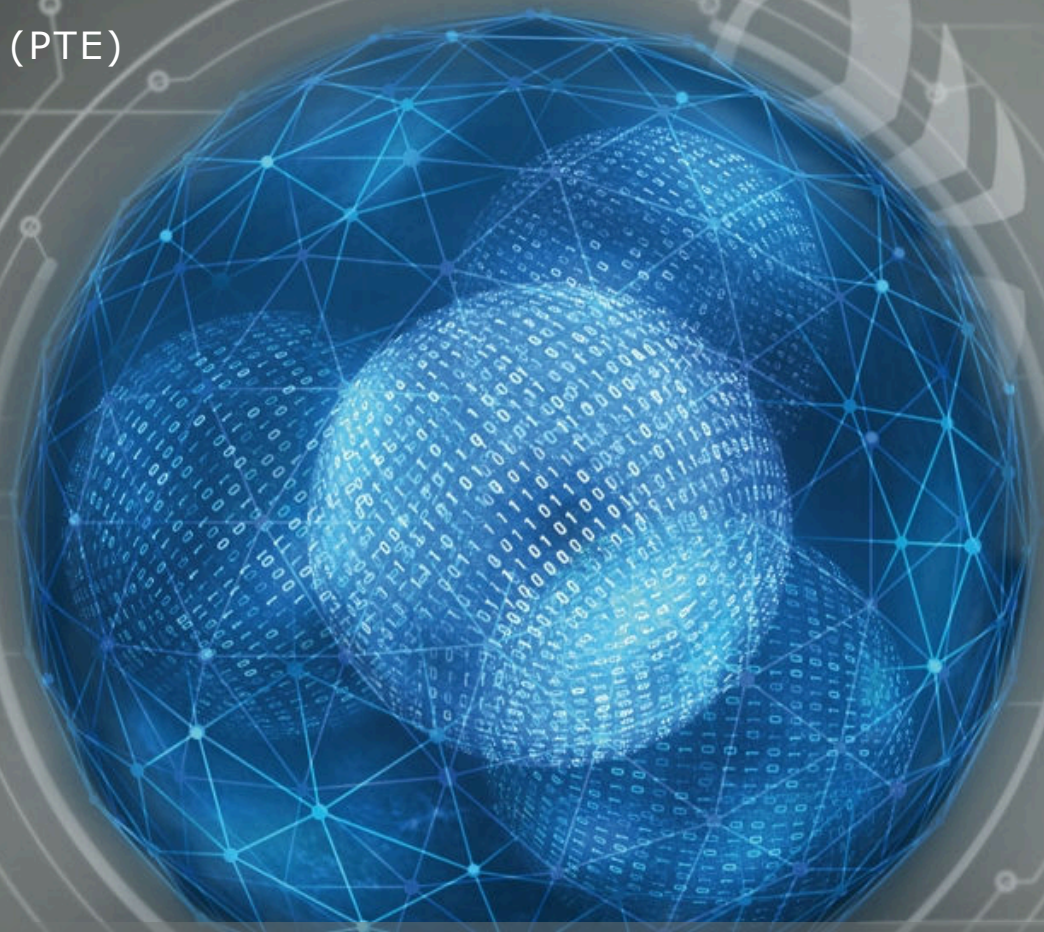
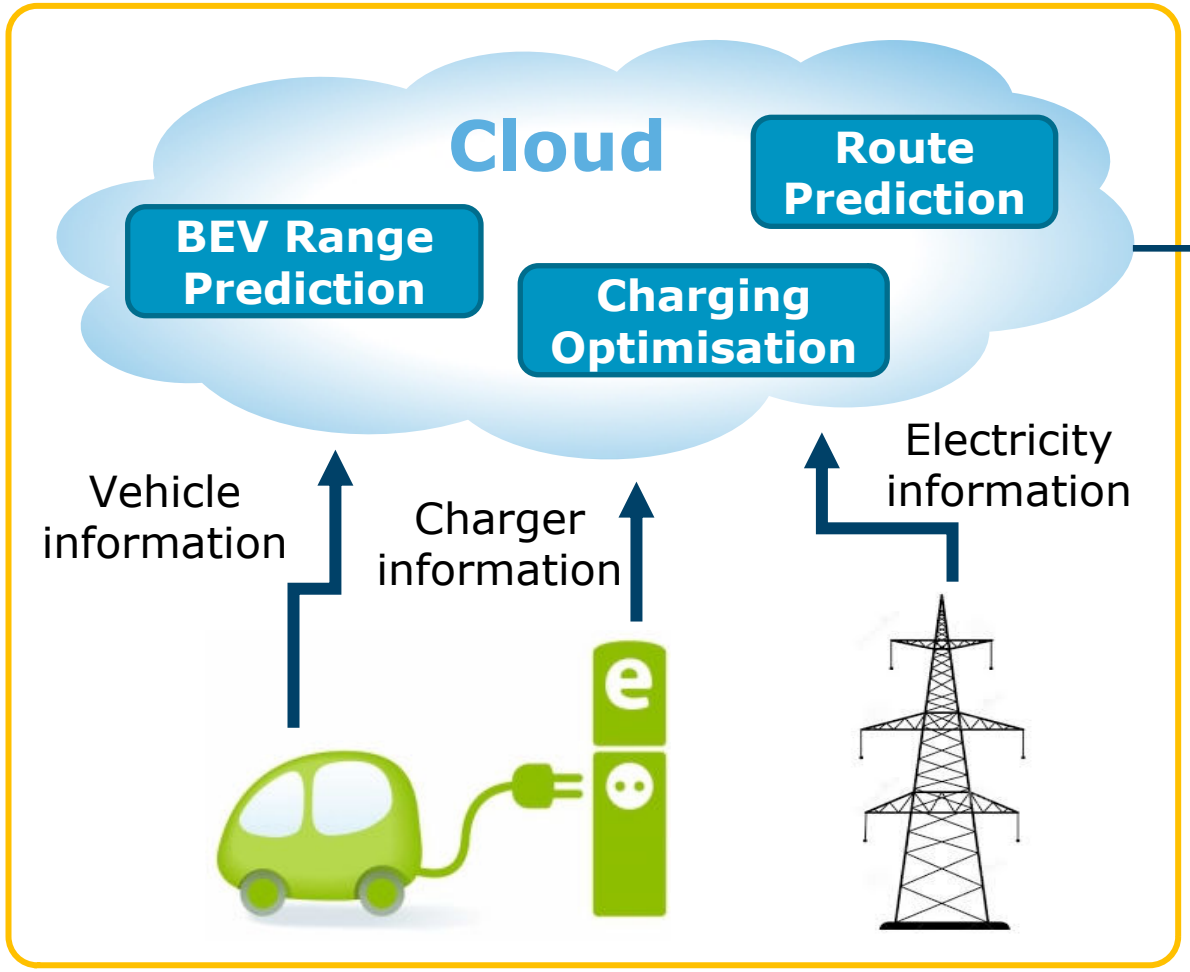
AVL Powertrain UK Ltd. (PTE)



# Cloud-Based Big Data Platform for V2G

## EVS32 Conference – Florent Grée

**Aim:** Create a cloud-based big data platform which optimise the V2G process thanks to machine learning and artificial intelligence and provide useful information to target customers




## Target Customers

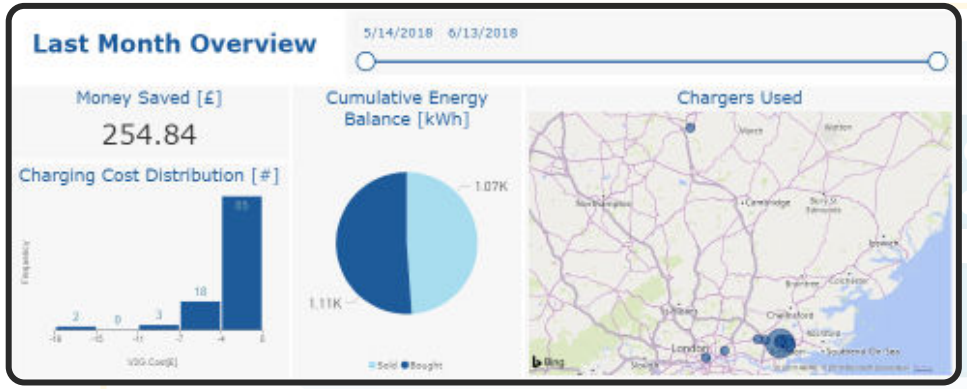
**BEV Owner**
(e.g. Charging optimisation)

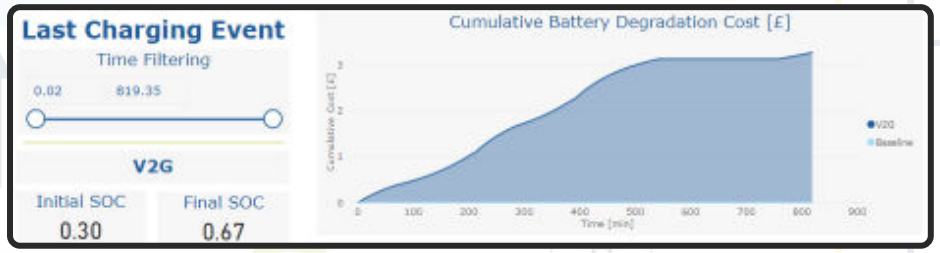
**OEMs**
(e.g. Battery degradation)

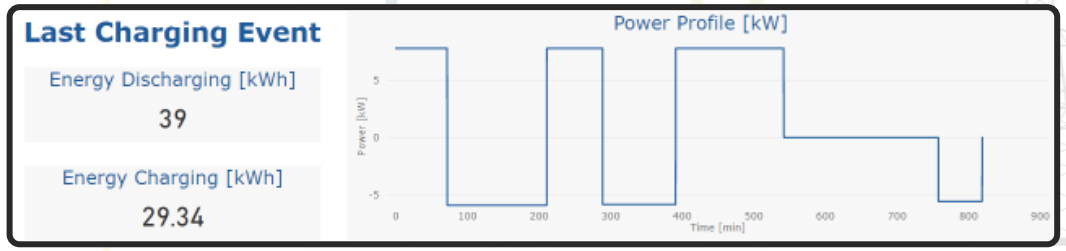
**Charger Provider**
(e.g. Charger location selection)

**Government**
(e.g. Utility strategy)

**Aim:** Create a cloud-based big data platform which optimise the V2G process thanks to machine learning and artificial intelligence and provide useful information to target customers




Vehicle information

## Target Customers

**BEV Owner**
(e.g. Charging optimisation)

**OEMs**
(e.g. Battery degradation)

**Charger Provider**
(e.g. Charger location selection)

**Government**
(e.g. Utility strategy)

## Various and unstructured data

Timeseries

Geo data

Metadata

Constants

## SQL vs NoSQL

Relational data model

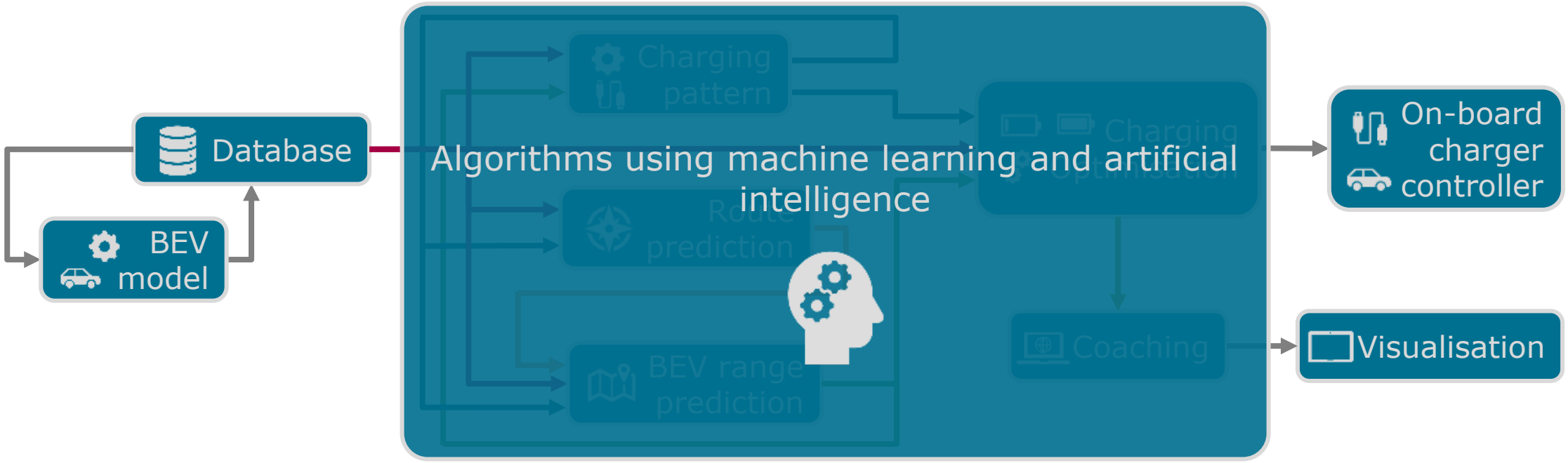

Document data model

## NoSQL and MongoDB chosen

NoSQL database type is chosen for its scalability & flexibility and schema-free characteristics
MongoDB is chosen for its capability to store data in JSON-like documents and support of Python

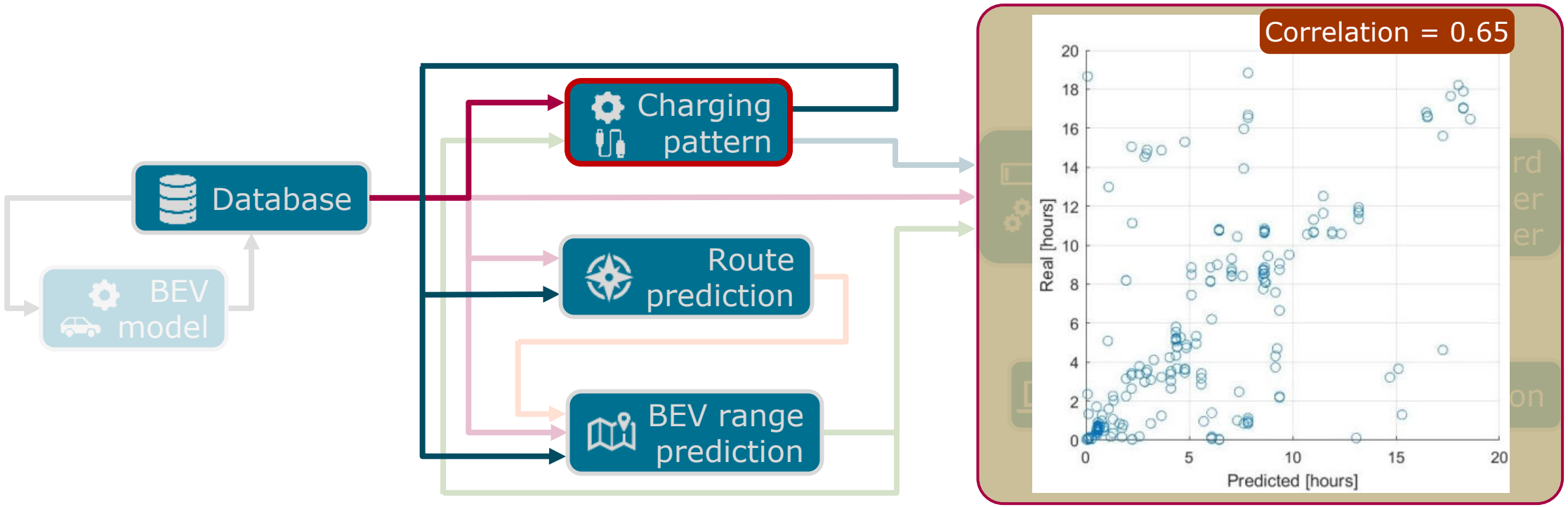
mongoDB.

# Algorithms & Data Process Flow



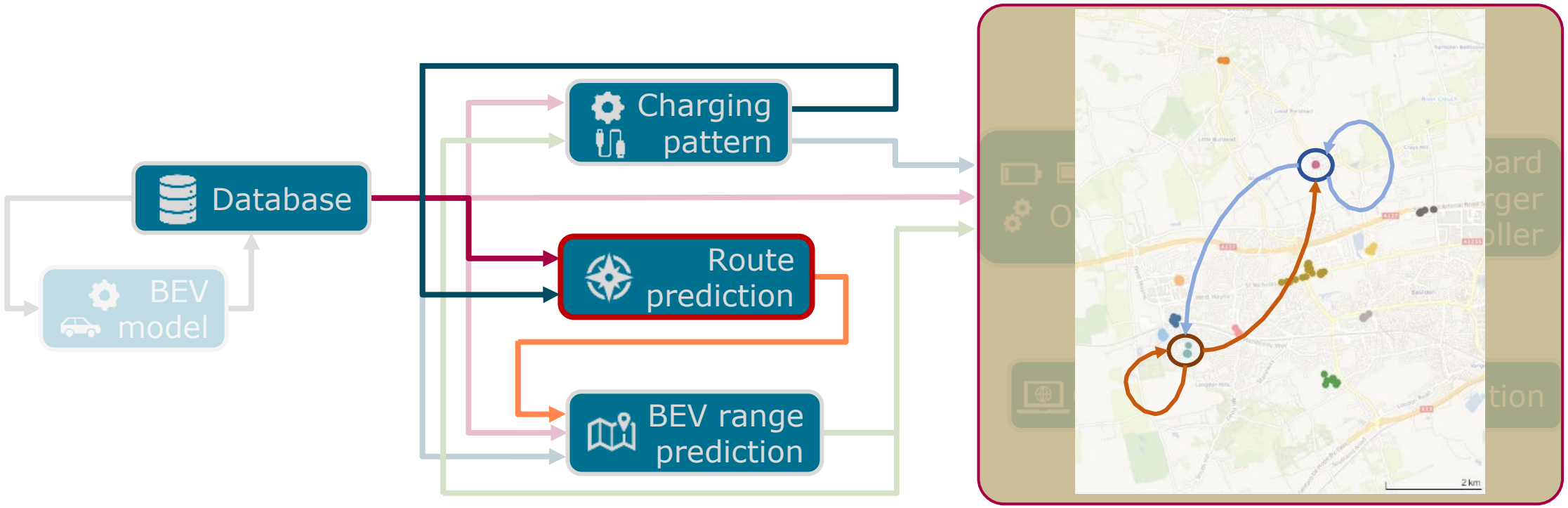

- Store real-world data into a database and enrich it with external sources
- Convert conventional vehicle data logged into BEV model

# Algorithms & Data Process Flow



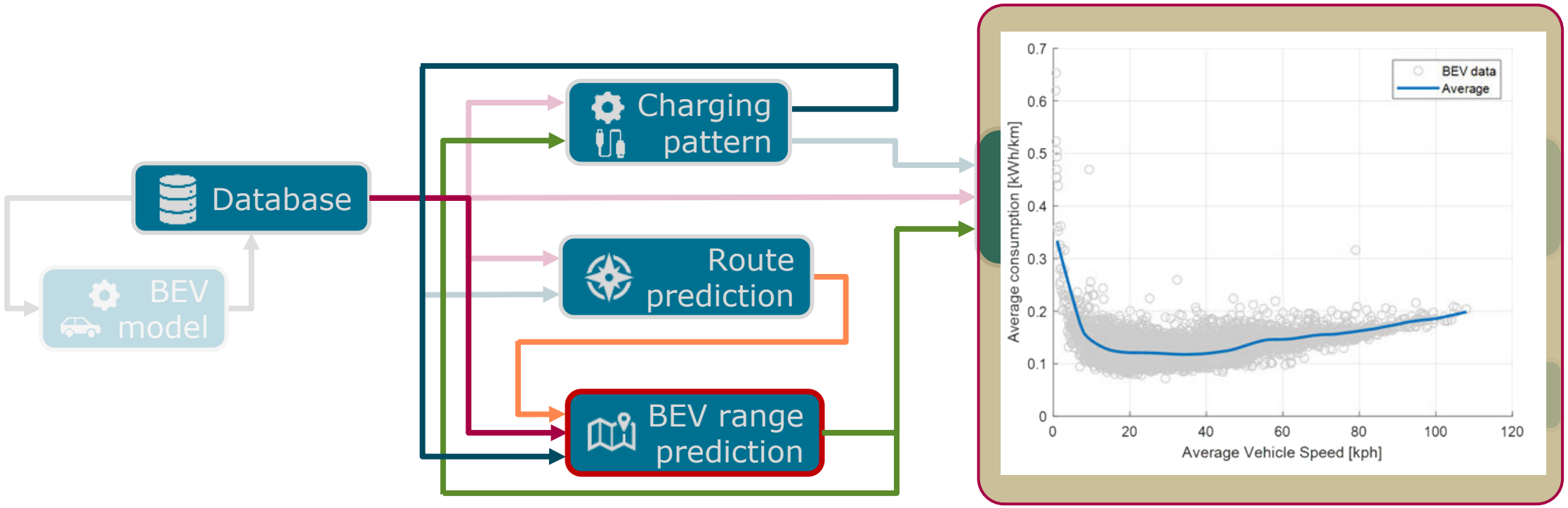

First part of charging pattern algorithm:
- Predict the duration of the parking event
- Use of Decision Tree

# Algorithms & Data Process Flow



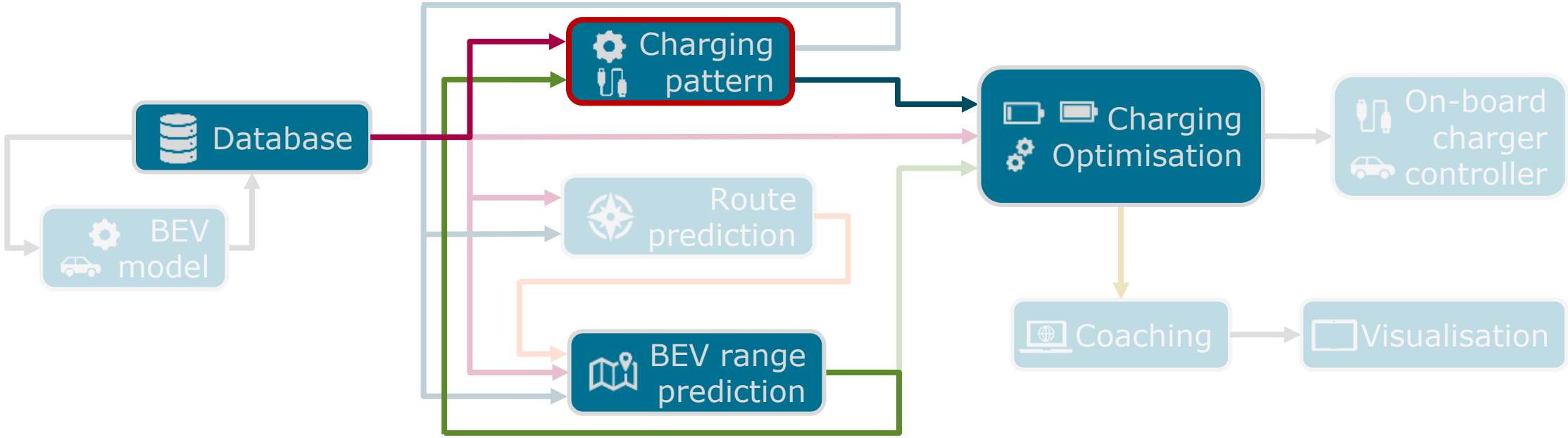

- Predict the next trip destination (latitude, longitude)
- Use of Density-Based Spatial Clustering and Markov chain model

# Algorithms & Data Process Flow



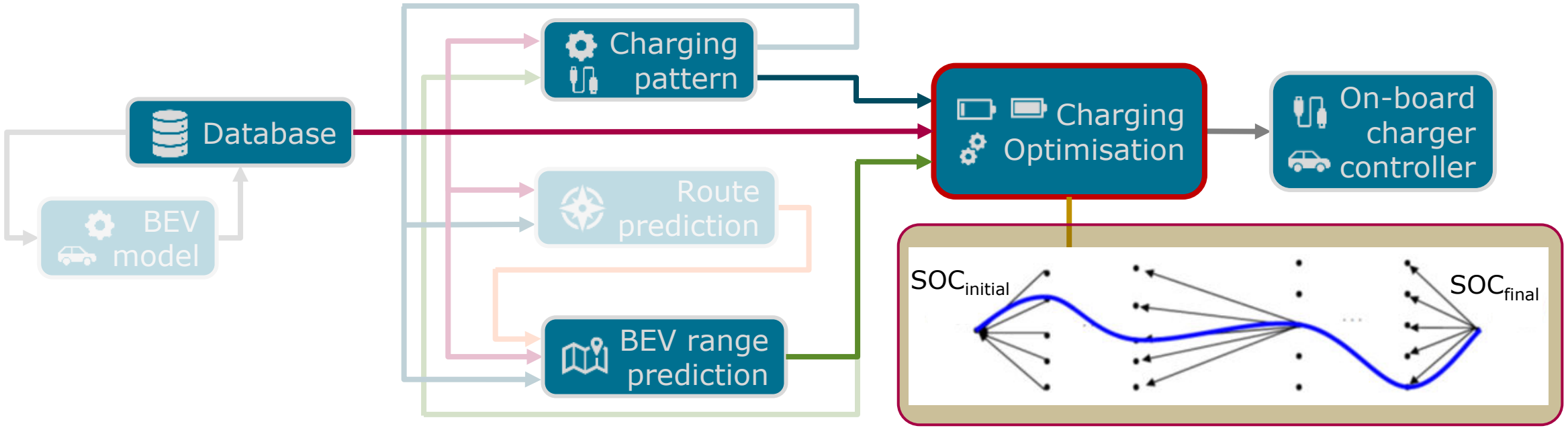

- Calculate the SOC required for the next trip (Average of consumption)
- Get the next trip distance (Google API)

# Algorithms & Data Process Flow




Second part of charging pattern algorithm:
- Define whether the vehicle is plugged-in or not
- Use of Random Forest

# Algorithms & Data Process Flow




Define the power profile thanks to Dynamic Programming allowing to:

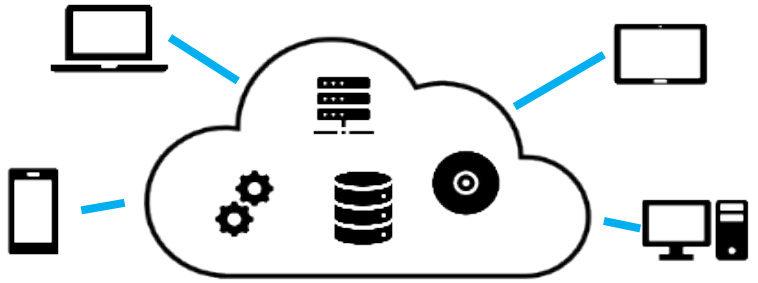
- Reach the minimum SOC level for next trip
- Minimise the charging and battery degradation costs

## Why using a cloud solution?

Provide a service to our target customers

## What is a cloud solution?

**Traditional approach**
Data, applications, services on-premises

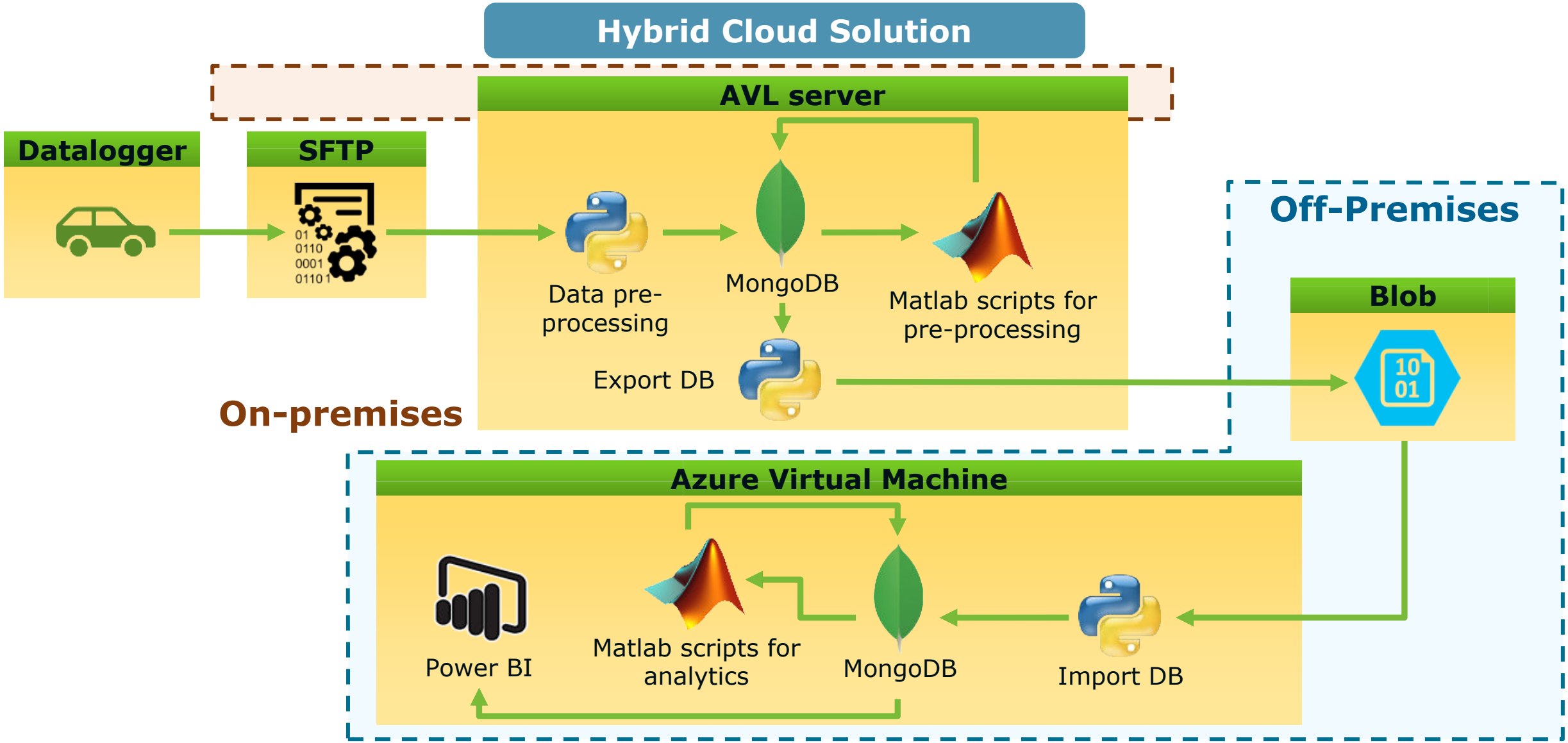


**Cloud approach**
Data, applications, services on cloud (off-premises)

## Our cloud solution

**Hybrid solution**
- Raw data and data pre-processing on-premises
- Analytics (ML, AI) and visualisation on cloud

# Hybrid Cloud Solution




## V2G Driver Usage

AVL

### Last Charging Event

Money Saved [£]

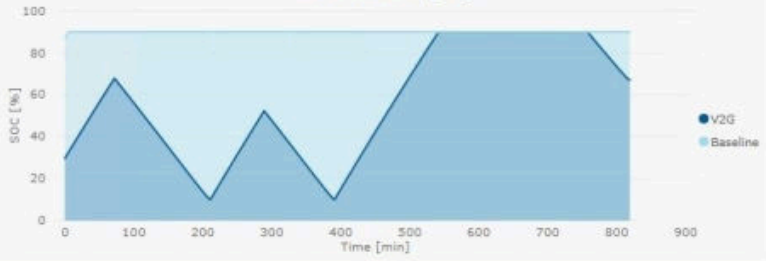
3.01

Degradation Cost [£]

0.27

"Money Saved" is the amount of money saved when using V2G compare to baseline (where only charging is happening).

SOC Profile [%]



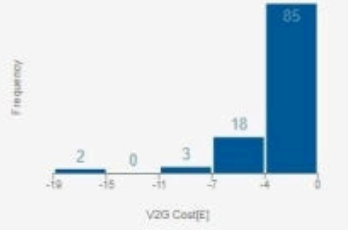

### Last Month Overview

5/14/2018 6/13/2018

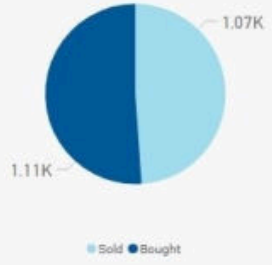
Money Saved [£]

254.84

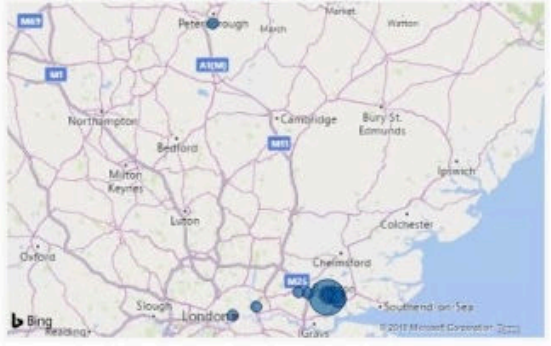
Charging Cost Distribution [#]




Cumulative Energy Balance [kWh]




Chargers Used




Electricity Cost For Each Charging Event [£]


## V2G OEM

AVL

### Last Charging Event

Time Filtering

0.02 819.35

**V2G**

| Initial SOC | Final SOC |
|---|---|
| 0.30 | 0.67 |

Total Degradation cost [£]

0.27

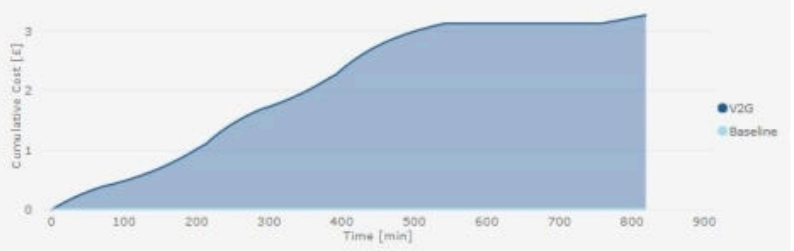
**No V2G**

| Initial SOC | Final SOC |
|---|---|
| 0.87 | 0.90 |

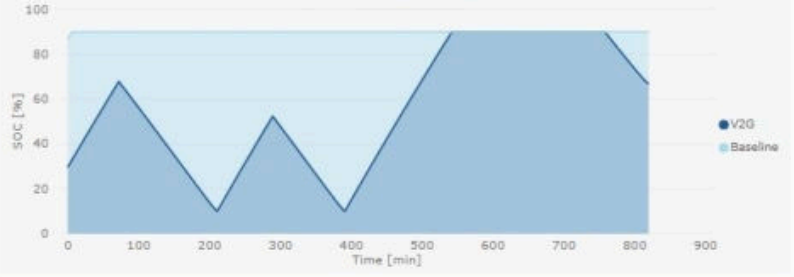
Total Degradation cost [£]

0.02

Cumulative Battery Degradation Cost [£]



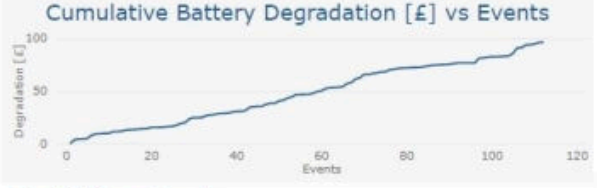

SOC Profile [%]




### Last Month Overview

Battery Value [£] vs Events


Cumulative Battery Degradation [£] vs Events




Battery Degradation Cost [£] Per Events


www.avl.com

**Please contact as below if you have any questions**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