Leading Smart Charging

Lennart Verheijen
Vision
Proud to be GreenFlux
Leader in EV smart charging solutions

20,000 connected charge points
61,000 drivers
Access to 100,000+ charge stations in Europe
Supporting 1,000,000+ drivers to use our customers’ stations
International customers in 20+ countries
White label CPO & eMSP platform

- Billing and transaction management
- Remote management and support
- Global Roaming via open standards
- Smart Charging
- App
- Interfaces / API
What is smart charging?

increase/decrease maximum charge rate
Why do you do smart charging?

GRID CONSTRAINTS
DYNAMIC ENERGY PRICES
USER REQUIREMENTS
LOCAL RENEWABLE ENERGY
How do we do it

GreenFlux platform
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infinitely scalable</td>
<td>Unlimited number of chargers</td>
</tr>
<tr>
<td>Interoperable</td>
<td>Works with any charging station</td>
</tr>
<tr>
<td>Independent</td>
<td>User input possible, not required</td>
</tr>
<tr>
<td>Intelligent</td>
<td>Cloud-based intelligence Ongoing updates and optimizations</td>
</tr>
<tr>
<td>Blazingly fast response</td>
<td>Communications through open standards</td>
</tr>
<tr>
<td>Any location, any charger, any EV</td>
<td></td>
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</tbody>
</table>
How do we do it

STEP 1

We set the available capacity over time
How do we do it

STEP 2
We distribute energy over time
How do we do it

Power

Max kW

Time
How do we do it

Power

Max kW

Time
How do we do it

Smart charging example

Amperage

Time

Mitsubishi Outlander - max 16A
BMW i3 - max 32A
Kia Soul - max 32
Opel Ampera - max 16
Maximum allowed capacity during the day
Use case

Head office of the largest Dutch grid operator

2013: 16 chargers at 250A
2018: 100 chargers at 400A

Smart charging saved ~€250,000 on infrastructural costs

Smart charging is active ~10% of the time, resulting in a 90% higher charge rate for an EV
Use case
Electric Nation Project
Use case

Electric Nation Project

- 673 participants
- 2 year trial
- Over 130,000 charging events
Electric Nation
Households come first

Consumption by office building
Electric Nation
Households come first

Consumption by households
Electric Nation
Households come first

Consumption by households

Spare capacity for electric vehicles
Electric Nation
Households come first

Load management

Consumption by households

Consumption by electric vehicles

Allocated to connected EVs
Available capacity for EVs
First iteration
Second iteration

High Priority

Medium Priority

Low Priority
Third Iteration

Introducing price incentives
Third Iteration

Electric Nation EV Charging "Tariff"

15p/unit fixed price tariff

- Electricity Price per Unit (kWh)
- 00:00, 06:30, 16:30, 19:00, 22:00, 00:00
Third Iteration

**REWARD BALANCE**
£ 20.62

**CHARGE SCHEDULE**
Minimise costs

**CHARGE SESSION**
Not charging

**RECENT TRANSACTIONS**
20 kWh
Reward: £GBP0.62
21/08 16:21 - 22/08 10:56

Electric Nation EV Charging "Tariff"

- **15p/unit fixed price tariff**

Graph showing electricity price per unit (kWh) over time from 00:00 to 23:00.
Third Iteration

Default setting
Third Iteration

Minimize cost

Electricity Price per Unit (kWh)

15p/unit fixed price tariff
Third Iteration

Optimise time and cost

Electricity Price per Unit (kWh)

15p/unit fixed price tariff

00:00 06:30 16:30 19:00 22:00 00:00
Third Iteration

At the end of the project:
Reward paid as an Amazon voucher
Electric Nation project

Learnings

Smart charging can be a challenge

1. **Data** is crucial and not always available
2. Some cars do not respond to smart charging **signals**
3. Some cars are on **timers**
4. Possible **network failure** requires fallback scenario’s
5. **Data costs** can ruin your business case
6. Limited **bandwidth** with 2G
Electric Nation project

Learnings
Electric Nation project

Learnings - 1

Demand management is **technically feasible**, and **acceptable** to the majority of participants.
Electric Nation project

Satisfaction with current charging arrangement

<table>
<thead>
<tr>
<th>Trial</th>
<th>1 to 4</th>
<th>5 to 7</th>
<th>8, 9 and 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 3</td>
<td>2%</td>
<td>14%</td>
<td>84%</td>
</tr>
<tr>
<td>Trial 2</td>
<td>6%</td>
<td>14%</td>
<td>80%</td>
</tr>
<tr>
<td>Trial 1</td>
<td>3%</td>
<td>15%</td>
<td>82%</td>
</tr>
<tr>
<td>Baseline</td>
<td>3%</td>
<td>12%</td>
<td>85%</td>
</tr>
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Electric Nation project

Learnings - 2

Data from smart chargers can provide a **strong data source** for building an evidence base for future developments.

Data shows there is **a lot of flexibility** in EV charging.
Informing and empowering EV-drivers is crucial in smart charging

It needs to be easy
• Finding chargers
• Smart charging
• Roaming and Paying

The best apps never leave the pocket
Electric Nation project

Learnings - 4

Trial data shows that **Time of Use incentives** appear to be highly effective at moving demand away from the evening peak.

The **right incentive is crucial** though.
Start of charging time – Dynamic Tariffs

Distribution of Start of Charging Times - ToU (Trial 3) compared to non-ToU - Weekday
(GreenFlux)
Start of charging time – Dynamic Tariffs
Start of charging time – Dynamic Tariffs

This is great for the grid,
For the energy supplier: not so much
What we now offer

Wholesale markets

Energy Supply

Grid limitations

Fixed discount / free charger / saving for towels / ...
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Learnings - 5

Waiting 15 minutes for a recalculation can be annoying
Switching to event-based algorithms

Smart charging example

- Mitsubishi Outlander - max 16A
- Kia Soul - max 32
- BMW i3 - max 32A
- Opel Ampera - max 16
- Maximum allowed capacity during the day
Switching to event-based algorithms

Our developers call this “smart charging art”
Switching to event-based algorithms

Responding directly to events:
- Start of charge session
- Stop of charge session
- EV nearly full
- EV full
- High priority request from driver
- High priority request from charger
- DC charger starting a session
- Sudden change in available capacity
- New setpoint from energy supplier
- New setpoint from TSO
- …
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Learnings - 6

We can apply this TODAY
Why do you do smart charging?

grid
constraints

dynamic
energy prices

user
requirements

local
renewable energy
Beyond Electric Nation

Continuously updating the algorithms
Further integration with apps, metering platforms, charging stations, etc.
Rolling this out commercially
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Project report: https://www.westernpower.co.uk/downloads/64369
Project summary: https://www.westernpower.co.uk/downloads/64369