



V2x

CHAdEMO Webinar #5

Learning from innovators: A better way to create business from V2G

March 2022



Presenters



Mike Schooling
Indra Founder and CTO

Presentation contents

Main Presentation Points:

- INDRA`s V2G unit
- History of V2G development/Project Sciurus
- Real World Findings
- Further Opportunities and Development

An introduction to Indra

Indra Renewable Technologies is a fast-growing electric vehicle and smart energy technology company developing innovative charging and energy storage solutions for the home.

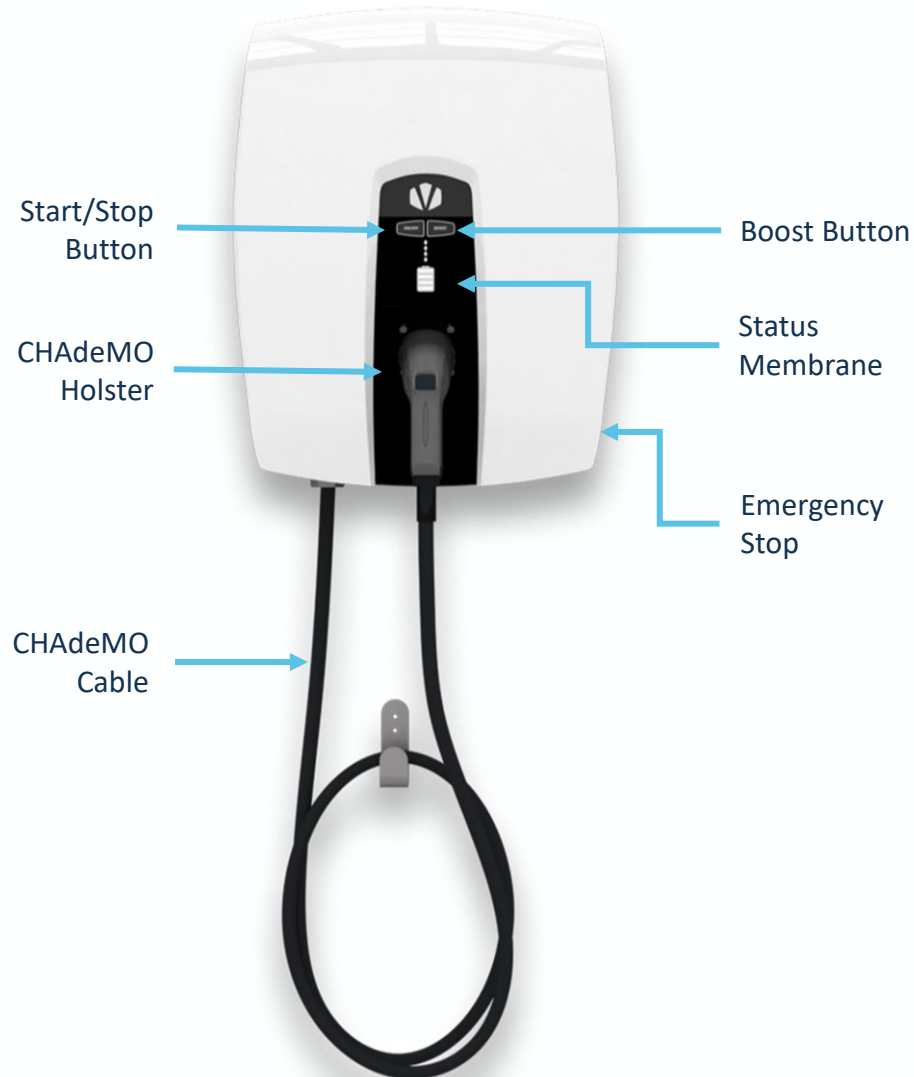
We are developing and manufacturing smart energy products:

- Vehicle to Grid (V2G) charger >1,000 manufactured to date
- Domestic Smart Charging (V1H and V1G)
- Vehicle Battery and Powertrain systems
- Founded in 2013
- ~75 staff in Malvern, Worcestershire, UK

What is Project Sciurus?

- Started 2018
- Innovate UK funded (~65%)
- Design, develop, certify, manufacture and install 1,000 Domestic V2G units using CHAdeMO
- 3-year trial
- 3MW connected load (6MW full swing)
- ~18MWh storage
- £5m Project
- Indra partnered with OVO energy, Nissan, Cenex, Kaluza
- >450 units online to date

Indra's Vehicle to Grid Solution



The Indra Vehicle-to-Grid is a mode 4 , V2H (CHAdeMO) certified , 'smart', grid tied bidirectional electric vehicle charging solution at up to 6kW, believed to be the World's first bi-directional domestic charging solution.

➤ Technical Specifications:

- CHAdeMO vehicle connection
- 6kW nominal Charge
- 6kW nominal Discharge
- UK residential (240V, 50Hz, single phase)
- Local smart charging
- Remote control using charging operator control platform
- Dimensions - 520mm x 210mm x 690mm
- IP65 protection rating

Development of V2G Hardware

When we started in 2017...

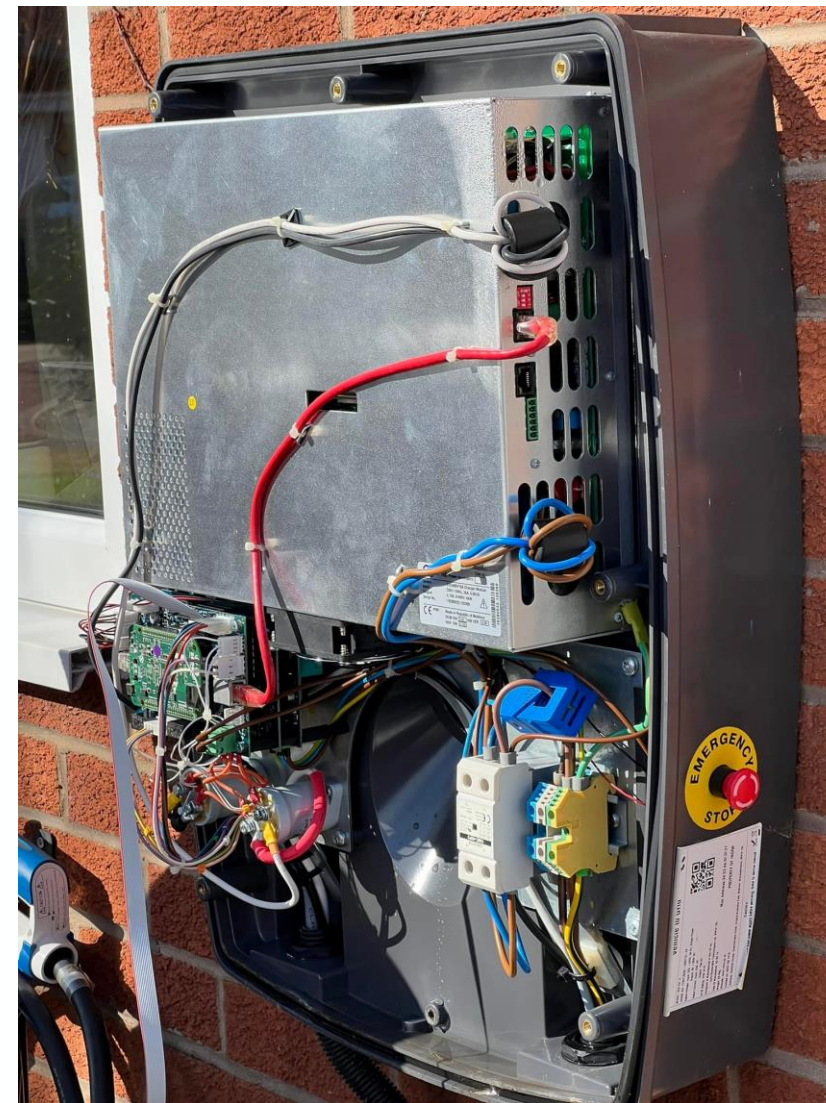
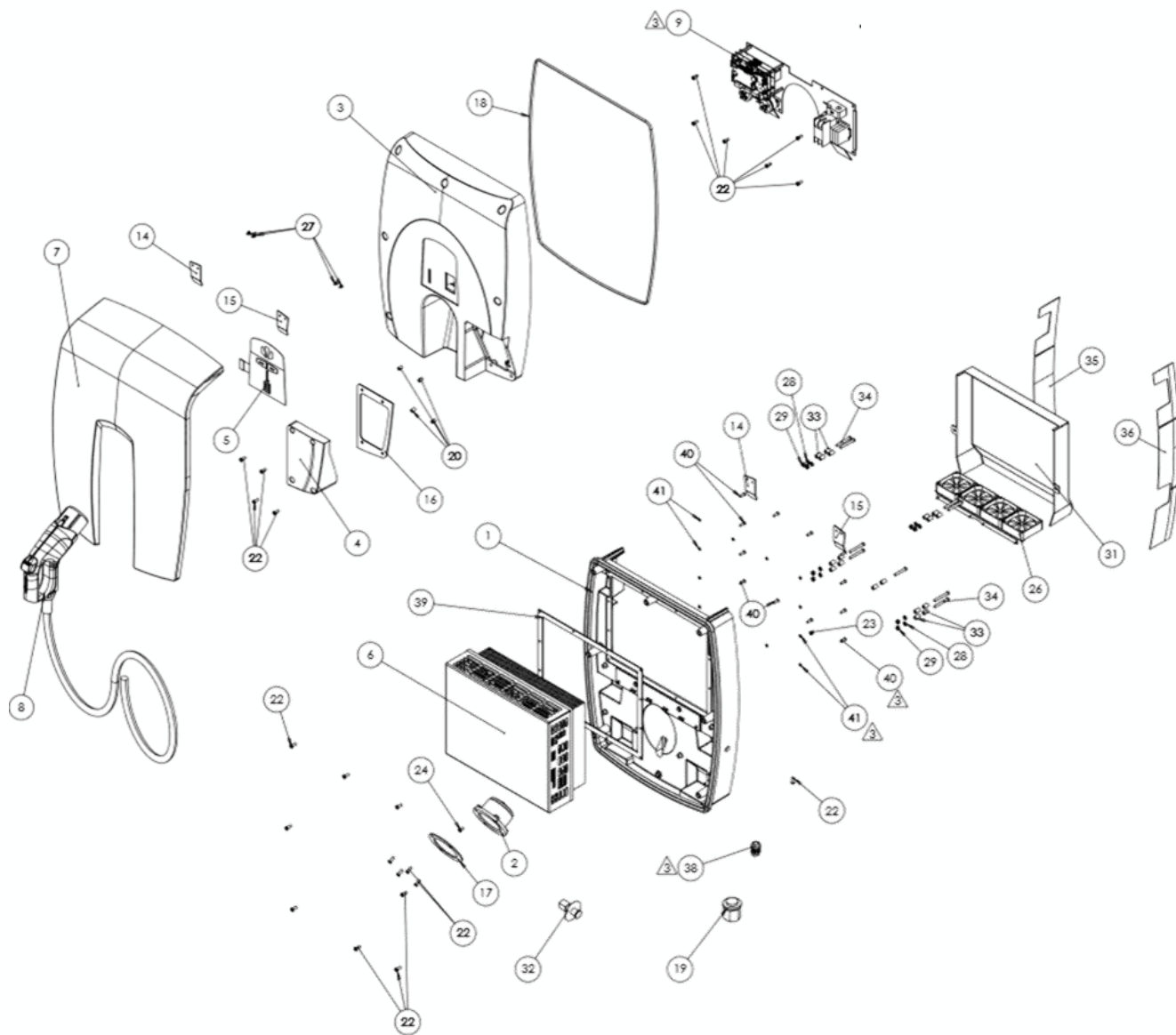
- Crane a unit onto a concrete pad!
- >£15,000 unit cost
- 3Phase only



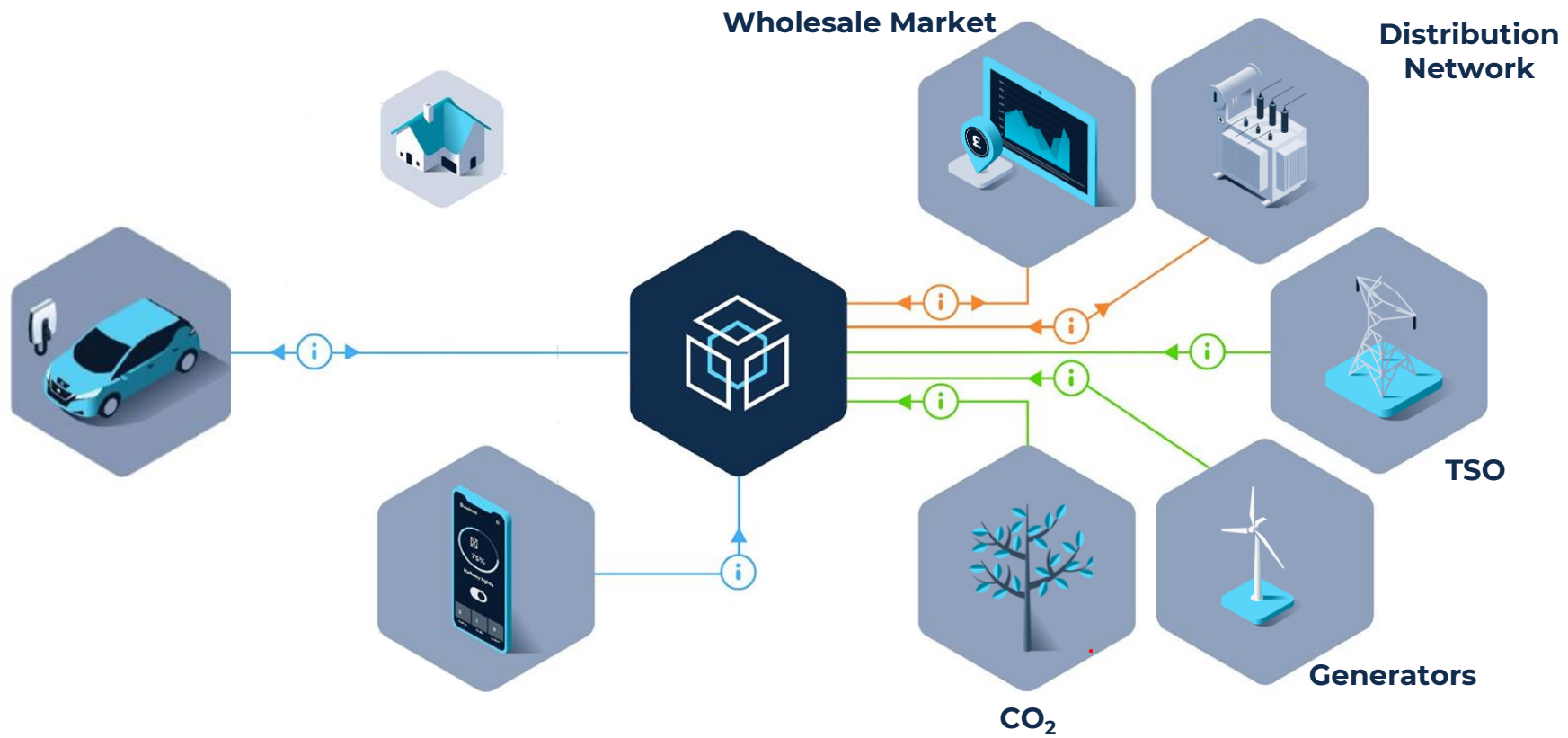
By late 2018...

- Wall mounted
- <25KG
- 6x cost reduction

Development of V2G Hardware



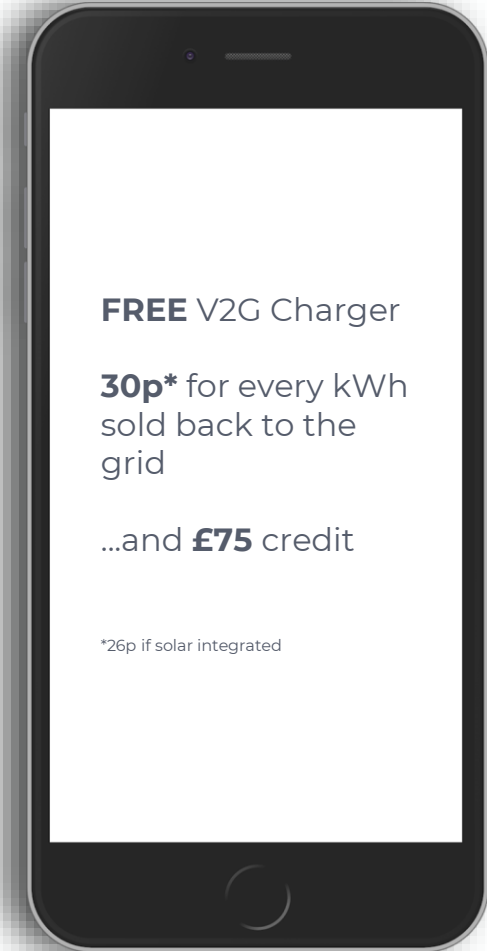
VPP for Sciurus - Kaluza



Development of V2G Hardware

- How is cost reduced by six times!?
 - Use of Silicon Carbide in power electronics
 - Lighter
 - More efficient
 - Less waste heat (reduced cooling requirement)
 - Fewer heavy copper components
 - Design for manufacture
 - Build time reduced
 - Injection moulded plastics
 - Reduced power level from 10kW to 6kW
 - In line with existing charging speeds
 - In line with DNO approval for domestic
 - Economy of scale

Customer Proposition for Project Sciurus



FREE V2G Charger

30p* for every kWh
sold back to the
grid

...and **£75** credit

*26p if solar integrated

Tangible Benefits

Charges for June 2019

Electricity	
Consumption charge	£91.02
<small>663 kWh at 13.72p</small>	
Standing charge	£8.22
<small>30 days at 27.40p a day</small>	
Gas	
Consumption charge	£4.27
<small>139 kWh at 3.08p</small>	
Standing charge	£8.22
<small>30 days at 27.40p a day</small>	
Standing charge	£8.22
<small>30 days at 27.40p a day</small>	
Upgrades	
POLAR plus	£7.85 £0.00
Green Electricity	£5.00 £0.00
OVO Interest Reward	-£0.72
VAT	£5.55
<small>5% of £111.01</small>	
Vehicle-to-Grid Export Credit	-£115.77
Total charges for June 2019	£0.79

Tariff Version 2.0

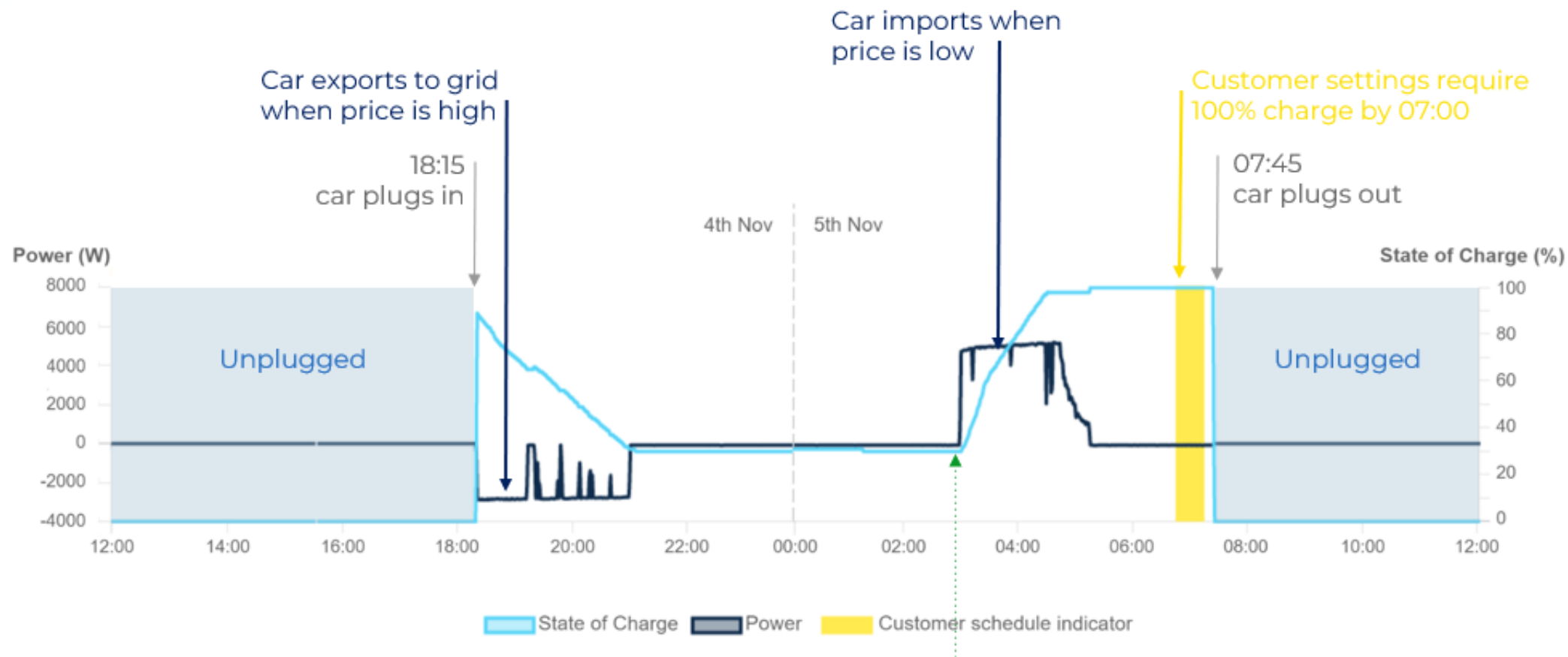
...in November 2019, one customer was credited:

£184.59

(exporting 547.63kWh).

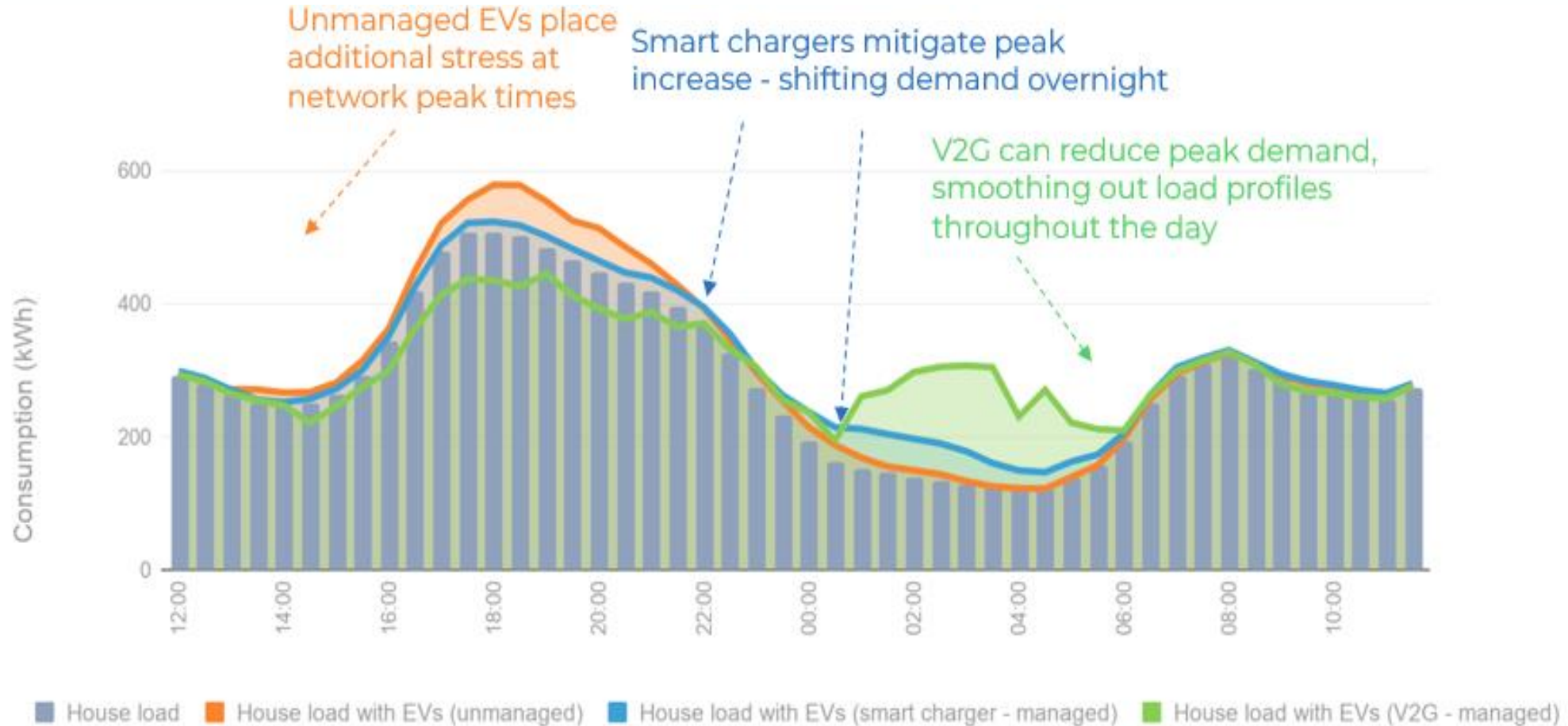
Real World Findings

Day profile of a V2G charger:



Real World Findings

Typical load demand profile alteration after a V2G installation:



Customer Insights

V2G customers plug
in their car **every day**

19% of V2G customers
have solar generation

V2G chargers are
plugged in **55%** of the
time



Average weekly non-V2G
charging consumption is
49kWh

10-15% of customers
already shift charge to
night-time for off-peak
pricing

Average EV V2G
connection period
duration **13 hours**

Business Case

Now

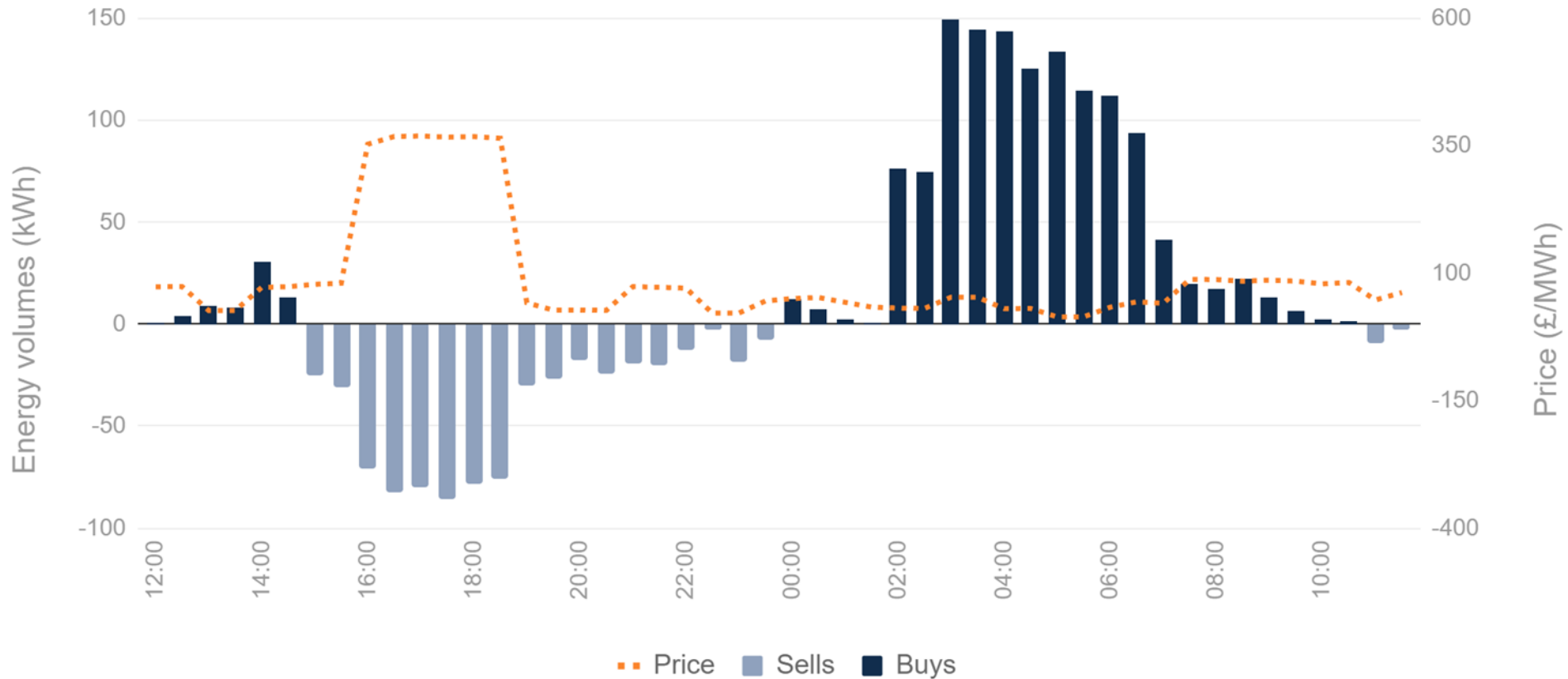
- V2G
 - Time of use trading
 - Arbitrage
- V2H
 - Self consumption
 - Tariff optimisation

Future (with embedded metering and change in regulation)

- Balancing Mechanism
- Frequency regulation
- Individual metering
- Energy Arbitrage
- Live Tariffs

Time of Use Trading

- Buy at £30 / MWh
- Sell at £314 / MWh



Arbitrage

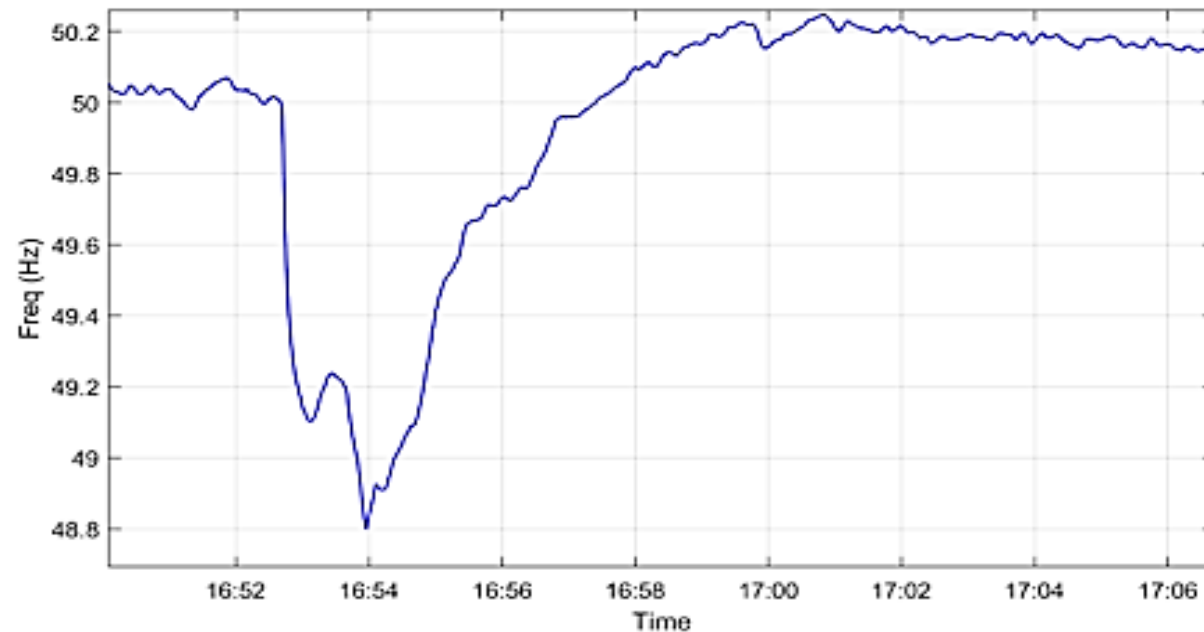
- Electricity purchased half hourly in advance
- Utilities charged for coming under or over.
- V2G and Smart charging used to provide control
 - Charge some cars in the last few minutes if over-purchased!

Self Consumption

- Storing locally generated energy for when it is needed
 - e.g. home solar into the cars battery
- No energy costs
- No distribution costs
- No infrastructure upgrades

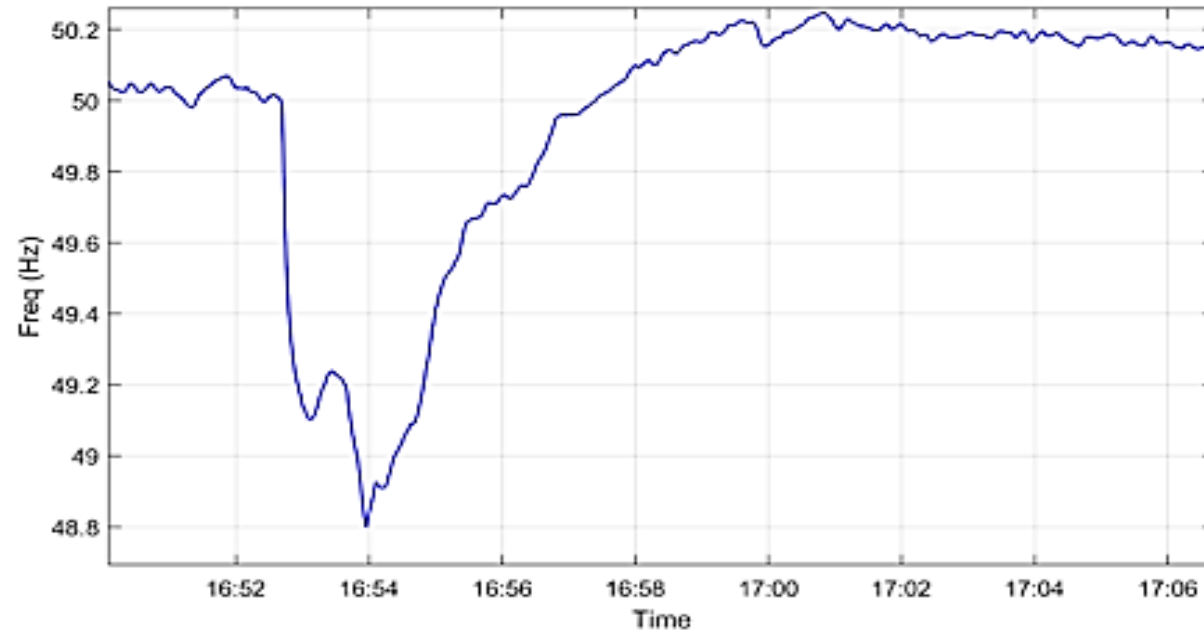
Balancing Mechanism

- Standby, short term reserve
 - V2G to step in for a few minutes during a surge in demand or loss of generation
- Load shedding
 - Stop cars from charging, or reduce charging rate for a short period



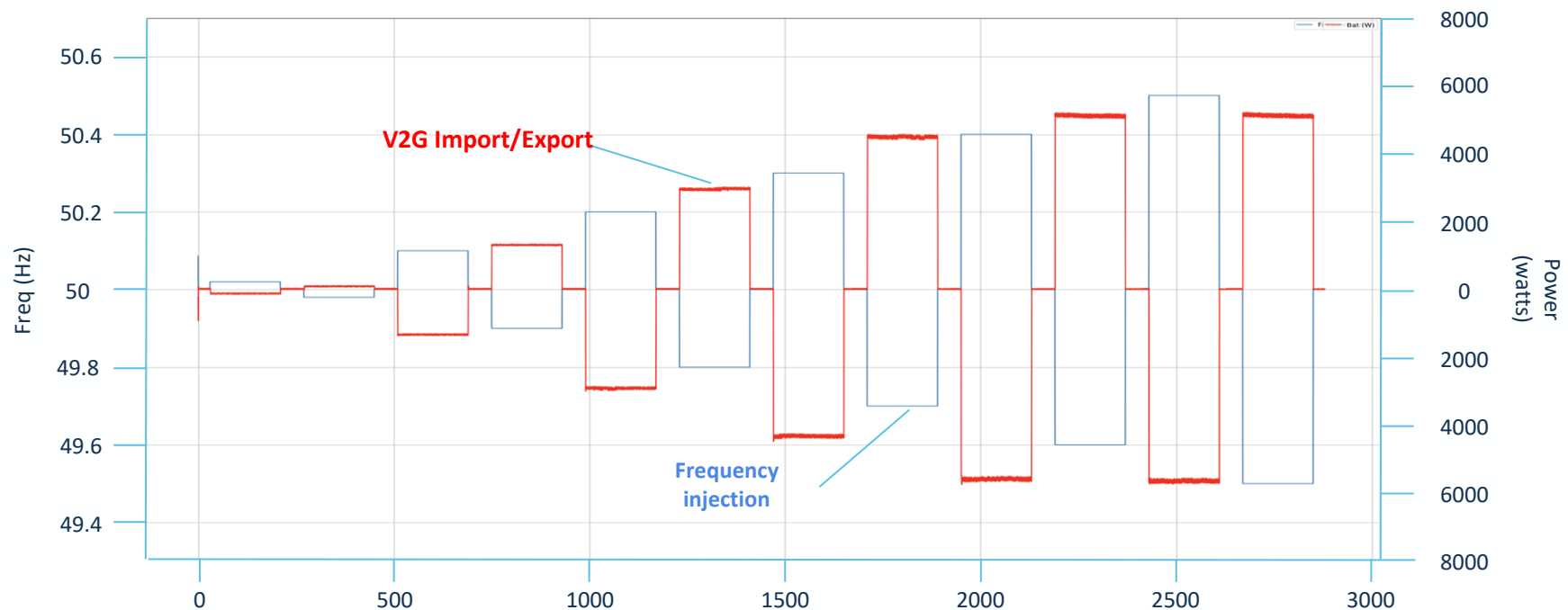
Frequency Regulation

- Non inertial, fast response load
- <2 second remote response time
- Sub second local response time (to preconfigured parameters)



Frequency Regulation

- The graph shows an Indra V2G, Nissan LEAF and Kaluza control undergoing National Grid's frequency response qualification tests.
- Blue Line – frequency injection
- Red Line, V2G response (power)



V2H – Real world findings – Saturday 5th March 2022

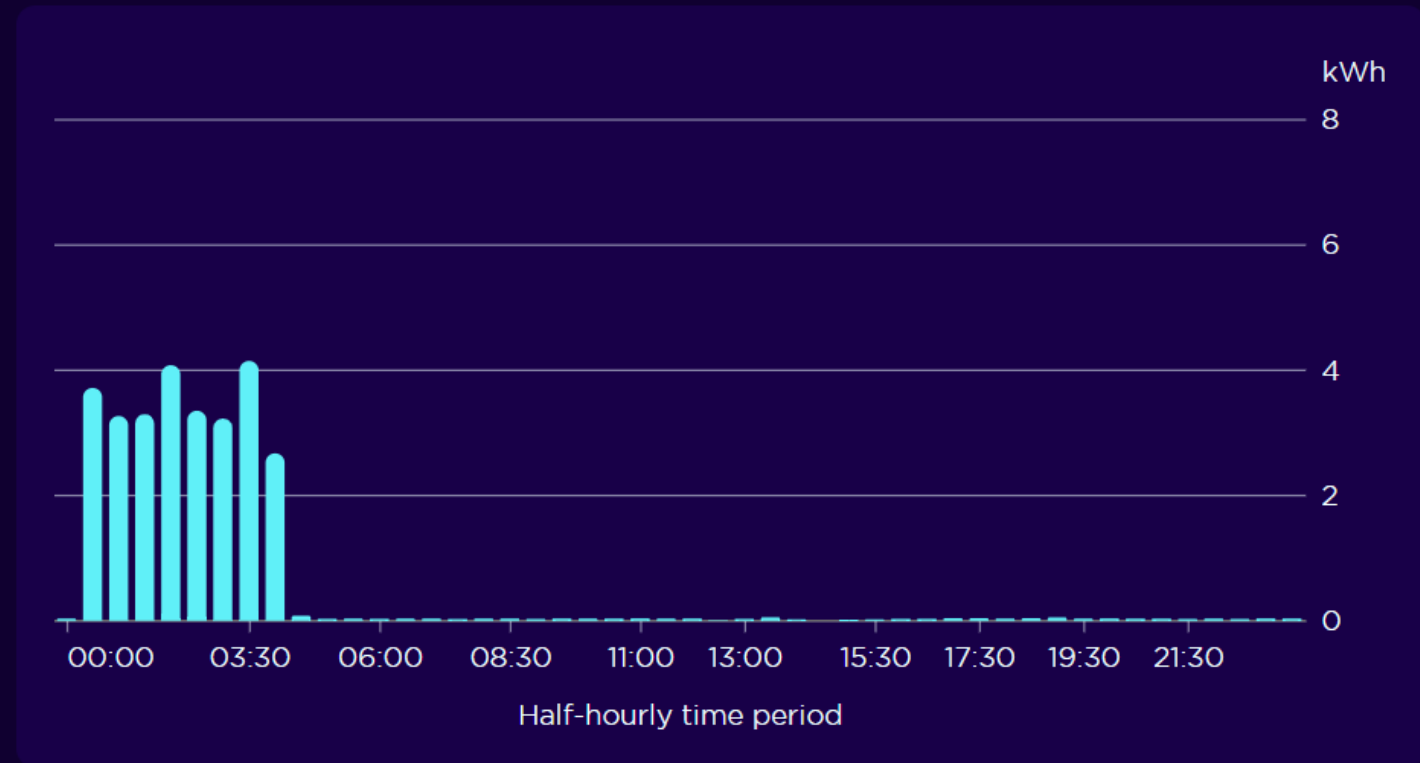
>£2000 a year savings... Really!...

Hardware payback <3 years!

- Octopus Go tariff
 - 5p 0030-0430
 - 24p 0430-0030
 - 3p export
- High energy household
 - 41kWh – single day
 - Heat pump
 - Two EVs
 - Solar
 - Electric cooking

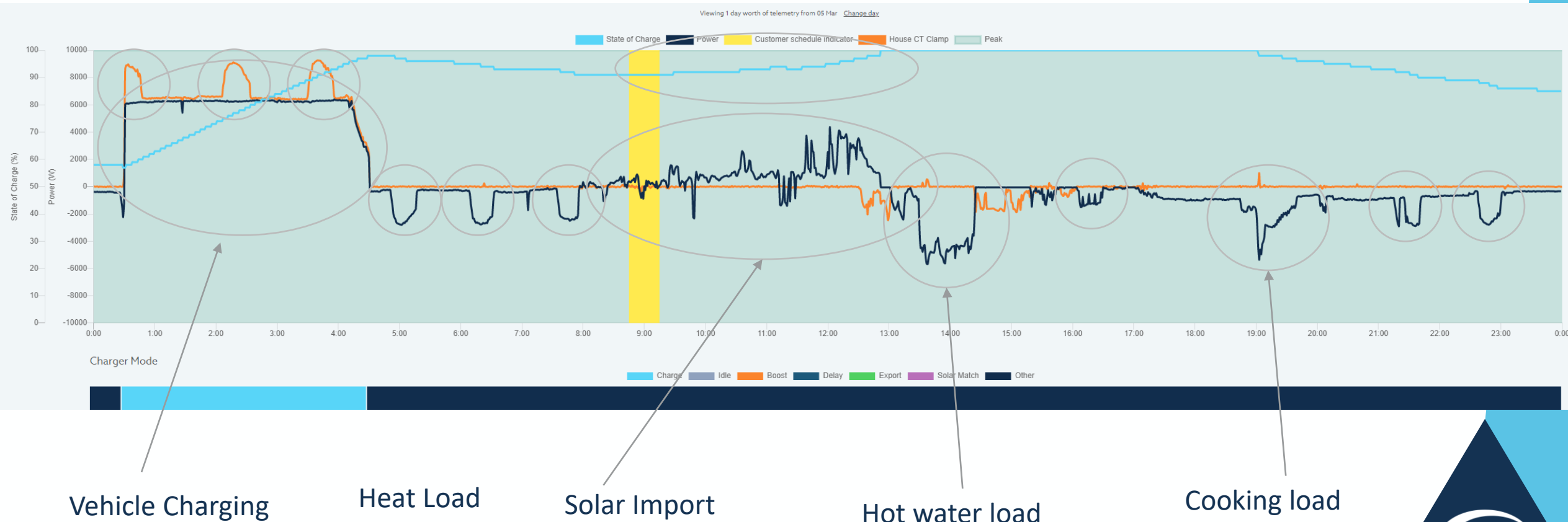
Your usage for Saturday, 05/03/2022

Total usage for this date: 29.183 kWh



V2H - Load Matching

- Predictive solar forecasting – don't charge to full
- Charge off-peak only
- Loadmatch through the day, in and out of battery



V2H – Real world tariff data

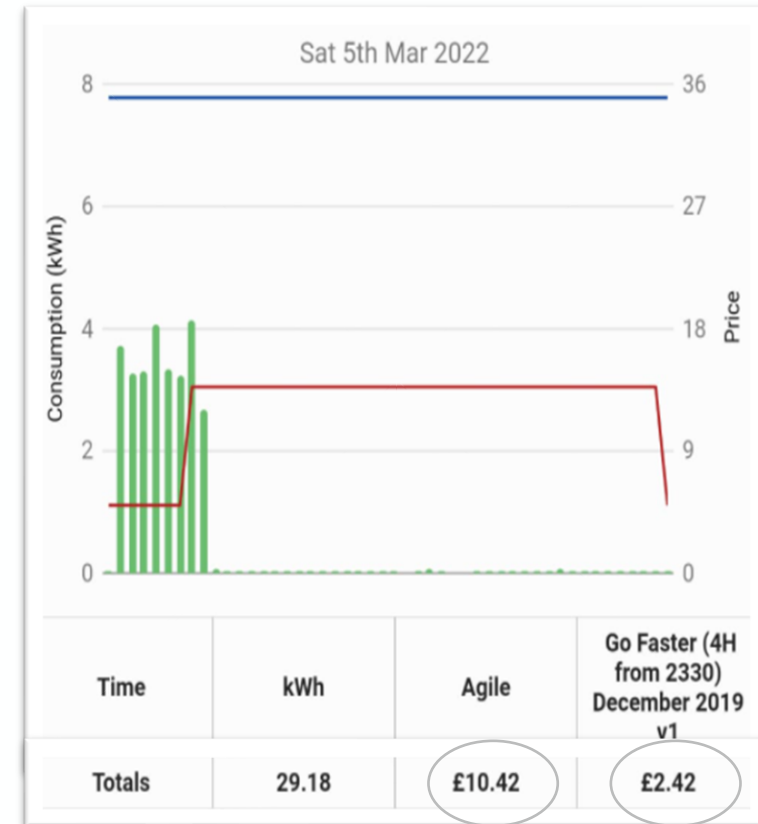
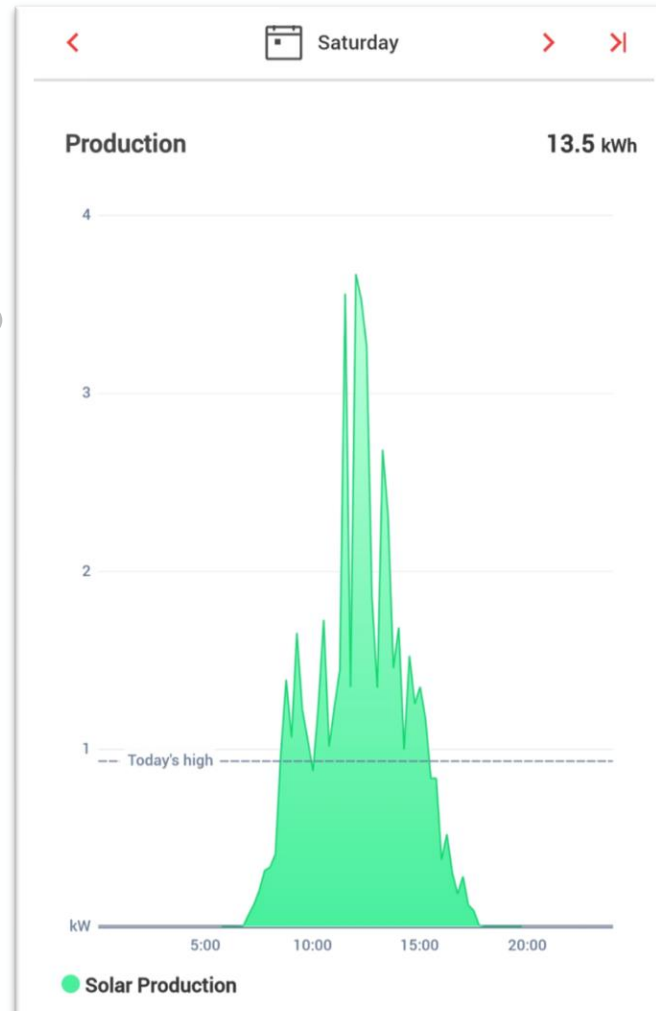
YOUR CONSUMPTION OVERVIEW

History

information may take more than 24h to show
savings vs. standard variable rate
savings always include the standing charge

Mon 7 March 2022	£3.05 go SEG	7.70p/kWh 4.10p/kWh	35.59 kWh
Sun 6 March 2022	£3.04 go SEG	9.32p/kWh 4.10p/kWh	29.33 kWh
Sat 5 March 2022	£1.85 go SEG	5.92p/kWh 4.10p/kWh	27.44 kWh
Fri 4 March 2022	£2.00 go SEG	8.95p/kWh 4.10p/kWh	18.00 kWh
Thu 3 March 2022	£2.60 go SEG	10.47p/kWh 4.10p/kWh	22.05 kWh
Wed 2 March 2022	£4.80 go SEG	8.82p/kWh 4.10p/kWh	51.97 kWh
Tue 1 March 2022	£3.19 go SEG	6.74p/kWh 4.10p/kWh	44.02 kWh

Last 7 Days – £2.93/day – £20.53 total
import: 34.65kWh/day – 8.14p/kWh
export: 2.03kWh/day – 4.10p/kWh



Flat rate

TOU tariff

£8 difference!

- 42.7kWh total consumption
 - 29.2 kWh purchased (off peak)
 - 13.5kWh generated
- 1.7kWh exported (battery full)

Further Opportunities and Development

- Balancing Services & Firm Frequency Response (FFR)

V2G can be further developed and tested against the qualification requirements to provide Dynamic or Non-Dynamic FFR Balancing services to the Network Operator

- CCS / ISO15118

The Combined Charging System (CCS) has emerged as the dominant EV Charging standard within Europe.

The existing Vehicle to Grid hardware can be used as the base for the development of Combined Charging System ("CCS") compatible V2G unit equipped with CCS inlets.

- Test and certification

CHAdeMO has this right! Independent validation and testing by a third party test house:

- Manufacturer data pack
- CHAdeMO evidence pack
- Testing in third party lab

CCS has no formal certification path leading to interoperability issues in the real world.

- Standalone/off-grid – Energy security

A stand-alone (islanded) system V2G that operates independently of, or is not connected to the distribution network.

This can be used in small off grid installations in collaboration with on-site renewable energy generation.

Ideal where energy security is critical – e.g. medical needs.

Thank you

INDRA Renewable Technologies
Making Energy Smarter



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