

ZENOBĒ ENERGY LTD

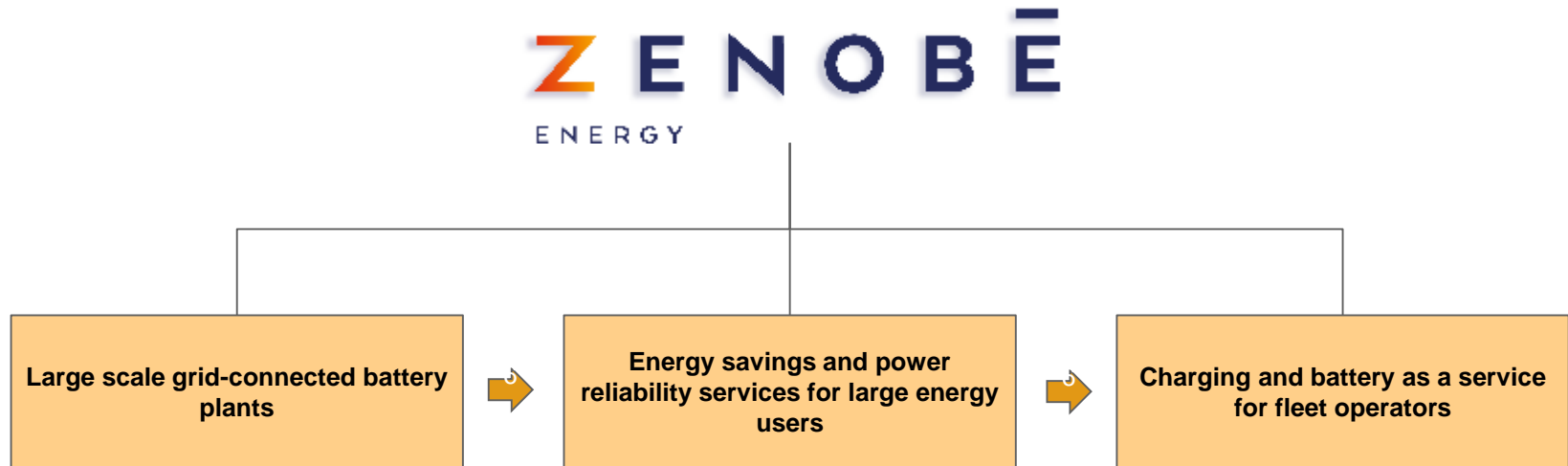
BATTERY STORAGE DEPLOYMENT AND POWER SUPPLY UPGRADE FOR EV BUSES



JUNE 2019

Zenobe Energy business lines

Zenobē Energy focuses on three distinct but complementary activities



Why does the grid need storage

Overall balance of supply demand, corrective or emergency actions and supporting local bottlenecks

Side view incl. Customer cabin



Side view incl. ducts



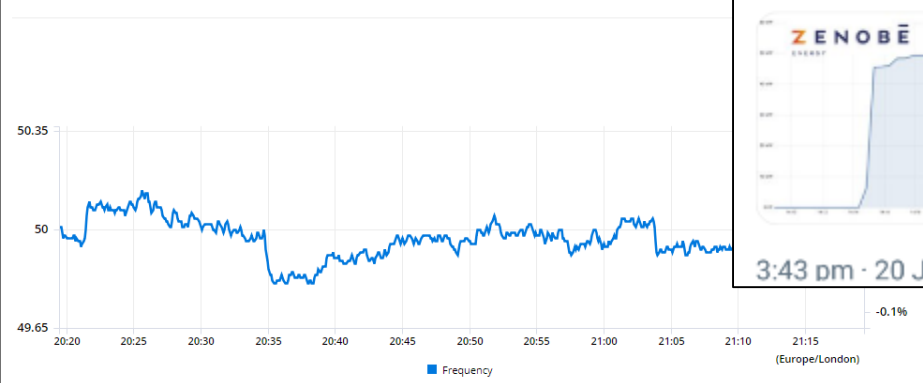
Internal view, cells



Top view




Dashboard view of service provided



National Grid Control Room @NGControlRoom

The Control Room have a new system for dispatching [#AncillaryServices](#), the Ancillary Services Dispatch Platform (ASDP). It allows NG greater access to new technology types enhancing our flexibility across energy sources. Yesterday we dispatched a [#battery](#) for the first time.



3:43 pm - 20 Jul 18

Services we provide with storage

We fund, own and operates energy storage assets, providing the technology as a service to its customers with no upfront costs

Services to large energy users






- **Renewable firming**
 - Firm up renewable generation by reconciling the intermittency of power from these sources and storing excess capacity to dispatch when required
- **Microgrid**
 - Operate a grid independently of the main power grid and reinforce overall power grid resilience
- **Emergency backup**
 - Provide 'clean' and immediate emergency backup power in the event of a power failure/voltage dips
- **Clean power consumption**
 - Maximise the consumption of on-site generated 'clean' power and reducing electricity imports to the sites
- **Load shifting**
 - Shift energy consumption from one time to another in order to improve energy efficiency and reduce costs
- **Demand Charge Reduction**
 - Discharge at times of peak demand to avoid or reduce demand charges

Additional income streams from grid

- **Ancillary Services**
 - Provide services to the grid such as balancing services (FFR) and CM services in order to generate income when the battery is not being utilised to provide services to the customer
- **Demand response**
 - Discharge or charge in response to signals from TSO
- **Transmission and grid reinforcement**
 - Supply power and/or energy capacity at a distributed location to defer or eliminate the need to upgrade grid connections/infrastructure in order to reduce costs
- **Capacity Reserve**
 - Provide power to the grid as a standalone asset

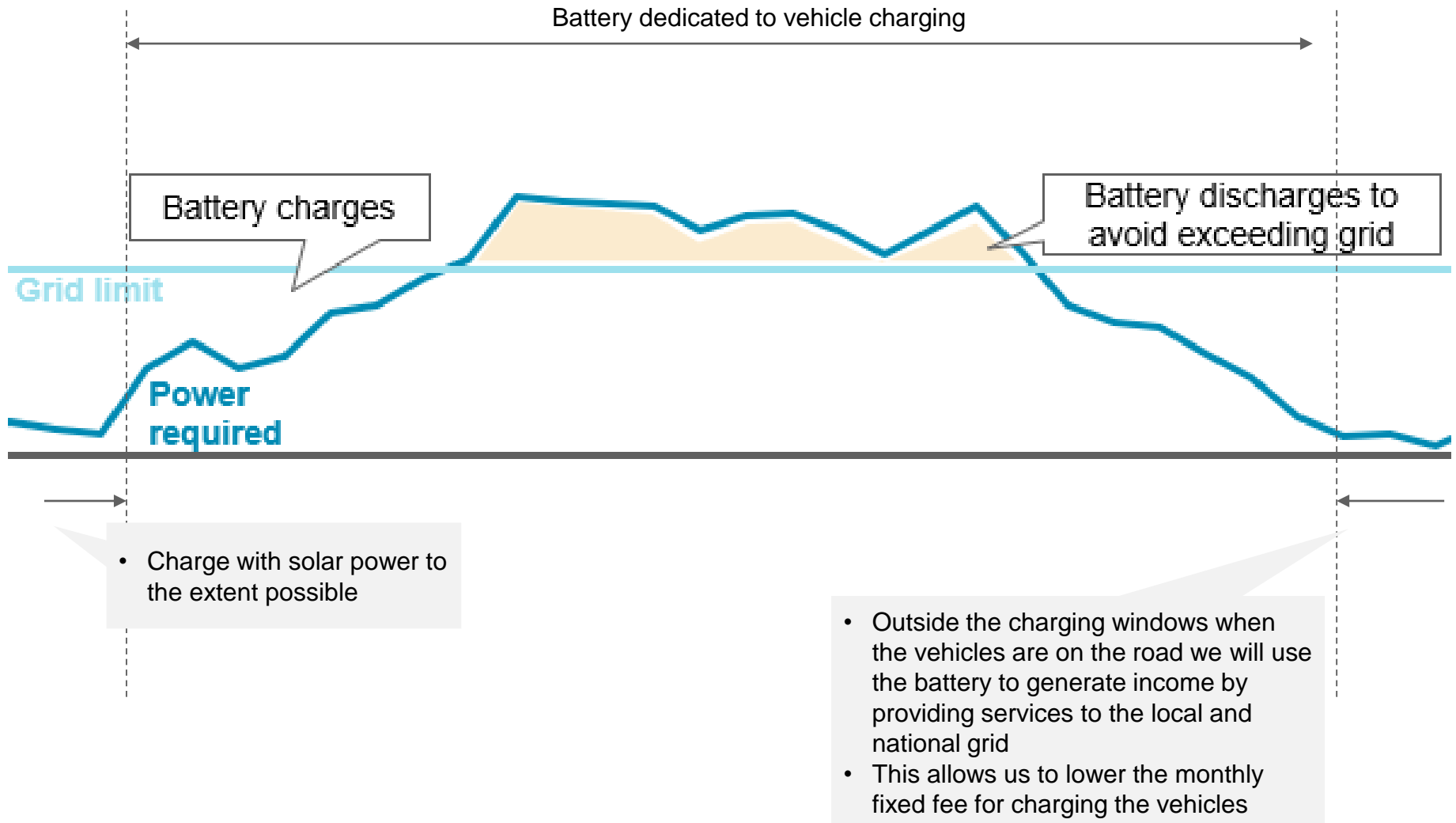
Zenobē core skills mapped to EV buses

Zenobē Energy can provide either infrastructure, or a fully wrapped solution for operators allowing you to focus on your core business

Solution	1. Reduce cost of charging infrastructure	2a. Fund and finance EV price differential	2b. Operate & maintain infra. & battery	2c. Provide 2 nd use for battery cells	3. one-stop-shop incl. body
					
Operator benefits	<ul style="list-style-type: none"> Remove up-front cost of infrastructure Leverage existing infrastructure with addition of a battery Accelerate speed of deployment Additional benefits as batteries will provide services to local grid reducing service charges for bus operations Experienced partner who guarantees service levels 	<ul style="list-style-type: none"> Allow operators to focus on the operation of the electric bus by owning and operating the battery Charging the cost of the bus battery on a monthly or price per km as part of the asset financing contract 	<ul style="list-style-type: none"> Optimise charging Modulate charging to provide grid services to generate income and reduce the cost of the infrastructure and bus batteries to the operator Obtain and log key charging and usage information of the battery to support its 'second life' use 	<ul style="list-style-type: none"> Remove and replace the bus battery when the bus battery can no longer meet the operator's route requirements/ Provide 2nd application for depleted battery lowering overall cost to operator Eliminate any future recycling costs to the operator 	<ul style="list-style-type: none"> One-stop-shop who carries overall responsibility All-inclusive offering including <ul style="list-style-type: none"> Battery-on-the-vehicle service plan Financing of vehicle body Provide and maintain charging infrastructure Optimise energy supply
Commercial model	<ul style="list-style-type: none"> Service charge based on throughput OLEV contribution possible, reducing on-going charges 	<ul style="list-style-type: none"> Service fee for period of the battery finance (15 years) plus additional km charge in excess of pre agreed distance limits Possible OLEV/council contribution to funding 			<ul style="list-style-type: none"> Operating lease for body Service plan for batteries and chargers

How does it work?

We install a small battery in your depot that fills up while the vehicles are out, and meets the gap between what the vehicles require while charging and your available grid



What are the benefits compared to alternatives

Energy storage can rapidly provide the required capacity whilst also delivering additional revenue streams and energy savings

Options	Description	Current EV charging speed	Cost	Time	Future-proofing	Movable	Potential income/savings	Financing options available
Grid capacity increase	Increase the connection capacity to the peak need of EV chargers and plant by reinforcing sub-stations and local cabling	Meets requirements	<ul style="list-style-type: none"> Up-front Recurring 	Doesn't meet requirements	Doesn't meet requirements	Doesn't meet requirements	Doesn't meet requirements	Doesn't meet requirements
Existing grid without battery	Use the existing infrastructure without requesting additional capacity from the DNO to avoid reinforcement costs	Doesn't meet requirements	Doesn't meet requirements	Meets requirements	Doesn't meet requirements	Doesn't meet requirements	Doesn't meet requirements	Doesn't meet requirements
Existing grid with battery	Leverage the existing infrastructure more by adding a battery which allows you increase capacity flexibly for EV charging and generate energy savings	Meets requirements	Meets requirements	Meets requirements	Meets requirements	Meets requirements	Meets requirements	Meets requirements



Meet the requirements



Meet part of the requirements



Doesn't meet the requirements

Sample demonstration units of our portable solution

Batteries and charging infrastructure can come in all shapes and sizes
purposes

Modular storage container

- IP rating > 54 (65 next)
- Incl. inverter and cells



Movable base

- Events
- Trials
- ...



Feeder pillar

- Connect with simple 3 phase power supply
- Electric isolation of the system
- Meters (current, power, etc.)
- 'plug-and-play'

Charger

- Rapid DC charging
- Incl. AC charging outlets
- Swap different test models
- ...

Cloud connectivity

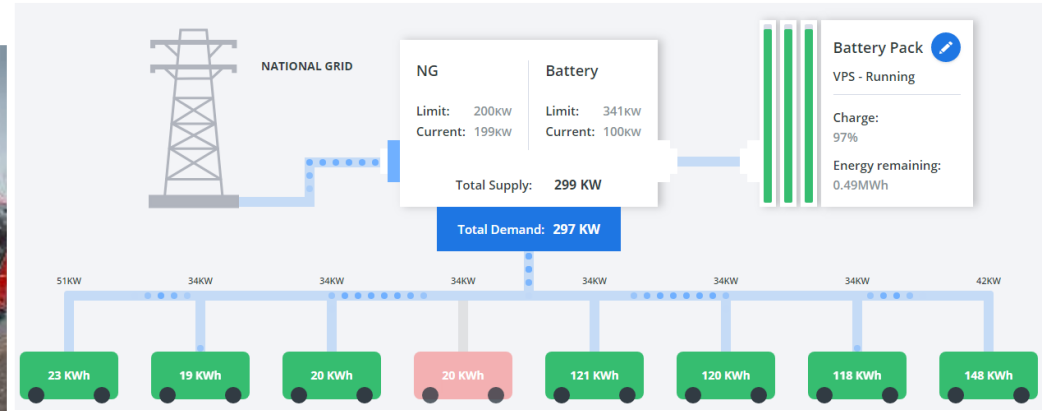
- Integration with monitoring platform
- ...

Local software

- Demonstrate peak-shaving capability on single vehicle level

First example of battery and charger units

It's not just about hardware, it requires careful consideration of schedules, operations and software



NG	Battery	Battery Pack
Limit: 200kW	Limit: 341kW	None - Standby
Current: 0kw	Current: 0kw	Charge: 61% Energy remaining: 0.31MWh

11pm yesterday - 8am today Energy delivered: 1,191 kWh / 1,705 kWh

Charge SN	Charger No	Start Time	End Time	Time Charged	Energy Delivered
BYDC101	1	15/01 - 23:41	16/01 - 01:18	1h 37m	100 kWh
BYDC102	2	15/01 - 23:19	16/01 - 00:30	2h 10m	185 kWh
BYDC103	3	15/01 - 23:15	16/01 - 00:18	2h 23m	195 kWh
BYDC104	4	15/01 - 23:15	16/01 - 00:18	4h 59m	178 kWh



Factors that can impact grid infrastructure

Some initial questions to consider

Energy audit/survey

- What is the maximum grid supply that you have available?
- Can you provide information on how much of it you use and a daily breakdown?
 - During and outside bus charging windows?
- Do you know what is the cost of an up-grade and for how much additional power: up-front and recurring capacity charge?
 - Is there free/spare capacity in the local system?
 - Do you know if there are constraints locally, is there development in the local area?
- Are you likely to move the vehicles, the route, the infrastructure, the depot?
- Do you or your neighbours have rooftop solar? Do you use the power generated? Do you expect to expand this?
- Where's your point of supply? How does that compare to where you'd like to charge the vehicles?
- What are your plans for electrification and what is your estimated power requirements and by when?
 - Have you made a choice of vehicle?
 - Do you know the speed and stages of electrification?

Some factors that may impact the above

- Regulatory changes...
- Competitive behaviour, are your neighbours likely to increase capacity?
- Depot traffic plan and charging speeds