessions so that fraudulent charging can be prevented.
- We can also integrate so that an individual car can be prioritized direct from the operational reservation system, wherever it is located.



Figure 11 Admin Interface

# Service Options

All DockChain units can be bought as standalone “charge point extenders” without needing to use any online services. The basic function of connecting 2 cars to a DockChain unit and charging both cars requires no online connection. If not provisioned in the back-end systems, the unit will not require any authorization and will make no record of charging.

## Basic Service

Any DockChain unit can be provisioned on basic services by registering the unique unit code on the DockChain portal. Basic service includes a few simple elements.

- Ability to restrict to specific users (authorization by mobile app)
- Consumption reporting per user over time
- Low monthly fee

## Parking Site Service

A parking location, or locations, can be enabled online with site specific and overall service. This includes.

- Ability to restrict specific sites or specific units to specific users.
- Consumption reporting per user and unit
  - Collection/billing can be done by Go Eve or left to the site owner.
  - Collection is an additional service.
- Priority change to set any unit to #1 in the charge queue (usually with an additional fee paid back to the other users)
- Basic time-of-day and electricity price logic, e.g., “all off between 4pm and 7pm” or “all off if price higher than \$x/kWh”. Can be overridden by a user – usually on payment of additional fee.

## Fleet Service

For rental fleet owners, there are several additional services.

- Ability to require dual authorization fobs for any charge (e.g., car fob and employee fob)
  - Various authorization schemes are possible, as required, to eliminate use of site electricity into non-owned cars.
- Integration with booking system to allow priority charging of any car at any location.
- Integration with operator financial system to send post-rental charging information for “refill” charging.
- Alerts on electricity price, requiring site office over-ride to continue charging.
- All analytic level data available by API or batch file transfer.



## Power Optimization Services

We can build several additional power management services if required. These are always customer specific, based on country, in-country locations, time-of-day usage patterns, head-office financial targets, etc.

Options available include but are not limited to.

- Alerts to operational sites on high power costs
- Turn-down or turn-off services based on custom electricity price signals.
- Integration with national grid signals for Demand Response or Frequency Response Services (see information on the UK Grid's schemes [here](#))
- The DockChain units are all compatible with V2G services, for futureproofing.
- Custom business-rules for charging, e.g., priority by vehicle class
- Etc.

Our use of modern IT infrastructure makes such additional functions cost-effective to deploy.



# Technical Specifications

## Specification – AC Chain

Input	<ul style="list-style-type: none"> <li>- For 22kW chain: 3-phase 32Amps per phase</li> <li>- For 42kW chain: 3-phase 100Amps per phase</li> </ul>
Output	<ul style="list-style-type: none"> <li>- Up to 42kW AC – limited by vehicle.               <ul style="list-style-type: none"> <li>o Or 3 x 7 kW if slow charging</li> </ul> </li> </ul>
Operating Temperature Range	-30 to +50°C
Waterproofness	- Up to IP67, depending on housing.
Certification	<ul style="list-style-type: none"> <li>- CE Certified</li> <li>- OCPP, OCPI, as required</li> </ul>
On-Chain communication	- RF on wire
Base communication	- Wi-fi to Ethernet and/or NB-IOT
Connections	- Type 2 Mennekes
Housing	<ul style="list-style-type: none"> <li>- FRP</li> <li>- Steel housings can be used if required.</li> <li>- See examples below.</li> </ul>
Authorization methods	<ul style="list-style-type: none"> <li>- RFID/NFC</li> <li>- Mobile application</li> <li>- Web panel</li> </ul>
On box interface	<ul style="list-style-type: none"> <li>- Status LEDs.</li> <li>- RED: Connected – not authorized</li> <li>- ORANGE: Connected – authorization in progress</li> <li>- GREEN: Connected – authorization successful</li> <li>- BLUE: Charging currently active</li> </ul>
Expected Life	- 10 years
Software	- OTA Upgradeable

Table 2 Specification - AC Chain

## Specification – DC Chain

Input	<ul style="list-style-type: none"> <li>- For 50kW chain: 3-phase 100Amps per phase</li> <li>- For 130kW chain: 3-phase 200Amps per phase</li> <li>- For 275kW chain: 2 x 3-phase 200Amps per phase</li> <li>- For up to 350kW: <ul style="list-style-type: none"> <li>o 2 x 200 Amps &amp; 1 3-phase 100 Amps per phase</li> </ul> </li> </ul>
Output	<ul style="list-style-type: none"> <li>- Up to 350kW DC – limited by vehicle</li> </ul>
Operating Temperature Range	-30 to +50°C
Waterproofness	<ul style="list-style-type: none"> <li>- Up to IP67, depending on housing.</li> </ul>
Certification	<ul style="list-style-type: none"> <li>- CE Certified</li> <li>- OCPP, OCPI, as required</li> </ul>
On-Chain communication	<ul style="list-style-type: none"> <li>- RF on wire</li> </ul>
Base communication	<ul style="list-style-type: none"> <li>- Wi-fi to Ethernet and/or NB-IOT</li> </ul>
Connections	<ul style="list-style-type: none"> <li>- CCS</li> </ul>
Housing	<ul style="list-style-type: none"> <li>- FRP</li> <li>- Steel housings can be used if required.</li> <li>- See examples below.</li> </ul>
Authorization methods	<ul style="list-style-type: none"> <li>- RFID/NFC</li> <li>- Mobile application</li> <li>- Web panel</li> </ul>
On box interface	<ul style="list-style-type: none"> <li>- Status LEDs.</li> <li>- RED: Connected – not authorized</li> <li>- ORANGE: Connected – authorization in progress</li> <li>- GREEN: Connected – authorization successful</li> <li>- BLUE: Charging currently active</li> </ul>
Expected Life	<ul style="list-style-type: none"> <li>- 10 years</li> </ul>
Software	<ul style="list-style-type: none"> <li>- OTA Upgradeable</li> </ul>

*Table 3 Specification DC Chain*

### Specification – AC/DC Chain (under development)

Input	<ul style="list-style-type: none"> <li>- For 50kW chain:               <ul style="list-style-type: none"> <li>o 3-phase 100Amps per phase</li> </ul> </li> <li>- For 130kW chain:               <ul style="list-style-type: none"> <li>o 3-phase 200Amps per phase</li> </ul> </li> <li>- For 275kW chain:               <ul style="list-style-type: none"> <li>o 2 x 3-phase 200Amps per phase</li> </ul> </li> <li>- For up to 350kW:               <ul style="list-style-type: none"> <li>o 2 x 3-phase 200 Amps per phase</li> <li>o Plus 1 x 3-phase 100 Amps per phase</li> </ul> </li> </ul>
Output	<ul style="list-style-type: none"> <li>- Up to 42kW AC – limited by vehicle.</li> <li>- Up to 350kW DC – limited by vehicle.</li> <li>- Both at the same time.</li> </ul>
Operating Temperature Range	-30 to +50°C
Waterproofness	<ul style="list-style-type: none"> <li>- Up to IP67, depending on housing.</li> </ul>
Certification	<ul style="list-style-type: none"> <li>- CE Certified</li> </ul>
On-Chain communication	<ul style="list-style-type: none"> <li>- RF on wire</li> </ul>
Base communication	<ul style="list-style-type: none"> <li>- Wi-fi to Ethernet and/or NB-IOT</li> </ul>
Connections	<ul style="list-style-type: none"> <li>- CCS</li> </ul>
Housing	<ul style="list-style-type: none"> <li>- FRP</li> <li>- Steel housings can be used if required.</li> <li>- See examples below.</li> </ul>
Authorization methods	<ul style="list-style-type: none"> <li>- RFID/NFC</li> <li>- Mobile application</li> <li>- Web panel</li> </ul>
On box interface	<ul style="list-style-type: none"> <li>- Status LEDs.</li> <li>- RED: Connected – not authorized</li> <li>- ORANGE: Connected – authorization in progress</li> <li>- GREEN: Connected – authorization successful</li> <li>- BLUE: Charging currently active</li> </ul>

*Table 4 AC/DC Chain (under development)*

## Specification – Housings

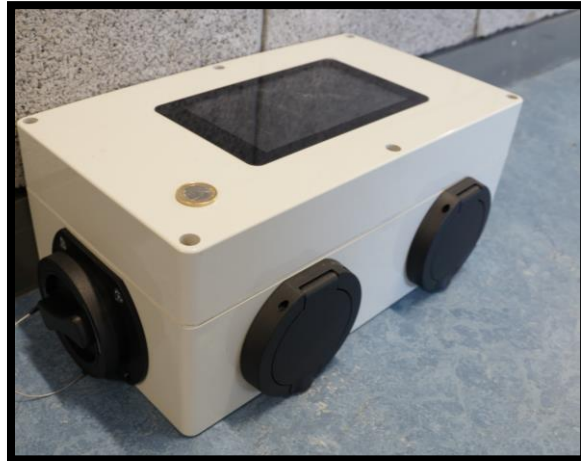
Input	<ul style="list-style-type: none"> <li>- 3-phase power as needed for the installation</li> </ul>
Output	<ul style="list-style-type: none"> <li>- Up to 350kW DC</li> <li>- Limited by vehicle</li> </ul>
Operating Temperature Range	-30 to +50°C
Waterproofness	<ul style="list-style-type: none"> <li>- Up to IP67 with FRP housings</li> <li>- Up to IP55 with stamped steel housings</li> </ul>
Certification	<ul style="list-style-type: none"> <li>- CE Certified</li> </ul>
Connections	<ul style="list-style-type: none"> <li>- CCS or Type 2 Mennekes (all standard units)</li> <li>- Main cable is secured inside the unit</li> </ul>
Housing	<ul style="list-style-type: none"> <li>- FRP</li> <li>- Steel housings can be used if required.</li> <li>- See examples below.</li> </ul>
Authorization methods	<ul style="list-style-type: none"> <li>- No penetrations (steel housings have recessed tap-pads) <ul style="list-style-type: none"> <li>○ RFID/NFC</li> <li>○ Mobile application</li> <li>○ Web panel</li> </ul> </li> </ul>
On box interface	<ul style="list-style-type: none"> <li>- Status LEDs.</li> <li>- RED: Connected – not authorized</li> <li>- ORANGE: Connected – authorization in progress</li> <li>- GREEN: Connected – authorization successful</li> <li>- BLUE: Charging currently active</li> </ul>

*Table 5 Housing Specifications*

## ***Housing Options***

Given that our main customers require lots of units, the physical design of the DockChain unit is obviously customizable to customer needs.

The basic unit is an FRP box approx. 200mm x 400mm x 150mm, or a bit smaller than a cavity block. It can be secured on the ground, on a wall or on a post, depending on the need.



*Table 6 Pre-production DockChain Unit<sup>2</sup>with Euro coin for scale*

Housings can be made of stamped steel if required. Waterproofness is not as good with steel units, which are recommended only for elevated installation. Branding is available for all unit types.

Consumer AC units, with lower durability requirements, can be produced in very different form factors, as shown here.



*Figure 12 Consumer AC DockChain unit on the ground between two cars*

We are also negotiating with several national manufacturers to provide local supply and maintenance, using a reference design and license.

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<sup>2</sup> The top screen has been replaced with LED Status lights in production units.



## Specifications – IT Systems & Hardware

Hosting	<ul style="list-style-type: none"> <li>- EU<sup>3</sup> Servers Google Cloud &amp; Azure, Multi-AZ</li> <li>- All data encrypted in transit and at rest</li> </ul>
Front end	<ul style="list-style-type: none"> <li>- Web type interface</li> <li>- HTML5 and JavaScript</li> <li>- Progressive web app compatible with all mobile and desktop devices<sup>4</sup></li> <li>- Also, installable packages for Windows and Android (Microsoft Store and Play Store)</li> </ul>
Back End	<ul style="list-style-type: none"> <li>- APIs running on NodeJS and Golang.</li> <li>- Database on Cockroach DB, Google Firestore and Azure CosmosDB (for different use cases)</li> </ul>
Security	<ul style="list-style-type: none"> <li>- SSO access with 1hr timeout (or less)</li> <li>- Role based access.</li> <li>- Customer administered lists of valid users, RFID cards, etc.</li> </ul>
Integrations	<ul style="list-style-type: none"> <li>- REST APIs</li> </ul>
Communications	<ul style="list-style-type: none"> <li>- NB-IOT/LTE-M and/or Wi-Fi and Ethernet from DockChain units               <ul style="list-style-type: none"> <li>○ See NB-IOT/LTE-M global coverage <a href="#">here</a>.</li> </ul> </li> </ul>
Devices	<ul style="list-style-type: none"> <li>- CE compliant electrical circuitry and components</li> <li>- Microcontrollers running comms and logic.               <ul style="list-style-type: none"> <li>○ Mostly STMicroelectronics (see BOM)</li> <li>○ OTA Upgradeable firmware</li> </ul> </li> </ul>

*Table 7 Specification - IT Systems*

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<sup>3</sup> While EU servers are likely to be always good for UK and US customers, the reverse may not be always true.

<sup>4</sup> Analytics screens will be visible but not very usable on small mobile devices



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