The Kortrijk Operational Pilot: Assembling the puzzle

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Kortrijk City Pilot, Belgium

Partners:
- KU Leuven (BE) (deployment, analysis)
- City of Kortrijk (BE) (voluntary participation)
- University of Northumbria, Newcastle upon Tyne (UK) (analysis)

Pilot type: Vehicle-to-business (V2B)
Kortrijk Pilot: location

- Consumption sites:
  - Sports centre
  - Depot 102

- PV on roof of Depot 102

- Most demand at Depot 102

- Sports centre: lighting loads (evening)
Power & information flows: start

78 kWp PV
~20 MWh export

Grid

Annual demand Kortrijk Depot 102
240-250 MWh

~10,000 km/y
Weekdays 7-15h

Diesel

Power flow in one direction only
Bidirectional power flow
Data and control

Database

Demand

PV production
Situation at the start: case for improved solar capture + V2G and/or BESS
Timeline

Sep '16-Jun '17: MSc thesis #1
Potential of:
- EV
- Relighting (energy efficiency)

Sep '17-Jun '18: MSc thesis #2
Smart charging & V2G algorithms

Sep '18-Jun '19: MSc thesis #3
- Thermal tests of V2G charger prototype
- V2G in practice

Sep '19-Jun '20: MSc thesis #4
- Solar charging of e-bikes

Nissan E-NV200 purchased by City of Kortrijk: replaced diesel van

17 Mar '20: Coronavirus lockdown in Belgium

Sep 2014: PV system installed

Sep 2016: Start SEEV4-City

Custom Li-ion BESS + BMS + EMS development

Mar '19: Personnel Change @KUL

BESS short-circuit

Apr '19-Mar '20: New Li-ion BESS procurement, development, EMS changes

Virtual operation

22 April 2020
BESS 2.0

- Procurement issues:
  - budget,
  - availability on market
  - delivery dates

- 6 kWh, 2.5 kW / 5 kW (ch/disch) LFP with 8 kW bidirectional inverter

- Developed enclosure (IP, temperature control)

- python-based EMS

- Ready to be moved to Kortrijk… coronavirus.
Ebikes universal charging station

- Accommodates up to 3 ebikes (0.5 kWh each)
- (Solar smart) charging via Android App for users
  - Priority is ability to cycle home (typ ~20 km)
- Improvements: MSc thesis (ongoing)
  - EPEX Spot charging
  - Upscaling potential (EVs, or 100x ebikes)
Power & information flows

- **Grid**
- **Annual demand Kortrijk Depot 102 240-250 MWh**
- **78 kWp PV ~20 MWh export**
- **V2G 1x EV 24 kWh Nissan E-NV 200**
- **6 kWh BESS**
- **3x E-bike 500 Wh Solar charge station**
- **Server Main EMS**
- **Database**
- **Demand**
- **PV production**
- **EPEX SPOT (day-ahead)**

**Power flow in one direction only**
- **Bidirectional power flow**
- **Data and control**

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22 April 2020
Snapshot of virtual operation

Kortrijk OP: 1x EV, 1x 6 kWh BESS, 100x ebikes

- Net demand, base case
- Net demand w EV, BESS, ebikes
- $P_{EV}$
- $P_{BESS}$
- $P_{ebikes}$

- EV charge from PV (weekend)
- EV charge from grid (weekday)
- EV charge + V2G
- EV departs
- EV returns
- EV V2G
- BESS charge from PV + discharge

100 ebikes
(3 ebikes negligible)
Preliminary impact of the project

Assumptions:

- ICE van = 244 g CO$_2$-eq/km (lifetime),
- EV: 24 g CO$_2$-eq/km (lifetime; driving km CO$_2$ impact already considered in EV charging),
- ebikes: 8 g CO$_2$-eq/km (lifetime)
- ICE & EV CO$_2$ estimates from A. Hoekstra (Joule, 2019)
- CO$_2$ emissions per hour from ENTSO-E platform

CO$_2$ emissions per hour from ENTSO-E platform
Lessons learnt

• Procurement
  • Market (im)maturity:
    • Hardware (BESS, V2G)
    • Software (EMS, BMS)
    • Services

• User acceptance is key
  • Trust in solution & reliability

• Technology
  • EV & BESS can be complimentary
  • Cost-benefit assessments still needed:
    • Ebikes vs EV,
    • energy efficiency

• Regulatory
  • Peak shaving currently of limited value in Flanders
  • Financial benefits / business models need work
Thank you

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