VtoX: An overview
The landscape of EVs for smart charging opportunities (VtoX)
<table>
<thead>
<tr>
<th>Sector</th>
<th>Value Stream</th>
<th>Definition and Value Derivation</th>
<th>Aggregated</th>
<th>Singular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wholesale</td>
<td>Resource Adequacy</td>
<td>Provides capacity through ability to discharge electricity (V2G) or ability to reduce demand (V1G/V2G) at future peak load hours. Value through RA mechanisms or Capacity Payments.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Frequency Regulation</td>
<td>Either fluctuate charge rate (V1G) or charge and discharge (V2G) to follow a 4 second regulation signal. Value through Ancillary Service markets or mechanisms.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Demand Response-Wholesale</td>
<td>Reduce charge rate or delay charge (V1G) or in addition to previous, discharge to grid (V2G) in response to grid conditions. Value through wholesale market DR mechanisms.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Energy Arbitrage</td>
<td>Buy electricity (charge) during low price hours and sell (discharge) at later high price hours (V2G only). Value through wholesale market in hourly price difference.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Spinning Reserves</td>
<td>Maintain electricity balance by immediately discharging to grid (V2G) or by interrupting charge (V1G) in response to grid contingencies. Value through Ancillary Service markets/mechanisms.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Load Following</td>
<td>Due to solar peak or wind fluctuation, discharge (V2G) to control system demand ramp rate. Value through Ancillary Services market.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Excess RES generation</td>
<td>Charge to absorb excess wind and/or solar generation. Value through reduced RES curtailment.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Peak Shaving</td>
<td>Charge at peak hours to reduce demand. Value through wholesale market.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Generation Pairing</td>
<td>Pared with RES to control ramp rate of large energy fluctuations or with thermal generator to improve flexibility and allow faster response time. Value through ancillary services market, bilateral contracts, and forged retro-fit upgrade costs.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Reactive Power Support</td>
<td>Adjust Reactive Power output to provide PFC, RPC, or VR (V2K only). Value through Ancillary Services market or through forged investment to reduce inductive loads.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Utilities/SO</td>
<td>Network Deferral</td>
<td>Reduce demand (V1X/V2X) or increase supply (V2X) at peak to meet projected load growth in capacity-constrained areas for the purpose of delaying, reducing, or avoiding Trans/Dist. build-out. Value via TSO/DSO direct payments or infrastructure deferral mechanisms.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Demand Response-Utility</td>
<td>Reduce charge rate or delay charge (V1X) or in addition to previous, discharge to grid (V2X) in response to grid conditions. Value through utility operated DR mechanisms.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Site-located RES firming</td>
<td>Discharge (V2X only) to firm site solar or wind generation capacity to improve RES utilization rates. Value through reduced RES curtailment and/or payments for meeting RES targets.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Customer</td>
<td>Bill Management</td>
<td>Reduce demand charges and adapt EV battery charge (V1X)/discharge (V2X) depending on tariff or TOU rates to minimize electricity costs. Value through cost savings.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Emergency Back-up</td>
<td>Provide emergency energy to buildings in the case of outage (V2X only). Value through costs savings of forgone diesel fuel or through V2U, estimation.</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Non-Emergency</td>
<td>Mobile source of electricity for recreational activities or rural areas: camping, concerts, construction sites, parties, etc (V2X only). Value through pricing for capability.</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Evs for transmission grid services: Tennet case
EV for City: Amsterdam
Electric Vehicles Can Provide Grid Services

- Car with charge-only capability
- Car with vehicle-to-grid capability

Reimbursement to vehicle owner

Smart Charge VtoG
Et en France?

DREEV
https://www.youtube.com/watch?v=xAnjug99ws&feature=youtu.be

Gridmotion
https://www.youtube.com/watch?v=VYeALAfE7c
Adaptations required
To do list

1. Standardisation
2. Regulation
3. Plateforms

**Communication standards**
- Goal: EVs « Plug and play » in VtoX environment
- Far from...

**Data collection and usages**
- Who is doing what with the data (EV / EVSE / Networks / OEMs...) ?

**Rooming rules for charging**
- National level
- European Level
- Moving with an EV and charge is a challenge

**Barriers to entry**
Most Flex markets are build for large players
Most VtoX revenues streams are still untapped => plateforms
Selected Literature

- Quentin Hoarau & Yannick Perez, 2019, Network tariff design with distributed energy resources and electric vehicles, Energy Economics.
- Ramírez Díaz Alfredo, Marrero Gustavo, Ramos-Real Francisco, Perez Yannick, 2018 Willingness to pay for the electric vehicle and their attributes in Canary Islands, Renewable and Sustainable Energy Reviews Volume 98, December 2018, Pages 140-149.
- Codani Paul, Perez Yannick and Petit Marc 2018 Innovation et règles inefficaces : le cas des véhicules électriques, Revue de l’Energie n° 638, Mai-Juin
- Rodríguez Brito Maria Gracia, Ramírez-Díaz Alfredo Jesús, Ramos-Real Francisco J., Perez Yannick, 2018, Psychosocial traits characterizing EV adopters’ profiles: The case of Tenerife (Canary Islands), Sustainability 2018, 10, 2053.
Call for papers de la conférence Internationale des économistes de l’énergie Paris 2020

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