

INTERNAL



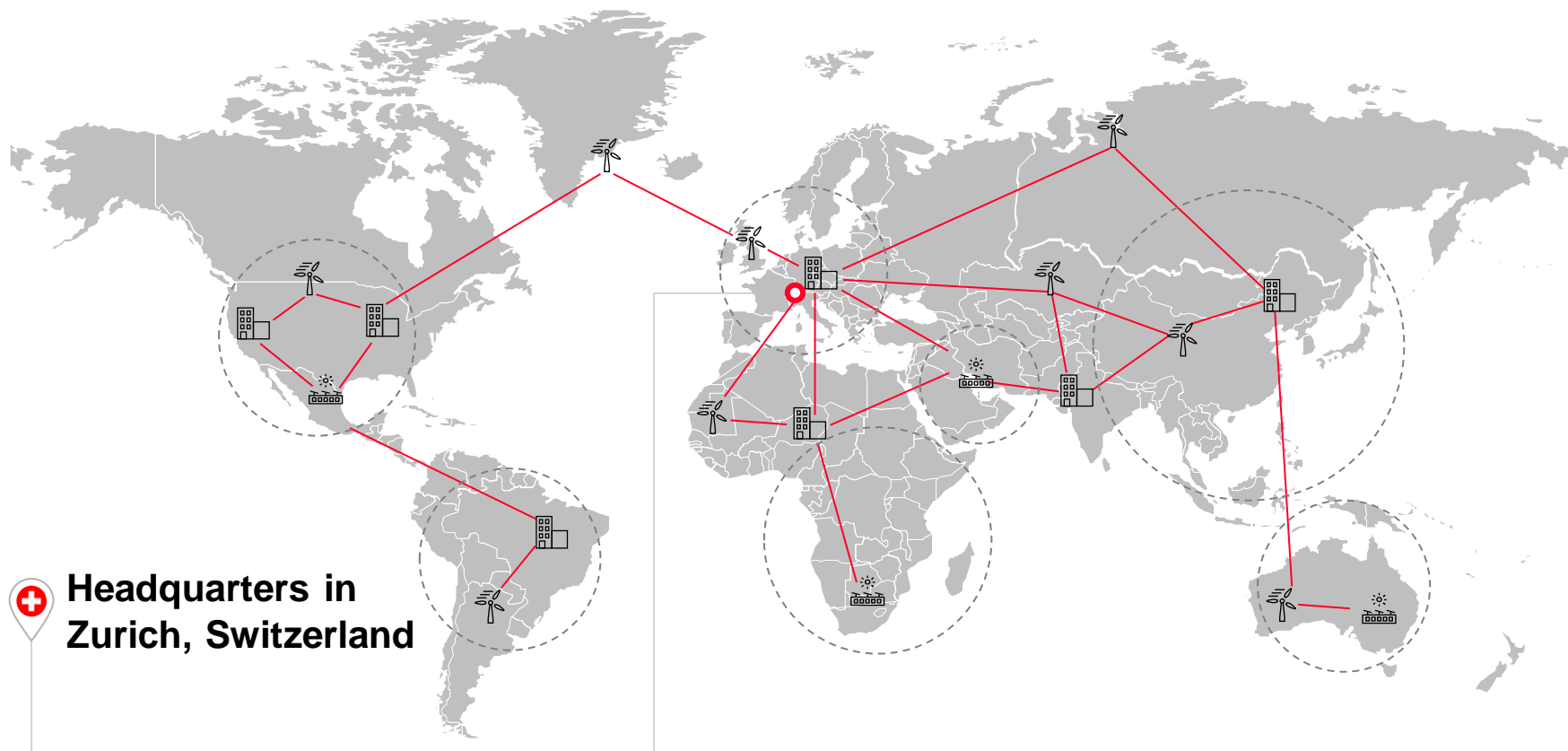
Grid-eMotion™

Overview



Hitachi Energy

Advancing a sustainable energy future for all



38,000 employees

90+
countries with
200 offices

~250
years' heritage
combined

5,500
sales employees
& field engineers

2,000
engineers &
scientists in R&D

Four Business Units

**Grid
Automation**

**High Voltage
Products**

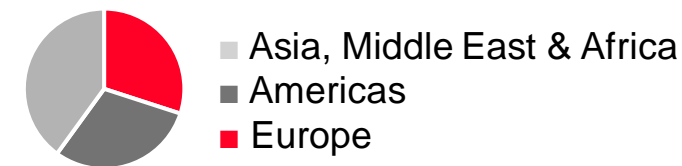
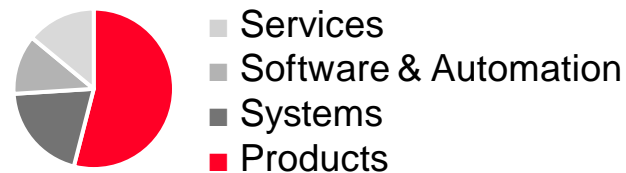
Grid Integration

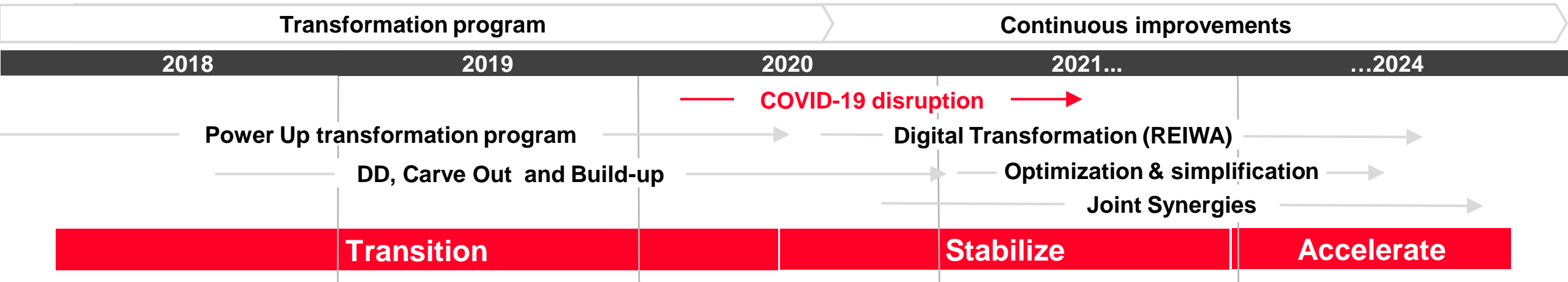
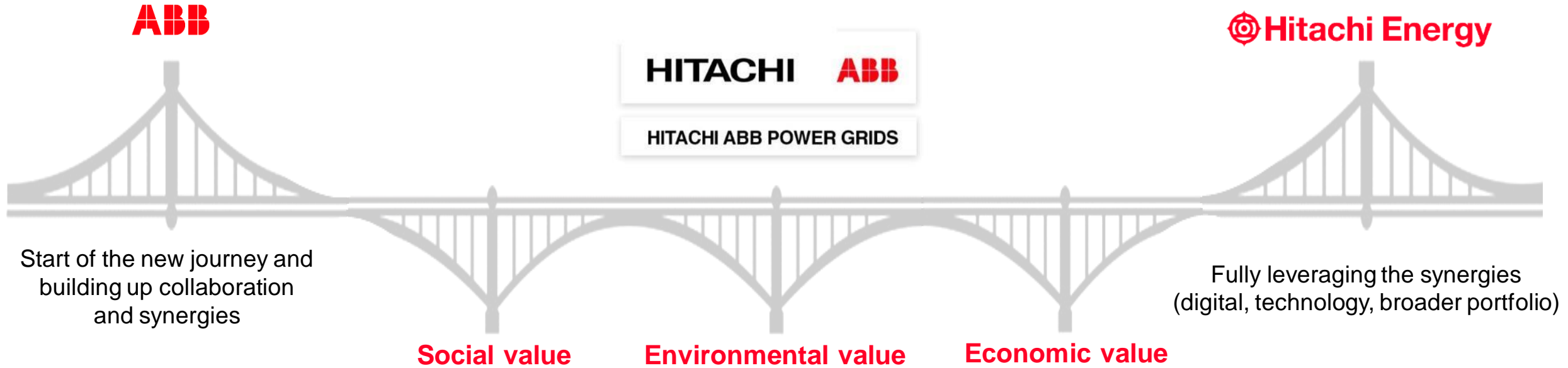
Transformers

Customers

Offering

Geographies







Hitachi Energy – eMobility

Market and Positioning

Our Value Proposition

We accelerate the future of smart mobility with revolutionary EV charging solutions. By decarbonizing the transport sector we contribute to a cleaner, healthier and more affordable future for everyone

Our Core Customer

We provide grid-to-plug solutions for public transportation and commercial vehicles. Our customers are transport infrastructure companies, that provide clean and efficient electrified commuting services and OEMs that use our solutions to enhance their offering

Our Competences

We specialise in developing, delivering and servicing **core technology packages** for eMobility applications across all continents leveraging our expertise in power electronics products and system projects. We deliver added value through our digital platform and services

01

Sustainability



Increased **awareness of climate change**, **CO₂ footprint reduction** and its **social impact** driving a global net-zero society and the **need for decarbonization**

02

Policy & Regulation



Government commitments towards **electrical transportation** and **shift from fossil-based to renewable power** generation – acceleration packages post COVID-19

03

Economy



Conversion towards **electrification** to improve **energy efficiency** and to **reduce Total Cost of Ownership (TCO)** amid reducing **dependence on the oil market** and lowering exposure to oil price volatility

04

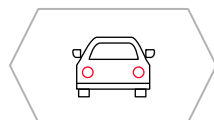
Operation



Innovative **digital solutions** and **power electronics** offer an opportunity to **transform traditional operations** into future-proven solutions

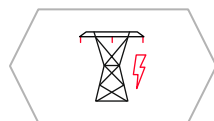
e-Mobility will need a lot of clean electricity ...

“ e-Mobility is about the leading the **energy-mobility nexus** ”



100 millions¹

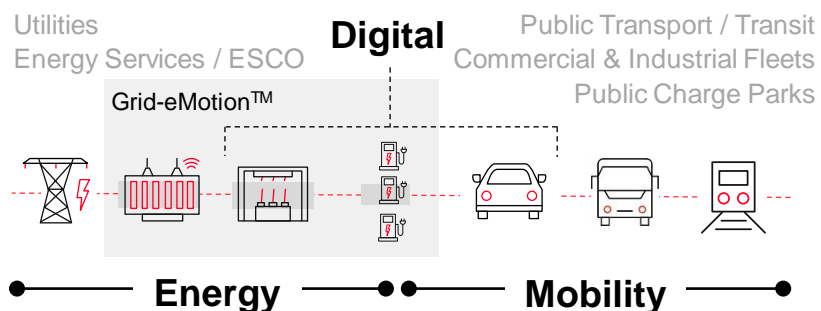
EV (cars, buses, trucks, trains, etc.) in our roads and tracks by 2030



500 TWh¹

Yearly electricity needs to power all EVs by 2030

“ e-Mobility will **scale-up with the convergence** of mobility actors and energy systems experts ”



... and scales of projects is growing

Until today

Going forward

Few	~ # cities with EV operating	Many
1-10	~ # EV per project	100-1'000
1-10	~ # EV chargers per project	100-1'000
0.1-10	~ MW power grid connection	10-100



Grid-eMotion™ Fleet

Large-scale EV charging

Grid integration projects at depots and terminals involving conventional or prefabricated substations including transformers, switchgear, rectifiers, chargers, pantographs, auxiliaries, smart digital or service solutions.



Grid-eMotion™ Flash

Flash-charging on- route

World's fastest flash-charging connection technology that lets cities reduce the environmental pollution of their transit systems without affecting passenger capacity or journey times.



Grid-eMotion™ Rail Battery-powered trains

Charging stations for battery-powered trains in DC and AC. Our solutions are designed for urban, suburban, regional train and people mover segments.



Small scale

<1MW charging ... <10 charging points

- Historically driven by home and work chargers, with power scale-up over time

Medium scale

1-2 MW charging ... 10-20 charging points

- Primarily driven by Commercial fleets & Transit with centralized charging system approach

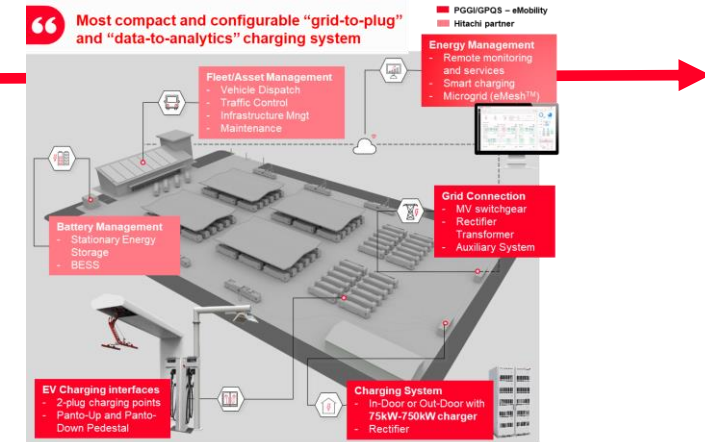
Large scale

2+ MW charging ... >20 charging points

- Move towards comprehensive charging hubs including integrated digital platform, energy storage, local power production and mega-watt charging (MCS)

7kW 22 kW AC 22 kW 50 kW 180kW 360kW

Hitachi Energy



22 kW – AC and DC charging

Up to 350 kW – DC mainly
DC Fast Charging (CCS)

Up to 4.5 MW – DC only
Megawatt Charging (MCS)

2019

2021

2023

2025

2027

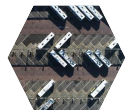
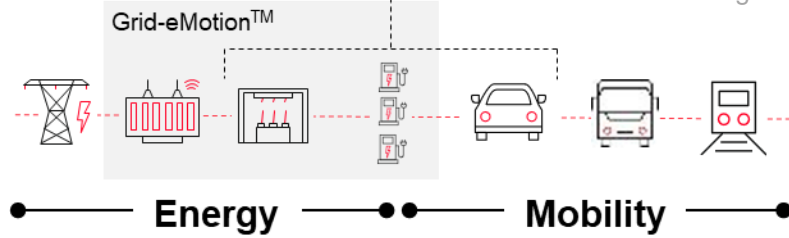
Hitachi Energy – eMobility

Large-scale charging solution

Utilities
Energy Services / ESCO

Digital

Public Transport / Transit
Commercial & Industrial Fleets
Public Charge Parks



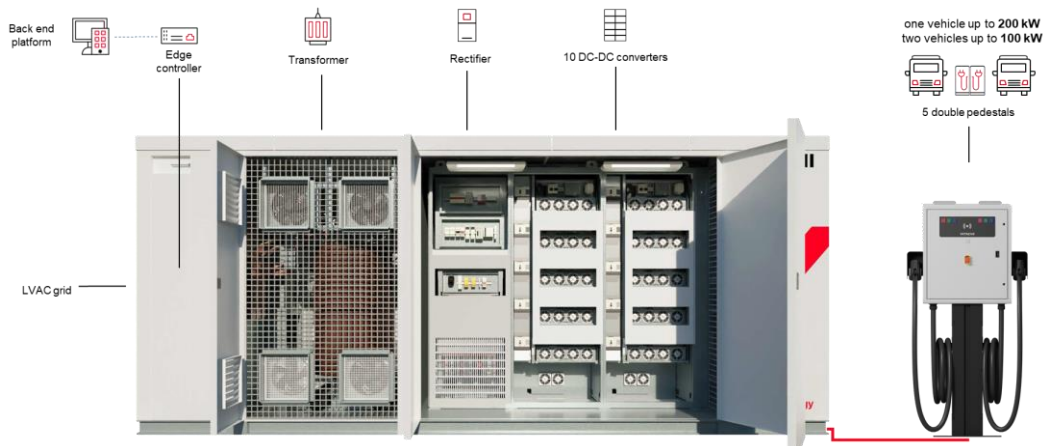
Grid-eMotion™ Fleet

Large-scale centralized charging at depot / terminals



Grid-eMotion™ Flash

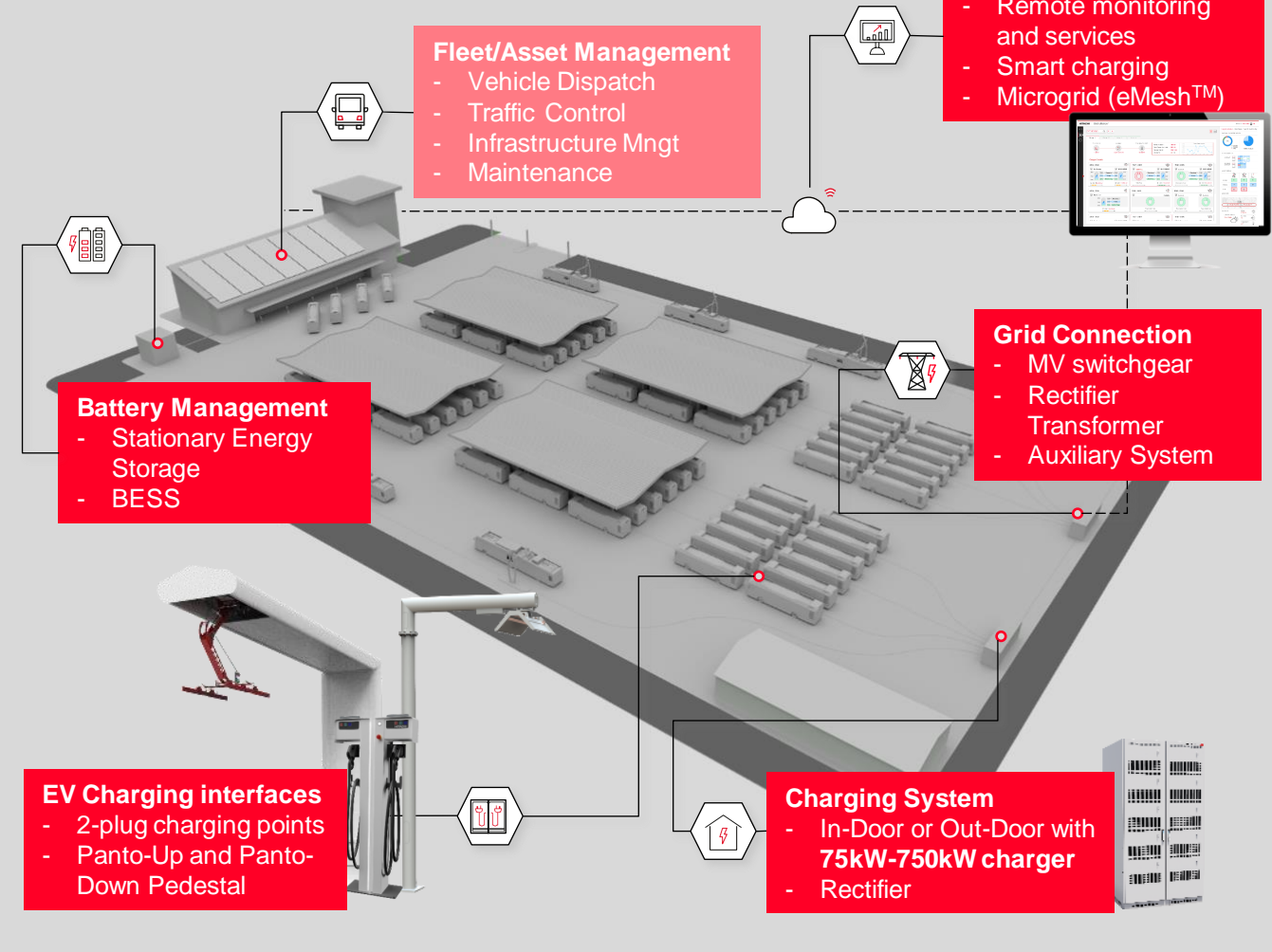
Ultra-fast and high-power charging on-route



Grid-eMotion™ Fleet

Most compact and configurable “grid-to-plug” and “data-to-analytics” charging system

Hitachi Energy
Hitachi GSIB

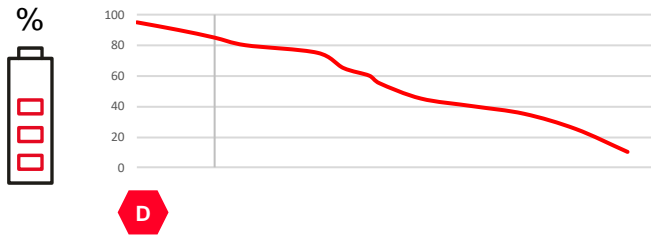


D depot **T** terminal **S** stops

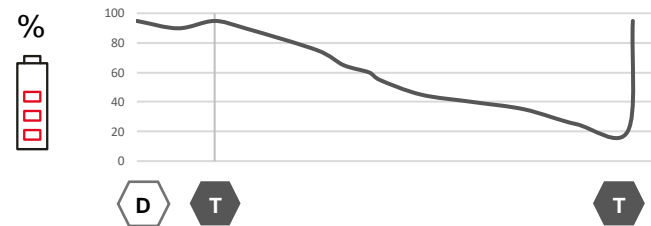
Overnight **Opportunity and Flash-charging**

50kW-150kW (plug) 150kW-600kW (pantograph)

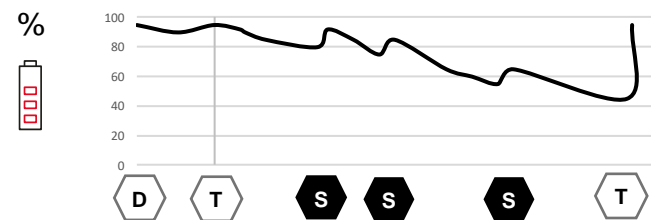
Overnight charging at depot



Opportunity charging at terminals



Flash-charging at some stops



- Significant footprint required
 - HV or MV substation needed
 - Large batteries
 - Long downtime to recharge
 - Usually small e-buses
 - Usually charging via plug
 - Interoperable with all bus and truck OEMs
-
- Space needed at terminals
 - Typically, 12m or 18m e-buses
 - Available on PantoUp
 - Available on PantoDown
 - Interoperable with few bus OEMs
-
- Light and spread infrastructure
 - Light batteries
 - No downtime to recharge
 - High frequency/capacity lines
 - Best suited to big e-buses and Bus Rapid Transit (BRT)

Grid-eMotion™ Fleet

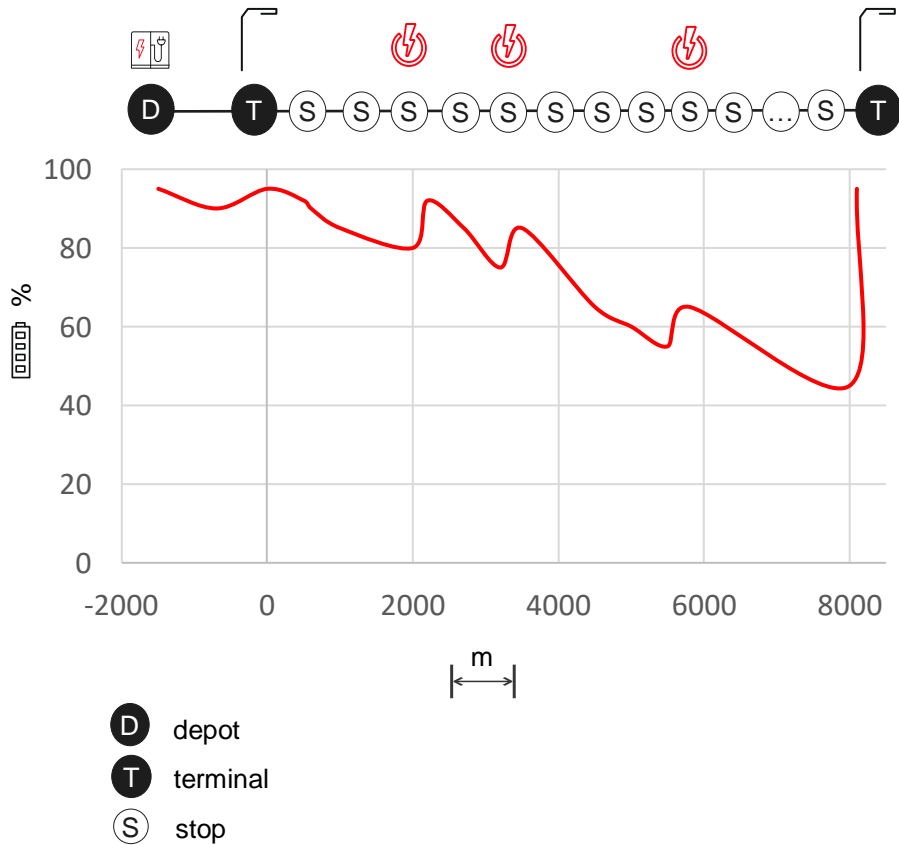
Grid-eMotion™ Flash



Hitachi Energy – eMobility

Grid-eMotion™ Flash

Why flash-charging?



Simpler interface
Reduced time to charge

Reduced fleet downtime

Reduced chargers' occupancy at terminals/depot

Increased utilization of charging terminals

Higher charger power density

Easier integration of wayside energy storage





Short stopping time

High frequency lines where a lot of people need to be transported e.g. BRT



High energy consumption

Typical for

- High capacity buses
- High auxiliary consumption for cooling or heating
- Long or uphill routes



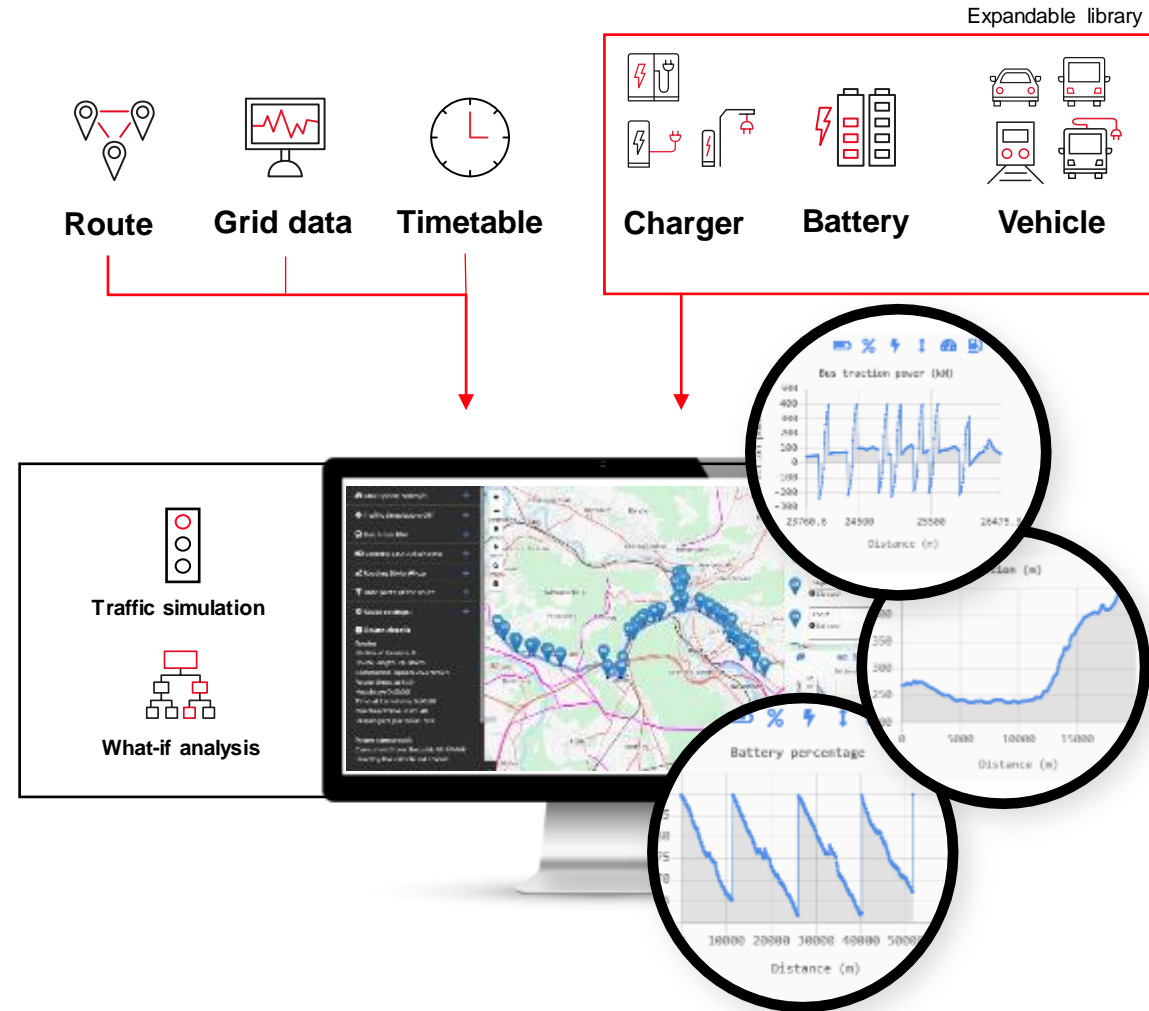
Flash charging

Web-based software tool for optimising the design of the e-bus system based on

- Energy consumption for both traction and auxiliary
- Battery life data
- Route data
- Traffic simulation

The tool provides an optimised system design

- Optimal battery dimensioning
- Optimal selection and placement of chargers
- Detailed information on energy consumption
- Speed and line profile, traction, auxiliary, charging power and energy profiles



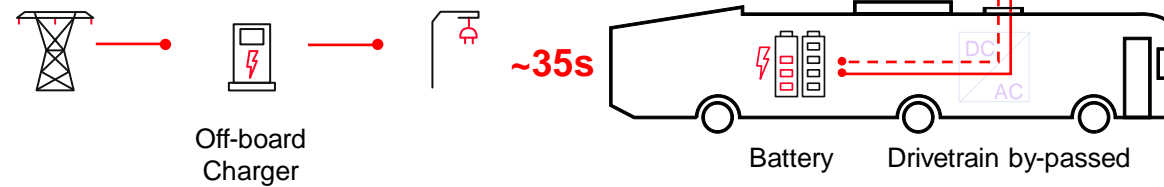
What

- The flash-charging concept uses a stabilised voltage source to provide a simpler interface to the vehicle
- The drivetrain automatically switches from delivering power to the wheels (DC/AC) to charging the batteries (DC/DC).
- There is no need to wait while communication is established, the charging process starts right away.

The concept to reduce time to start charging down to 1s

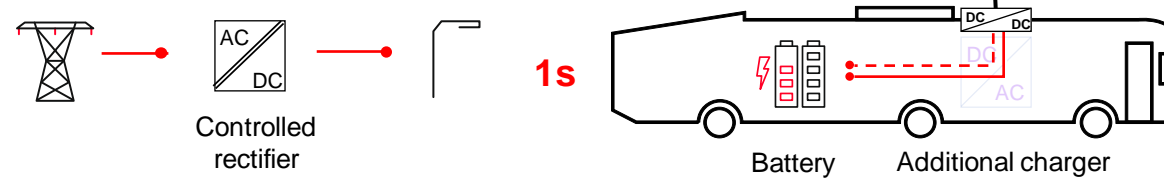
Grid-eMotion™ Fleet

with OppCharge



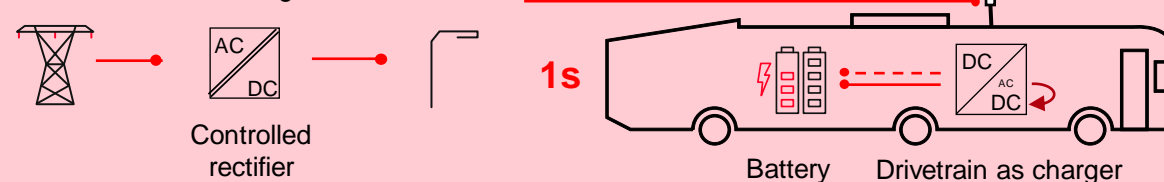
Grid-eMotion™ Flash

with extra DC-DC

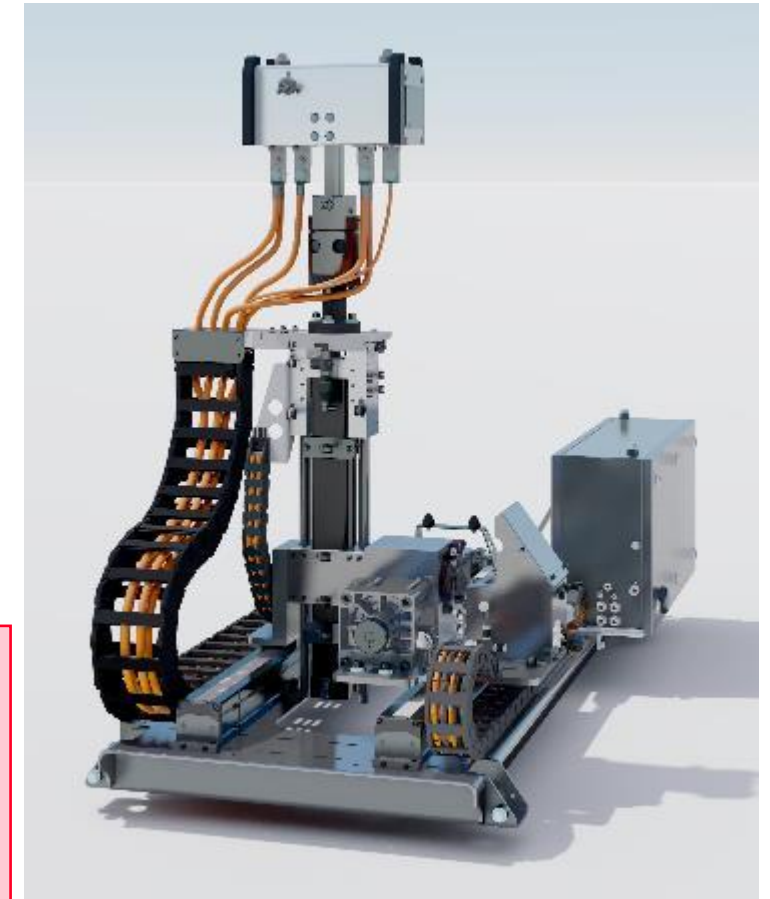


Grid-eMotion™ Flash

with automatic switching



Smart robotic pantograph



- 4 contacts (+, -, CP and PE)
- The system is still “floating” so even in the event of a single failure it poses no danger of electrical shock
- The overhead receptacle (or the socket) is only energised when the bus is connected
- The earth is the first to connect and the last to break
- The earth between the bus and the charger, the insulation between positive and earth as well as negative to earth are continuously monitored



Hitachi Energy offering

Charging solutions up to 1MW based on flash-charging technology developed for bus rapid transit (BRT) high capacity lines

- Full containerised
- Grid connection
- Network management, SCADA, EAM
- Earthing system
- Charging poles
- Grid compliance (harmonics, insulation coordination, RAMS, EMC)
- Installation and site commissioning
- End-user approval

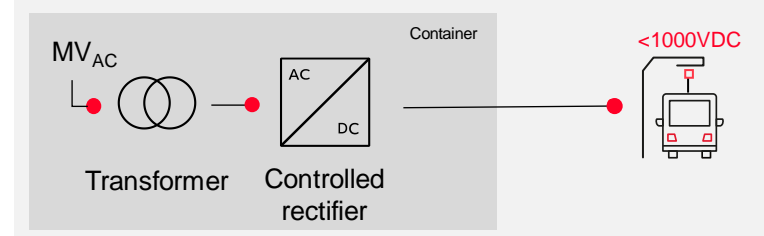
Smart robotic pantograph

- Less than 1s to connect (suitable for charging at stops)
- 1000A permanently

Flash-charging stations

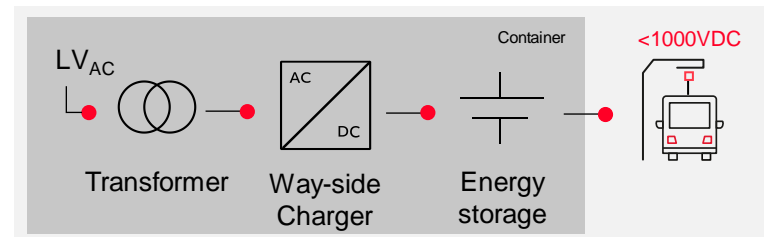
At bus terminal or stops with MV

- MV connection
- Converter stations up to 1MW
- Up to 1000VDC connection



Optional at bus stops with LV

- LV connection
- Wayside Energy Storage System



Flash-charging station with ESS



Light infrastructure at depot





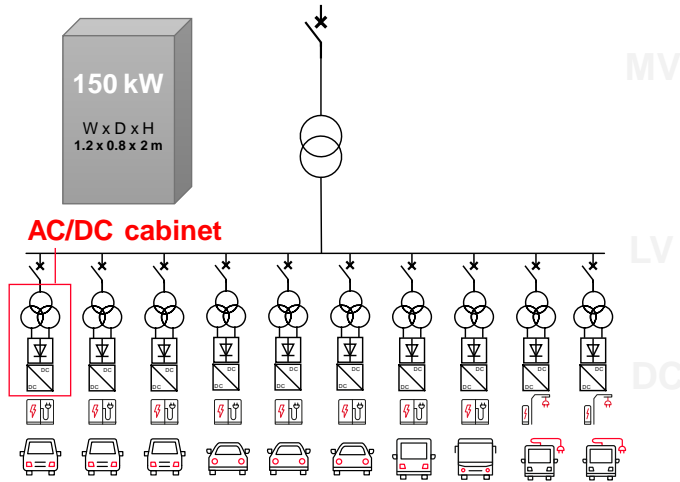
Hitachi Energy – eMobility

Grid-eMotion™ Fleet

Grid-eMotion™ Fleet

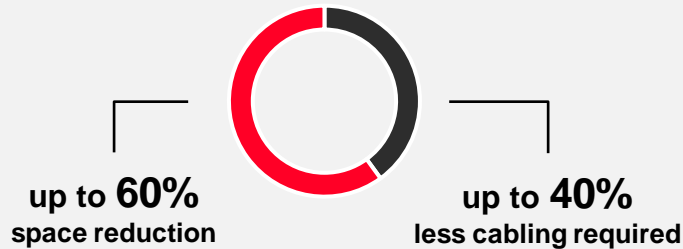
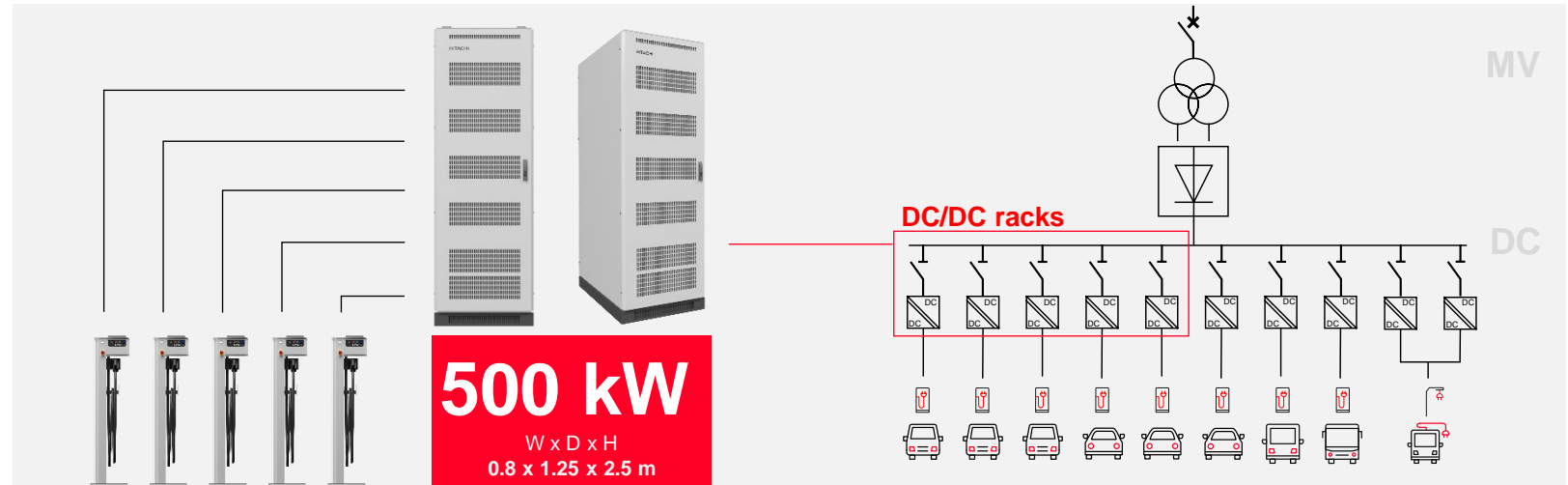
From single to bulk AC/DC power conversion

Single AC/DC units



- Each charger has its own **AC/DC power converter** cabinet fed from LV
- For EV fleets requiring MV connection, **voltage needs to step down in LV**
- Large **AC distribution board** required
- Good approach for projects requiring few fast chargers (pilot project)

AC/DC bulk conversion



- DC/DC converters are withdrawable racks to **ease maintenance & scaleup**
- Direct connection to MV is up to 3 MW transformer blocks for **better efficiency**
- Only **DC cabling** to EV dispensers
- Future-proofed for large scale with **reduced footprint & complexity**

Charging modules can easily be racked in and out



Front side of modules with handle and rails



Fixed back panel with contacts

Main power unit of the rectifier is also rackable



Movable rig for easy replacement of diodes

Indoor

Configurable
delivery of
standalone core
components



Outdoor

Configurable
plug-and-play
delivery of
“Grid-to-Plug”
charging box



- **Remote condition monitoring** features
- Predefined **smart charging** engines that comply to industry standard (OCPP, VDV, Modbus, OpenADR)
- Interoperable interfaces with **EV fleet telematics, scheduling and asset management**

.. Delivered with all-in-one digital platform

1 Converter transformer



Converter transformer

Type	Dry Type
Application	12 pulses
Power	1.2 MVA to 3.3 MVA
Primary voltage	400V _{AC} to 42kV
Primary taps	+/-2 x 2.5%
Secondary voltage	2 x 530 V _{AC}
Frequency	50 +/-1% Hz
Number of phases	3
Vector group	Dy11d0
Cooling	AN
Duty cycle	100% continuously
Standards	IEC 60076-11 EN 50329

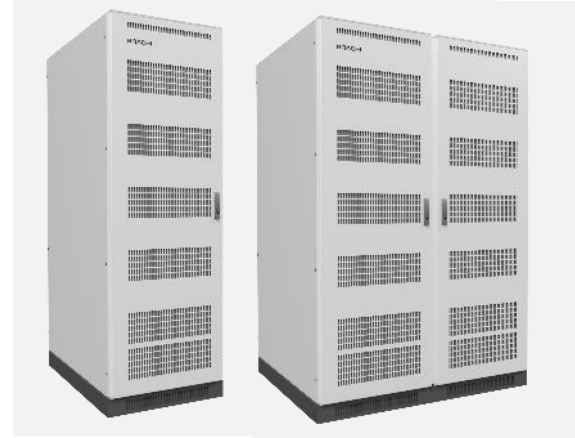
1 Rectifier



Rectifier

Type	Diode/Thyristor
Configuration	12 pulse
Power	1 MW to 3 MW
Input	530 V _{AC}
Output	750 V _{DC}
Max Perm Voltage	900 V _{DC}
Insulation Voltage	2500 V _{DC}
Overvoltage Category	OV3
Standards	IEC 60146 EN 50163

5 DC cabinets



DC Cabinets

Rated Power	10 outputs of 100 kW 5 outputs of 200 kW
Rated Input Voltage	750 V _{DC}
Input Voltage Range	600 ÷ 750 V _{DC}
Rated Output Voltage	650 V _{DC}
Output Voltage Range	150 ÷ 1000 V _{DC}
Cooling	AF
Overvoltage Category	OV3
Standards	IEC 61851-23 IEC 61851-23-1

12 Double-plug CCS2 wall boxes



CCS2 wall boxes

Type	CCS2
Plugs	Two
Rated Current	125 A, 250 A
Voltage Range	150 ÷ 1000 V _{DC}
Base dimensions	300x300 mm
Height	1620 mm
Standards	IEC 61851-23 Status indicators
Accessories	Push buttons Hook for cable management
Optional	RFID for user authentication

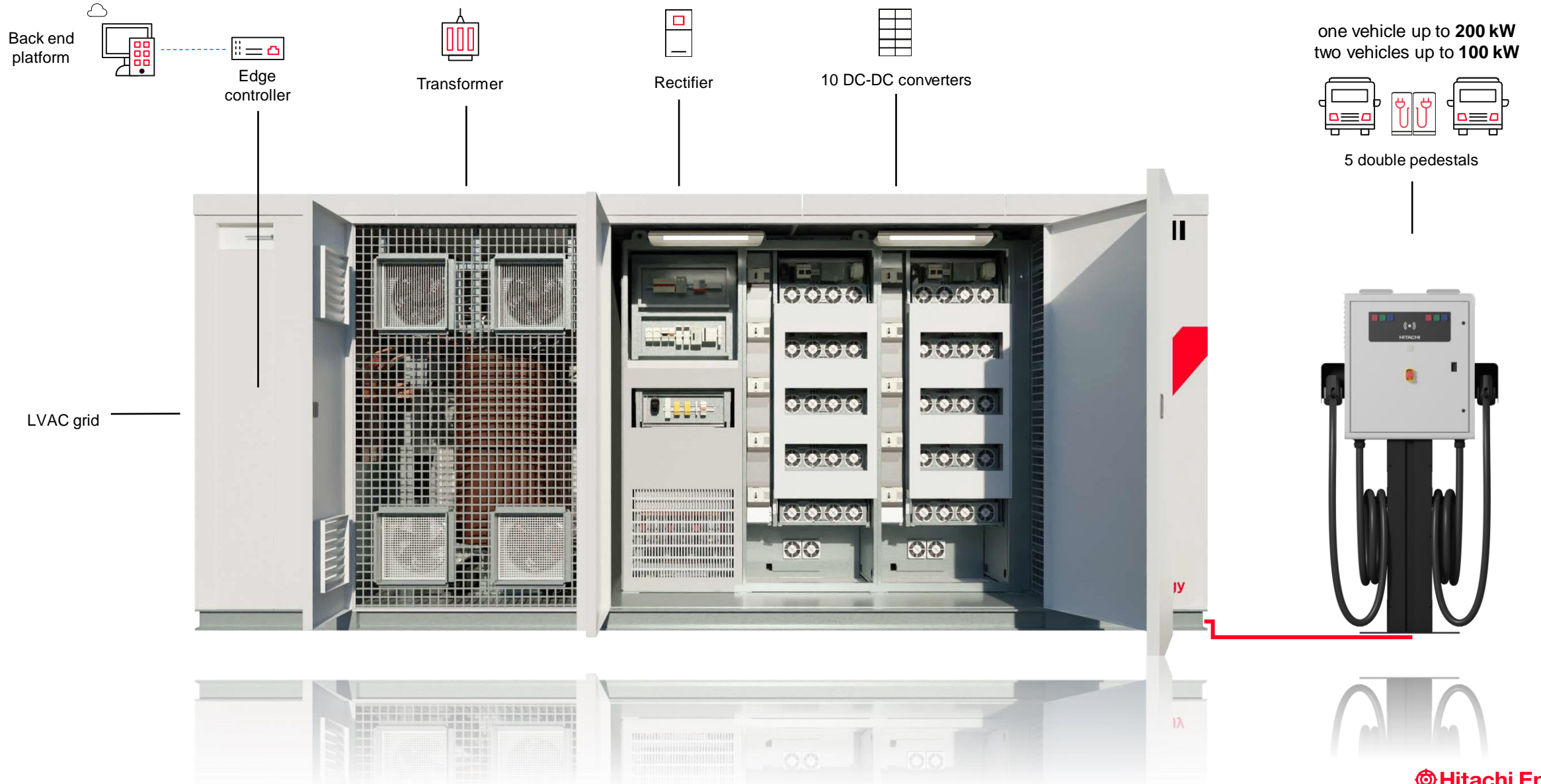
Grid-eMotion™ Fleet

Outdoor solution (1MW box)



Grid-eMotion™ Fleet

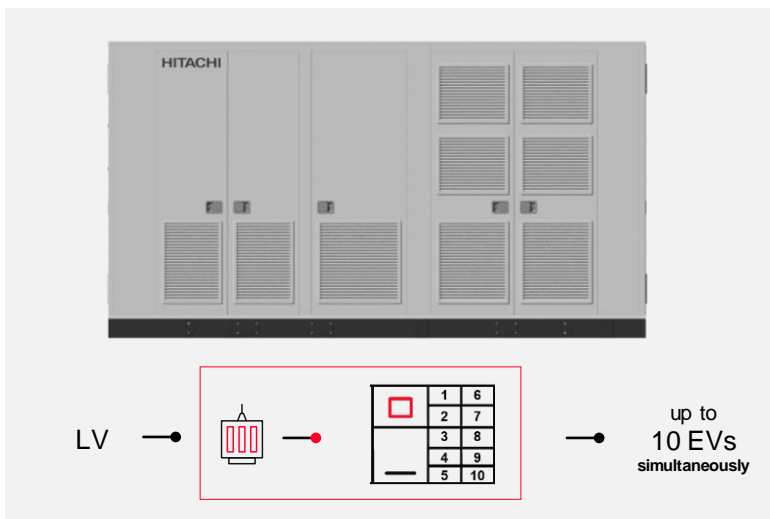
Outdoor solution (1MW box)



Grid-eMotion™ Fleet

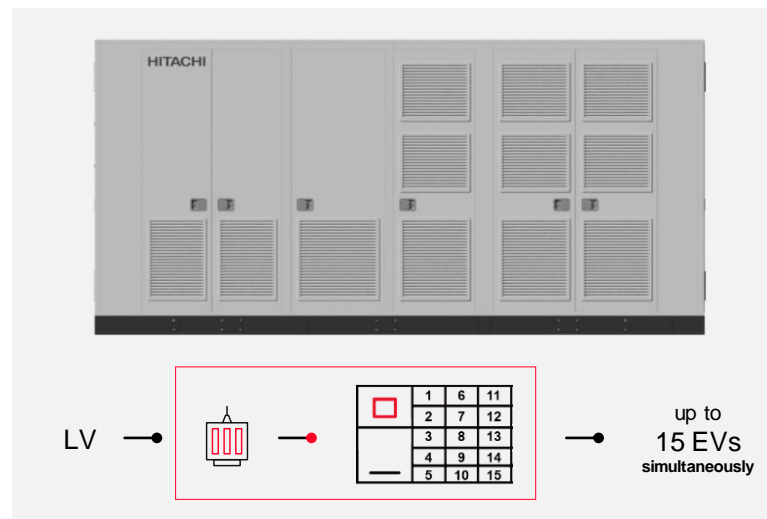
Outdoor configurations (LV grid-connection)

Up to 10 charging points



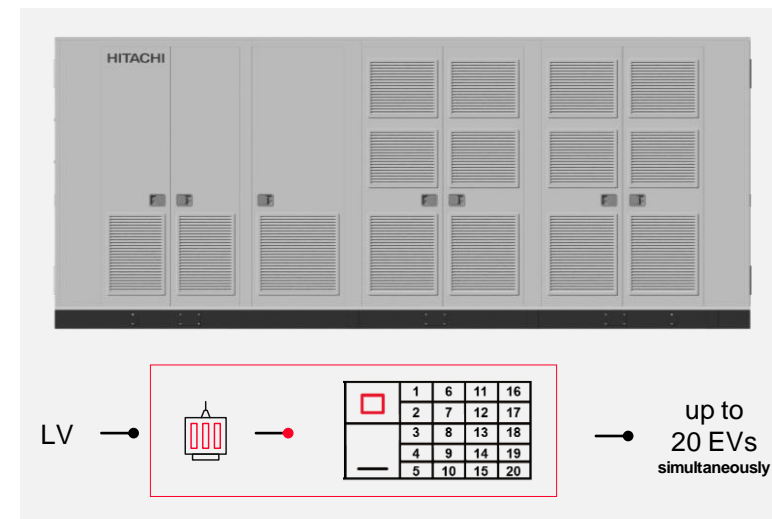
Grid voltage	LV _{AC}
Transformer	1200 kVA
Rectifier	1000 kW
DC Cabinets	2
DC-DC modules	10 x 100 kW
Dimensions	5.8 x 2.0 x 2.5 [m]

Up to 15 charging points



Grid voltage	LV _{AC}
Transformer	1600 kVA
Rectifier	1500 kW
DC Cabinets	3
DC-DC modules	15 x 100 kW
Dimensions	6.65 x 2.0 x 2.5 [m]

Up to 20 charging points



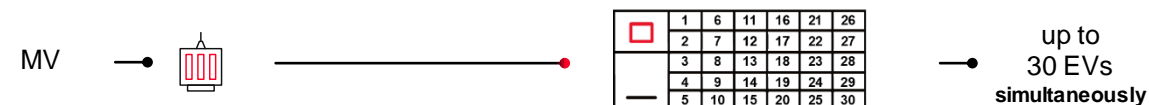
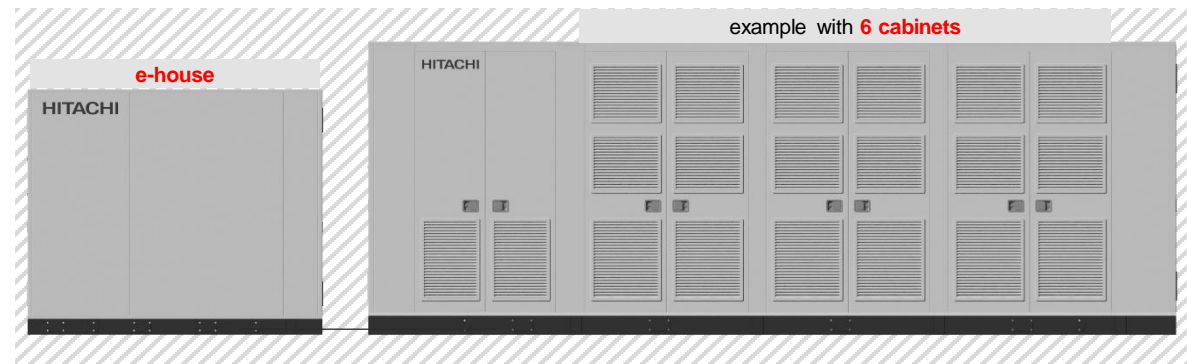
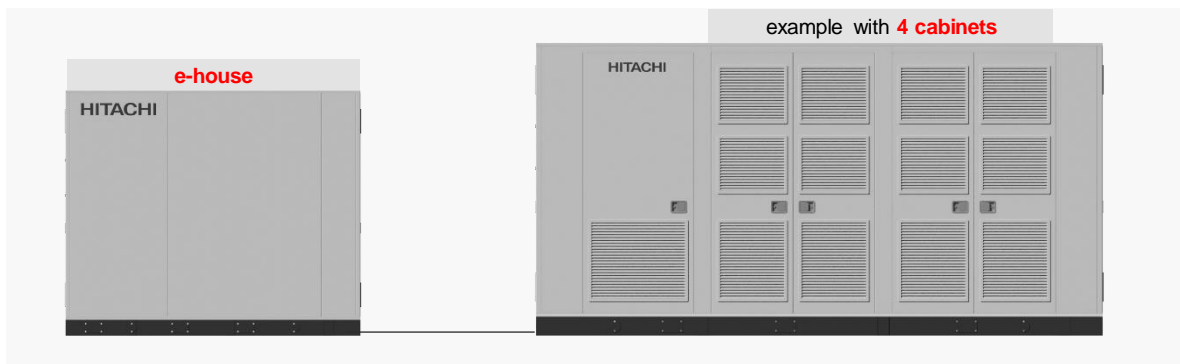
Grid voltage	LV _{AC}
Transformer	1600 kVA
Rectifier	1500 kW
DC Cabinets	4
DC-DC modules	20 x 100 kW (*)
Dimensions	7.5 x 2.0 x 2.5 [m]

(*) included smart charging to limit the peak demand

Grid-eMotion™ Fleet

Outdoor configurations (MV grid-connection)

Rectifier transformer and MV switchgear in a separate e-house



Grid voltage	MV
Transformer	2.3 MVA
Rectifier	2 MW
DC Cabinets	4
DC-DC modules	20 x 100 kW
Dimensions (*)	5.9 x 2.0 x 2.5 [m]

	MV	
	2.8 MVA	2.5 MVA
	2.5 MW	2.25 MW
	5	6
	25 x 100 kW	30 x 75 kW
	6.8 x 2.0 x 2.5 [m]	7.6 x 2.0 x 2.5 [m]

2023+

Grid-eMotion™ Fleet

Charging Interfaces



CCS wall mounted box (up to 300 A)



Panto DOWN on route (up to 1000 A)



Panto UP on route (up to 1000 A)



CCS cable reel box (up to 300 A)



Panto DOWN depot (up to 400 A)



Panto UP depot (up to 400 A)

Design, engineering, fabrication and supply, installation and commissioning of charging infrastructure for a depot charging infrastructure, comprising:

- Fully enclosed building with following equipment
- 50 kVA transformer for auxiliary power
- 12kV rated, 1250 kVA rectifier transformer
- 1000 kW rectifier
- 4 x DC-DC charging cabinets with 18 modules of 75 kW
- 5 x Dual plug charging stations with parallel and sequential charging up to 150kW
- 3 CCS Wallbox charging plugs for 150kW charging

The contract included establishing interoperability for Volvo buses.









Design, engineering, fabrication and supply, installation supervision and commissioning of charging infrastructure for a depot charging infrastructure, comprising:

- 11 kV switchgear
- 50 kVA transformer for auxiliary power
- 2 MVA rectifier transformer Dd0y11
- 1750 kW rectifier
- 6 x DC-DC charging modules of 75 kW (racked power module)
- 11 x Dual plug charging stations with parallel and sequential charging

The contract included establishing interoperability for ADL/BYD Enviro400 buses.

In phase 1, 22 buses will be charged using the charging infrastructure at the depot. Also included is a two-year service contract for the charging infrastructure.

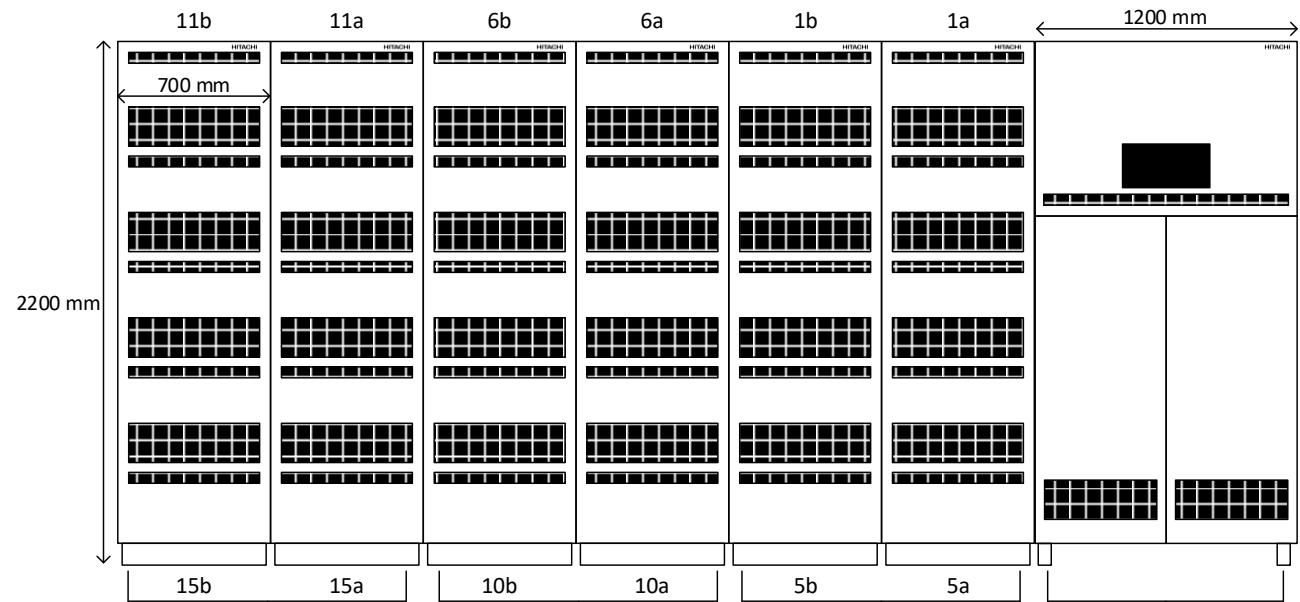
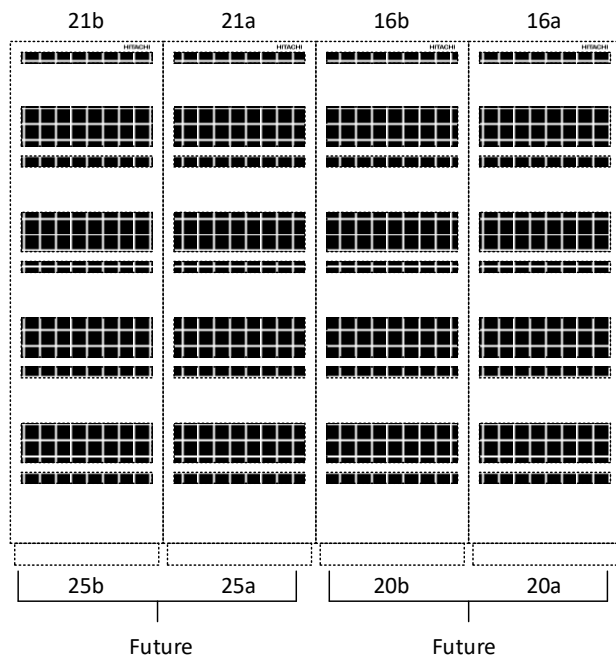
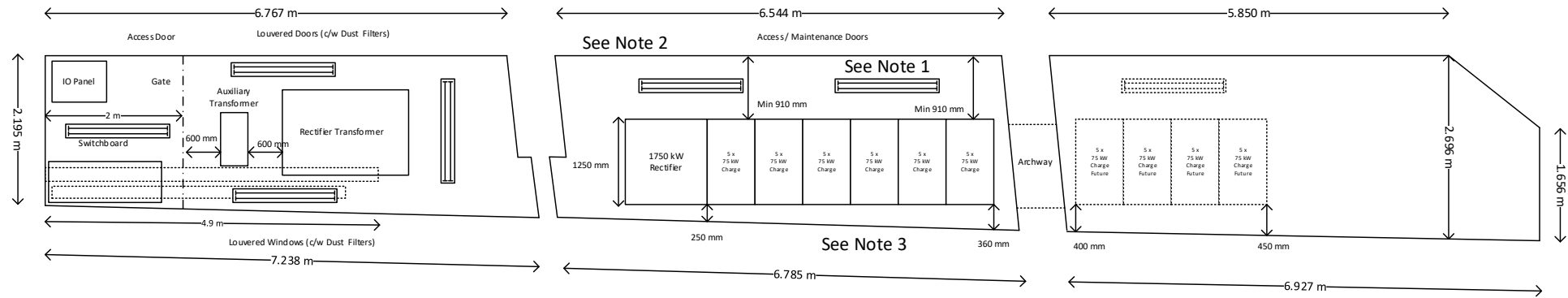
Phase 2, Will enable the remaining 8 modules of Phase 1 as well as add another 22 modules providing 18 additional charging points.











Chargers 11 – 15
Charge Points
15 & 16
17 & 18
19 & 20
21 & 22

Chargers 6 – 10
Charge Points
7 & 8
11 & 12
13 & 14

Chargers 1 – 5
Charge Points
3 & 4
1 & 2
5 & 6
9 & 10

Rectifier

Design, engineering, fabrication and supply, installation and commissioning of charging infrastructure for a depot charging infrastructure at the Britz and Cicero depot.

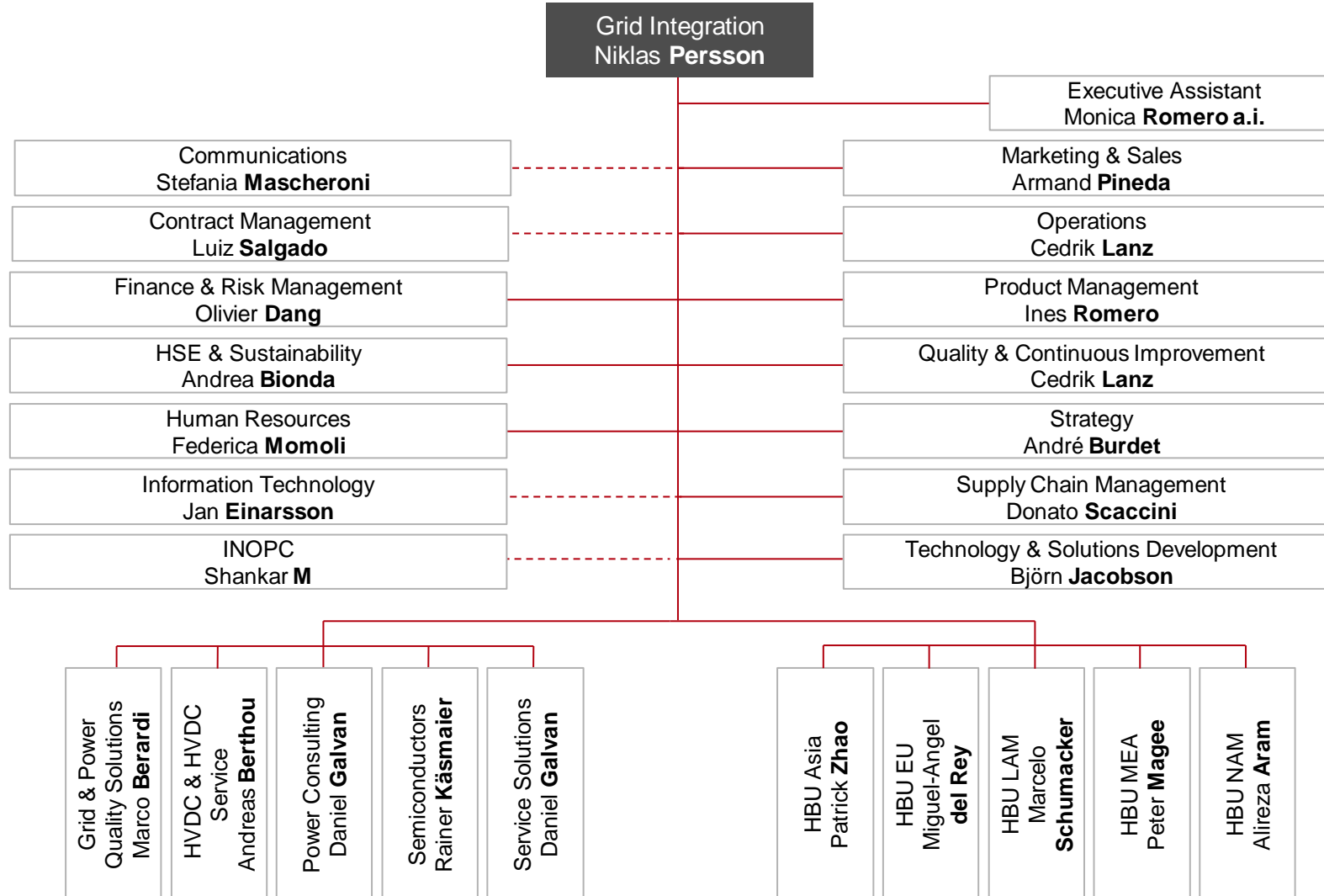
- 4 charging systems Grid-eMotion™ Fleet containers (2 in each depot) including:
 - Medium voltage grid connection
 - 12kV switchgear
 - 14 x charging points of 75 kW, CCS2 charging stations
 - 12kV rated, 1250 kVA rectifier transformer
 - 1000 kW rectifier
 - 3 x DC-DC charging cabinets with 14 modules of 75 kW
 - Single and Dual plug charging stations







March 1, 2022



Supply Grid-eMotion suite of products and solutions gobally

To Hitachi Energy regional entities (e.g HBU NAM)

To external customers on specific cases

GCoC eMobility Manager
André Burdet

Finance and Controlling¹
Sofia Zetterlund

Quality¹
Thomas Hoffmann

SCM¹
Ivan Semprini

HR¹
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Bruce Warner

Product Management GPQS
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Product Specialist
Javier Iglesias

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Roberto Cameroni

R&D
Michel Mansour

Sales & Tendering
Sergey Rummyantsev

Production
Olivier Frantz

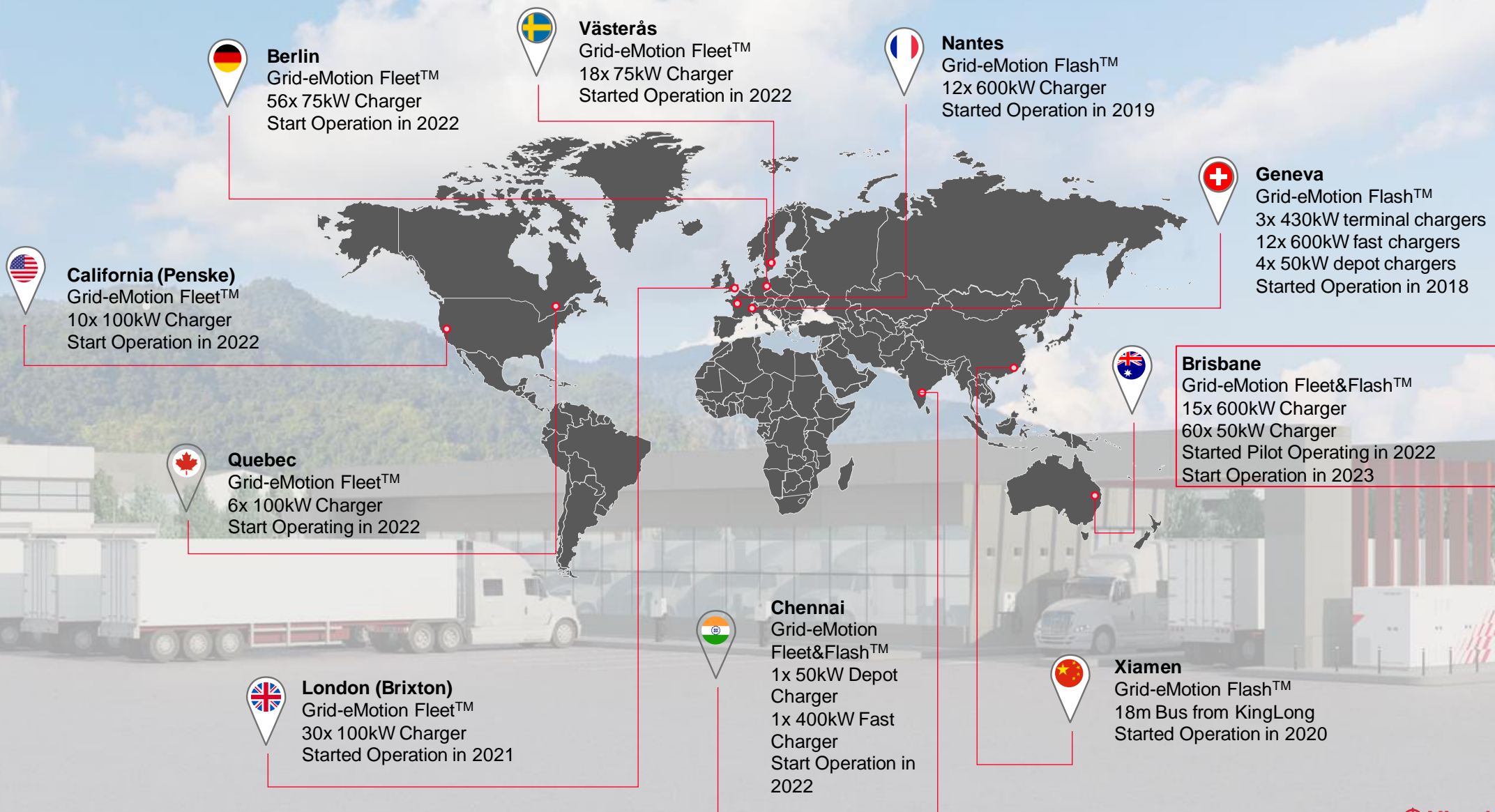
Operation
Roberto Cameroni

Engineering
Subrat-Kumar Behera

Service
Olivier Frantz

Hitachi Energy – eMobility

Leveraging a global Installed Base



Hitachi Energy – eMobility

Meeting the highest standards across the value chain

HITACHI
Inspire the Next



Selection of top-quality components



In-depth engineered solutions



Highest reliability starting in our factories



Unparalleled expertise in power connection



Modularity for easy scale up



Simplest integration into existing mobility



Simple and user friendly charging points with minimal space requirements



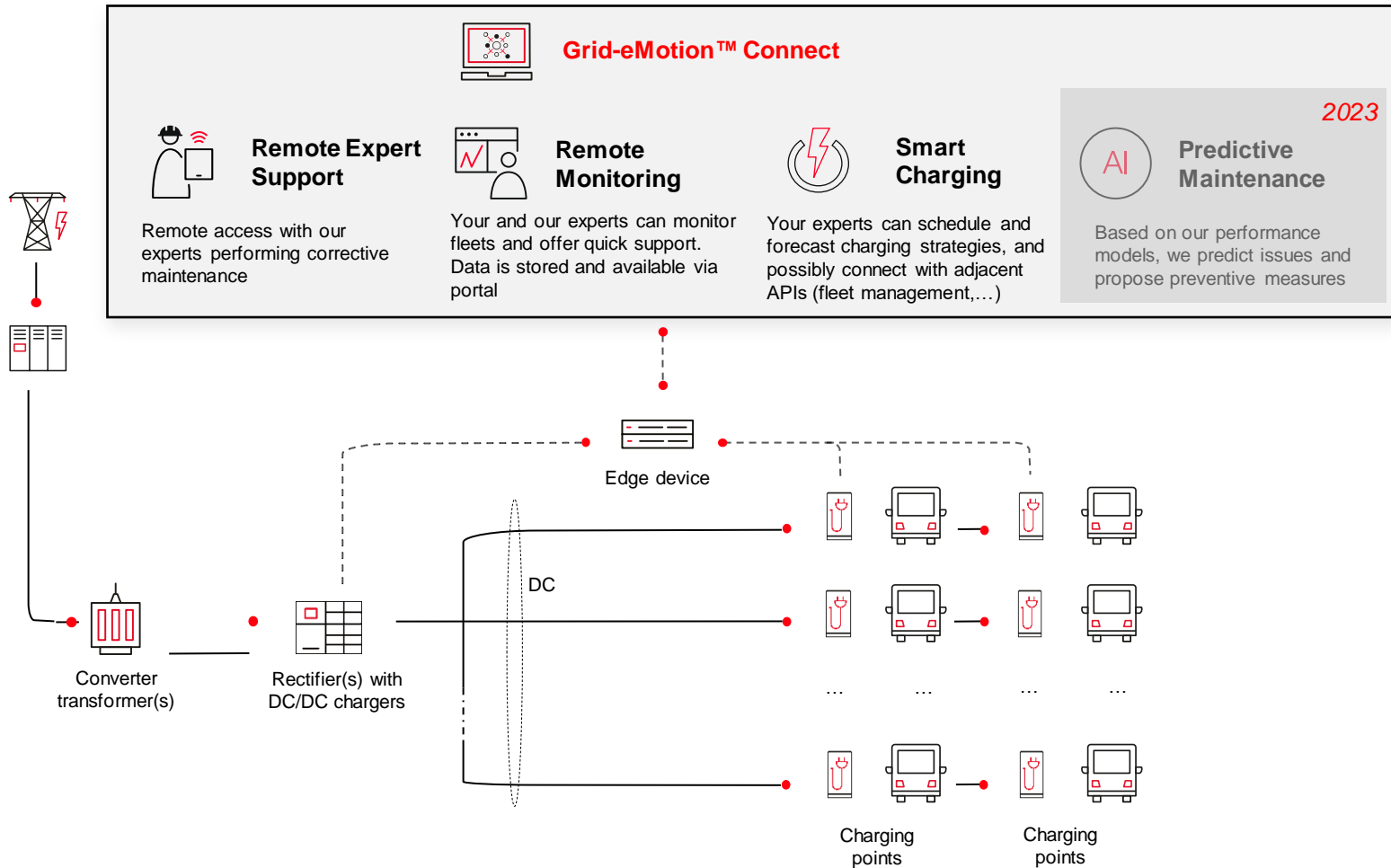
Modularity allowing for lean installation and maintenance as well as future scale up requirements



Grid-eMotion™

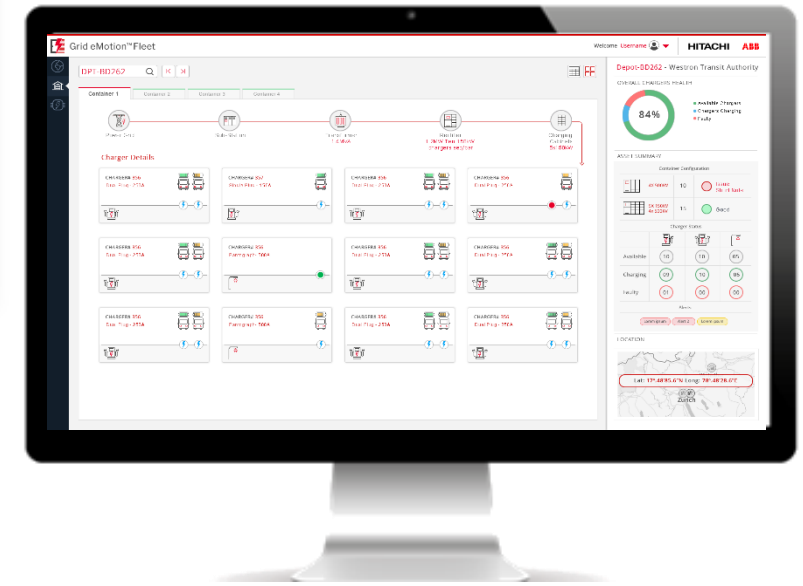
Digital

Peace of mind for your equipment – Our integrated customer experience



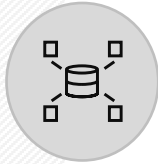
Grid-eMotion™ Connect

Customer Portal



With Grid-eMotion™ Connect you get access to your equipment (in real-time and historical) and to Hitachi Energy global expertise. The platform is prepared for EMS integration to provide a seamless experience

Features:



Data collection & visualization

- Visualized on web portal
- Data stored on cloud
- From assets on site



Remote access

- Remote control of assets
- Quick troubleshooting
- Through VPN



Notifications and alarms

Based on equipment data



Trends and reports

Of operating parameters, power equipment and chargers

Charger(s)

- Location
- Status
- Power
- Charger Type
- Charger manufacturer

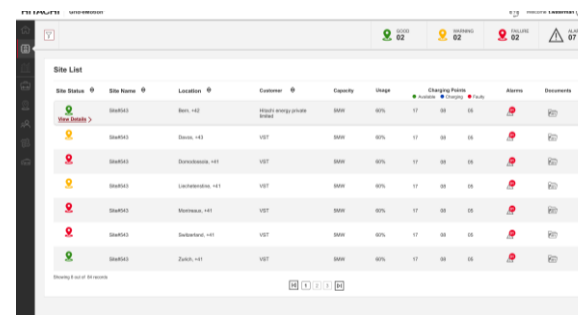
Connector status

Alerts and fault codes

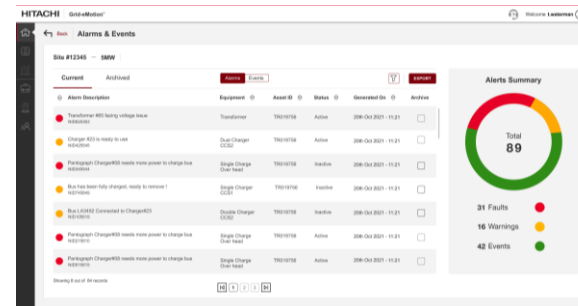
Energy consumption and Uptime reports



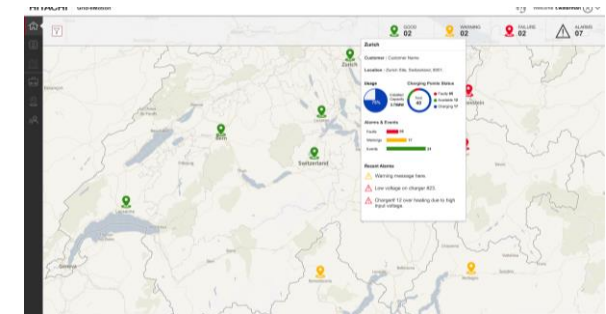
Single log-on



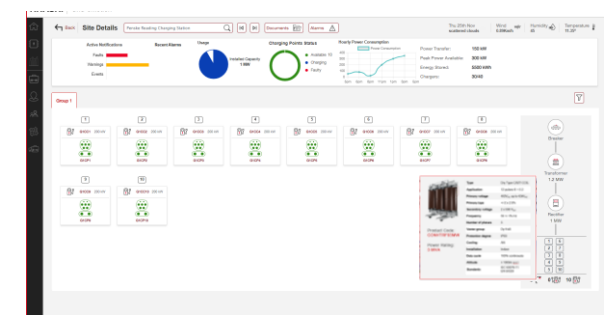
Site list



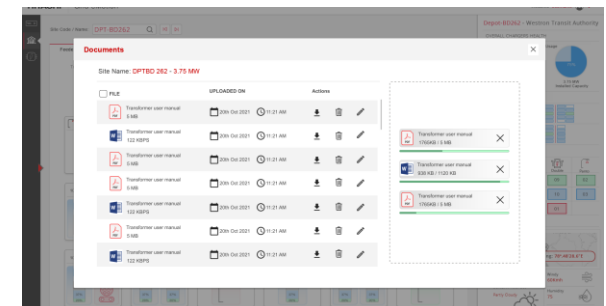
Alarms per equipment



Multi-site map



Single component overview



Document library

Features:

- Smart Charging
- Pre-conditioning
- Load Balancing
- Priority Charging
- EV SOC Management
- Connected Vehicle
 - ID, SOC, Remaining range
- Transaction History and In-depth Transaction analysis
- Charging Controls
 - Remote Start/stop transactions
 - Remote soft/hard reset



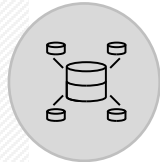
Load balancing

- Set maximum peak load and distribute load
- Manage SoC¹ for vehicles
- Integration of BESS, renewables and V2G



Charging scheduling and control

- Schedule optimization
- Custom parameters and scheduling logic
- Controllable through HMI



Interfacing to other systems

- Connection to depot management, telematics
- Essential for fleet operators
- Flexible integration through APIs



Pre-conditioning

- Prepare vehicles ahead of its use
- Valuable function for overnight charging
- Customizable according to customer's needs



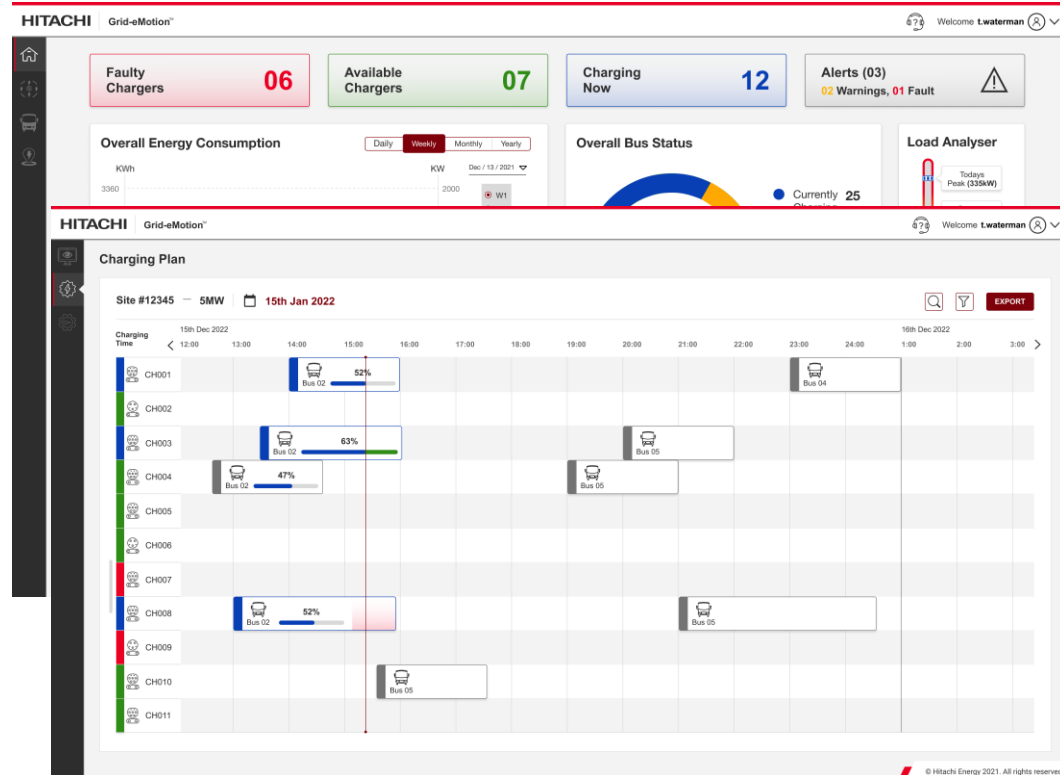
Reporting and notifications

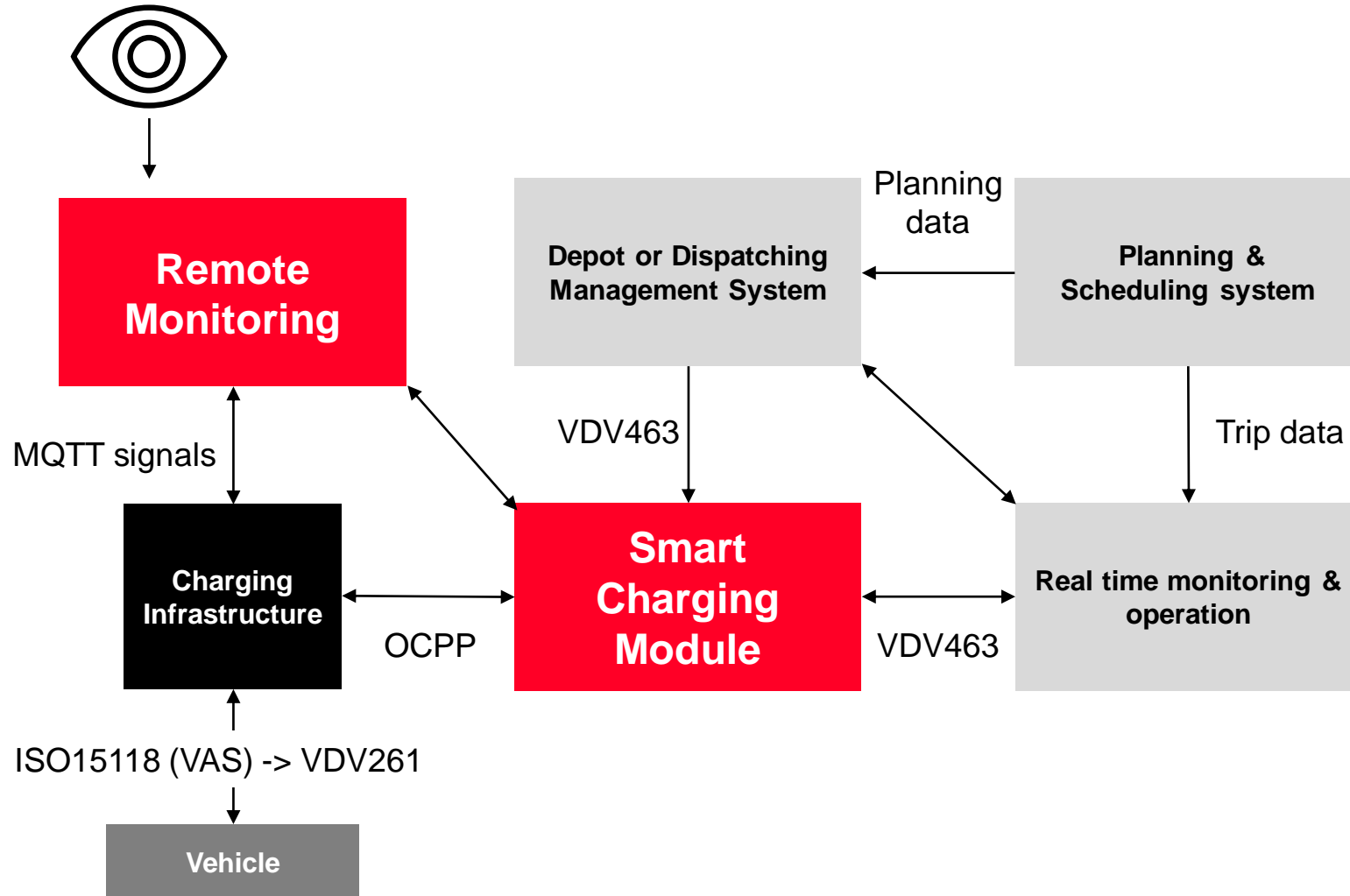
- Easy access to data and reports
- Alerts on important alarms and events
- Essential for long-term optimization



Forecasting

- Day-ahead optimization
- Energy price forecasting
- Asset failure prediction





- Smart Charging module can be **connected to several fleet management solutions via VDV463**
- The **Remote Monitoring portal is the main interface** connecting the smart charging module as well as MQTT signals from the charging infrastructure
- **Further integrations needs to be assessed and evaluated** with specific digital platform of the operator
- Typical questions to be addressed:
 - FleetInsight APIs available?
 - Which system talks to which user?
 - Fleet: face/app to driver? Eg for reservation, delays, status, ...
 - Fuel Billing: Smart Charging transactions are sent to this one
 - Telematics might supply arrival time from charge planning



Grid-eMotion™

Service Concept

Rapid Response



Fast and flexible service to maximize equipment availability

Maintenance Excellence



Knowledge and expertise to optimize and extend equipment life

Performance optimization



Maximizing efficiency and use of energy with smart charging

Grid-eMotion™ Charger Monitoring Platform

Solutions

- Office hours or 24/7 response in 10 languages
- Agreed response time for corrective maintenance

- Rapid Response +
- Preventive Maintenance Execution

- Maintenance Excellence +
- Smart Charging via Charger Monitoring Portal

Benefits

- Faster communication process
- Efficient procurement, product support and mobilization to site

- High Quality
- Higher reliability with preventive maintenance

- Well-informed maintenance decisions with live data
- Maximize operational efficiency with energy management capability of smart charging

Results

- **Higher availability**
- **Faster failure repairs**
- **Shorter unplanned outages**

- **Optimized maintenance spending**
- **Early identification of problems**
- **Failure mitigation**
- **High quality of maintenance**

- **Avoided cost of failure**
- **Avoid unplanned outage**
- **Lower TCO**

Type of agreements

The service offerings for the Grid-eMotion products can be included under different types of SLAs such as commitment on response time and availability. Solutions such as OBC and XaaS can also be offered. We offer fixed/variable fees depending on needs.

The Rapid Response offering comes with a variety of levels to meet different customer needs. The levels are organized based on the response offering with Bronze, Silver, Gold and Platinum as options.

	Bronze	Silver	Gold	Platinum
1st line support*	1 h, 24/7	1 h, 24/7	1 h, 24/7	1 h, 24/7
2nd line support	Next business day	2 h, business hours 4 h, outside business hours	2 h, business hours 4 h, outside business hours	1 h, business hours 2 h, outside business hours
3rd line support	3 day response	8 h response	4 h response	2 h response
Mobilization time	1 week on site	72 h on site	24 h on site	12 h on site

Support channels

Definition 1st, 2nd and 3rd line support



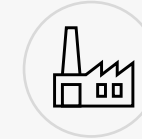
1st line

- Diagnostic of error
- Reset of charger
- Involvement of OEM support



2nd line

- Analyse error
- Change spare parts
- Issue analysis and verification



3rd line

- Grid-eMotion factory experts
- Last escalation step

Tools and services to enable fast response



Phone Support

Describe the problem by calling our level 1 support.



Charger Monitoring Portal

For more thorough understanding, all of our support levels can reach your assets remotely



Augmented Reality

With the use of augmented reality (AR) we can get a live visualization through the eyes of **someone on site**. The service can be used via our app and in any of our support levels



On-site corrective maintenance

Local Hitachi Energy or partners service engineers with right equipment and training respond to site within an agreed time-frame.



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