ELECTRIFIC: SEAMLESS ELECTROMOBILITY

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MOTIVATION: CHALLENGE ELECTROMOBILITY

Today in Europe: ~1Mio

Goal 2020: 8-9Mio

Goal 2030: ~Half of all vehicles in Europe!

Problem 1:

Challenges for the grid stability (DSO)

→ + 5-15% load till 2030

Reasons:

Uncoordinated charging
Uncertain demand
Unknown duration and speed of charging
MOTIVATION: CHALLENGE RENEWABLE ENERGY

Problem 2:
Volatility of electricity supply is constantly increasing

Reason:
Intermittent renewables
(in Europe today: 20% of the overall energy share, 2030: > 27%, 2050: > 80%)

Source: http://euanmearns.com/eu-2020-renewable-energy-targets-part-1/
EMOBILITY ECOSYSTEM – ELECTROMOBILITY SERVICE PROVIDER

[Diagram showing interactions between different entities in the electromobility ecosystem, such as ESO, RESG, CSP, EVO, ES, EFU, and local business, highlighting the processes of stabilizing the grid, maximizing profit, attracting customers, and providing incentives to maximize EV attraction.]
ELECTRIFIC ADAS
Advanced driving assistance system
ADAS, ROUTING FOR SMART CHARGING

3 ways to optimize journeys

The driver gets 3 suggestions:
• The «greenest» route
• The fastest route
• The cheapest route, in terms of energy price

Key parameters collected:
• % of REN available during the charging process
• Journey price (incl. grid cost)
• Journey duration including the charge

http://electrific.eu
ADAS APP

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CS RESERVATION VIA ADAS

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Battery tip: Sun damages your skin and also your battery - try to park in the shade today.

Battery tip: You would hate racing in this heat - and so does your battery. Slow charge today!

Battery tip: No one likes to freeze, and your battery is not wearing a sweater. Park somewhere warm today!

Battery tip: It's not cold enough to get a snow day just yet, but cold enough that you have to charge slowly (> 1 C) to take care of your battery.

Battery tip: We don’t recommend overeating – your battery is nearly full and charging more will decrease its lifetime.

Battery tip: Don’t starve your battery – charge it at the next opportunity to keep it well-fed and healthy.
SMART CHARGER
Seamless charging
SMART CHARGING SOLUTION

Smart charger helps stabilizing the grid

- **Proactive**: Based on demand, prevents possible issues at local level
- **Reactive**: If issues, it helps returning to stable status

Design Criteria

- Scalable real-time architecture
- Separation of concerns of the different stakeholders
- Safe test and deployment in real-world environment

P1, P2, P3: Power of the charging station
KPI: Key Performance Indicator of the power grid, e.g. voltage
E1, E2, E3: Event from the power grid
OCPP: Open Charge Point Protocol 1.6+
TESTBED IN VILSHOFEN
SMART CHARGER SETUP

Architecture developed by Gfi (algorithms by UniPassau)
EVALUATION

Simulation Setup

• Real low voltage grid with realistic load profiles
• Four CSs at three different locations
• One minute between FSM transitions
• Baseline scenarios
  • Baseline_min: No charging at all
  • Baseline_max: All CSs charge with 22 kW
EVALUATION

Baseline_max: All CSs charge with 22 kW

Baseline_min: No charging at all
**EVALUATION**

**Baseline_min**: No charging at all

**Baseline_max**: All CSs charge with 22 kW

*Voltage level at the critical point*

![Graph showing voltage levels over time](image-url)
CHARGING SCHEDULER

Fleet charging optimization
Cost optimization for whole fleet charging

4 optimization parameters

- Working price,
- grid friendliness,
- renewables
- battery friendliness

Fundamental constraints

1. Charging availability
2. CS-EV-Compatibility
3. Charging powers of CS/EV
4. Grid capacity compliance
5. Single charging of EV at CS adapter
6. No multiple chargings of one EV
7. Battery capacity compliance
8. Consideration of startSoC and endSoC
9. Tour readiness
10. (Location matching)
CHARGING SCHEDULER WEB INTERFACE

Input screen – integration with SCADA systems

Visualization Screen: Charging Plan
CHARGING SCHEDULER BALANCING CRITERIA

Preferences

Feeder Line Forecast

04/06/2019

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CHARGING SCHEDULER, HOW DOES IT WORK?
ALLOCATION MECHANISMS

Price based, demand based, etc
PRICING/ALLOCATION MECHANISMS

- Flat rate
  - Current practice
- Location/time based rates
  - Shift demand in time and space
  - Medium complexity
- Dynamic rates
  - Dynamic response to events, practical with high demand
  - Maximizes benefits
  - High complexity

Example: projected demand of location based pricing
DASHBOARDS
Complete solution for DSOs, EFOs, CSPs
Main DSO dashboard view containing the location and structure of a specific low voltage grid
DSO DASHBOARD INFORMATION ON THE TRANSFORMER STATION

Short term info

Long term info

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EFO (ELECTRIC FLEET OPERATOR)

SHORT TERM VIEW

Short term EFO dashboard shows the impact of the optimisation on the exploited percentage of renewables from the grid.
EFO, SHORT TERM VIEW

Display of the user preferences between the different optimisation criteria

Display of information about the most active vehicles of the fleet
Show the impact of the optimisation on the exploited percentage of renewables from the grid

Display of the user preferences between the different optimisation criteria
CHARGING SCHEDULER INTEGRATION WITH ENERGY MANAGEMENT SOLUTIONS

**Assets**
- Depos
- Feeder lines
- Charging stations
- EV (Batteries)

**Metrics**
- Max consumption
- Average consumption
- Consumption per each charging station
- « State of Charge » of batteries
- Time till full charging

**Dashboards**
- Charging stations usage (current and historical)
- Usage of « feeder line » per contract
CSP → OFFERED AS PART OF THE CSMS
FROM THE RESULTS PERSPECTIVE

• ADAS → Mobile app
  • Car manufacturers: Better service to their drivers
  • Public authorities: Better mobility, less CO2 emissions
  • EFOs: Dynamic pricing on CSs based on demand and DSO constraints

• Smart charger → Solution to be used by the EFO, integrated to the CSMS
  • EFOs: Avoiding penalties from DSO
  • DSO: Regulation of capacity and demand

• Charging scheduler
  • EFOs of any type (public fleet, public CSs on the street, corporate – collectivities): Able to serve more vehicles keeping QoS

• Allocation mechanisms
  • Public authorities: Who to distribute traffic in the city
  • EFOs: Who to increase benefit while optimizing fleet management
ANY QUESTIONS?

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