Electromobility challenges: VtoX experiments

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Electric vehicles are challenging for Grid operators

1. Vehicle to Transmission grid = Vto TG
2. Vehicle to Distribution grid = Vto DG
3. Vehicle to buildings = VtoB
4. Vehicle to Home = VtoH
5. Vehicle to Load = VtoL

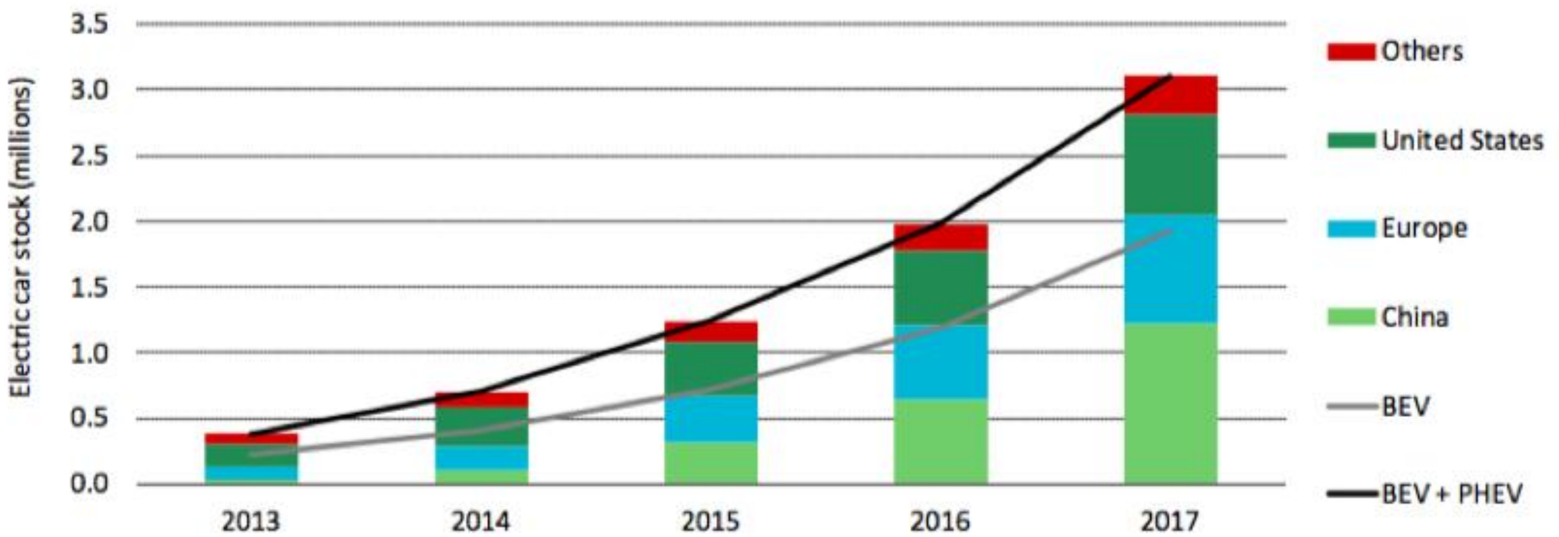
=> VtoX

Outline

1. The electromobility challenges
2. Solution by markets coordination
3. Solution by contracts
4. Conclusion

Sales are booming

Figure ES 1 • Evolution of the global electric car stock, 2013-17



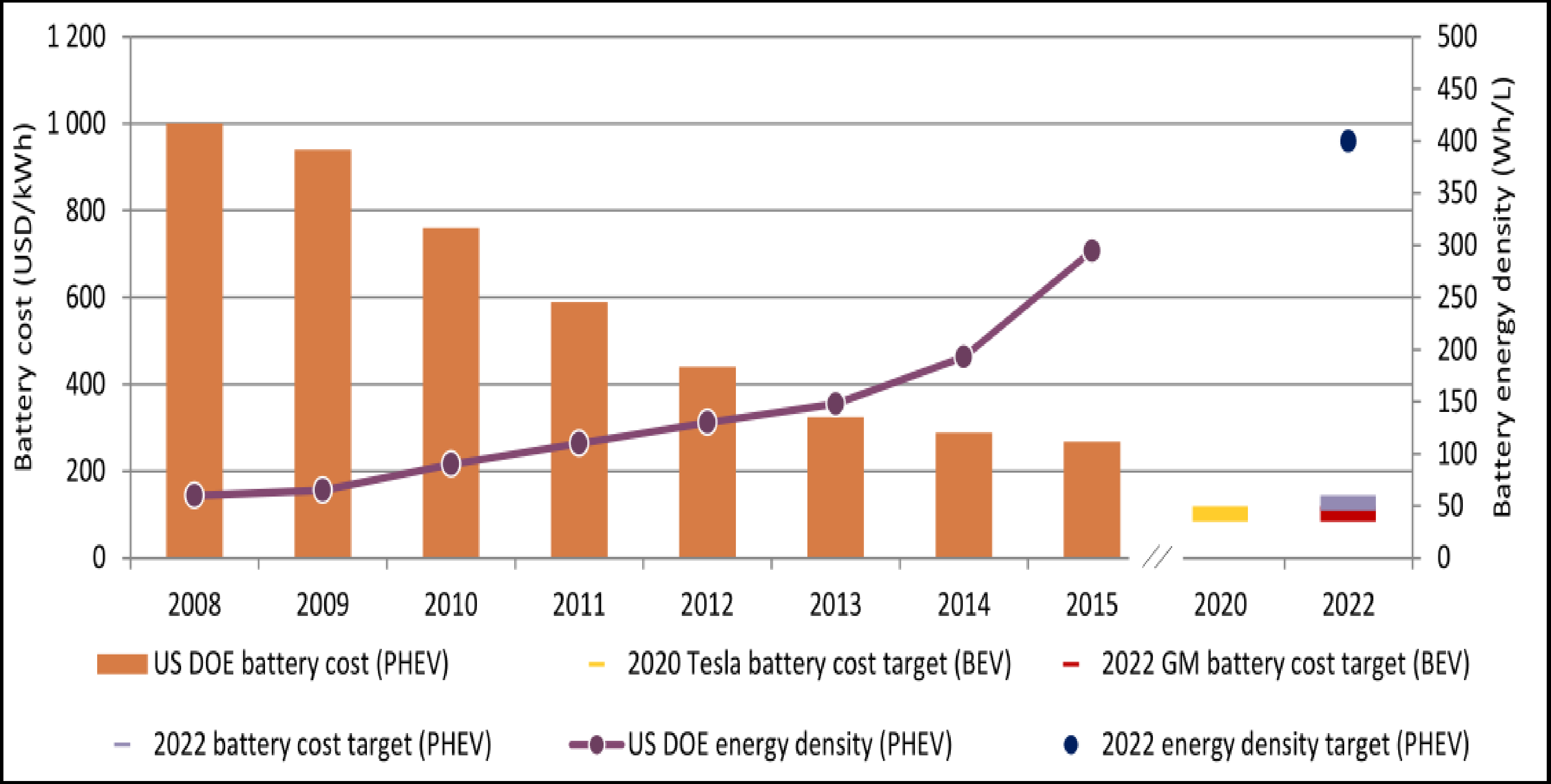
Notes: The electric car stock shown is primarily estimated on the basis of cumulative sales since 2005. Where available, stock numbers from official national statistics have been used (provided that the data can be shown to be consistent with sales evolutions).

Sources: IEA analysis based on country submissions, complemented by ACEA (2018); EAFO (2018a).

Key point: Global electric car stock is expanding rapidly, crossing the 3 million vehicle threshold in 2017.

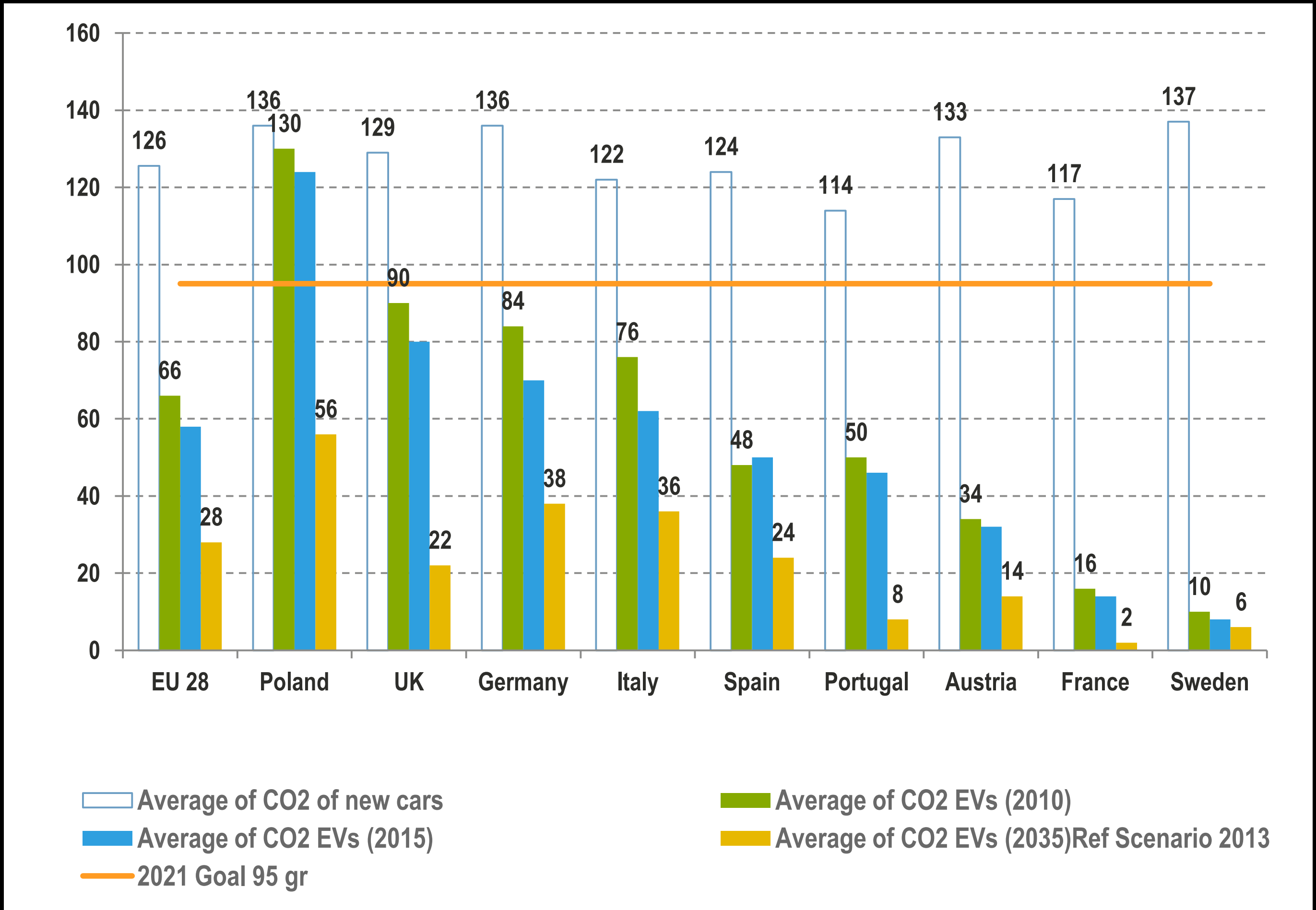
Source: IEA Global EV Outlook 2018

EVs enjoy a Double dynamic: Increase in ENERGY DENSITY & decrease of COST



Source: IEA Global EV Outlook 2016

EVs emit less CO_2 than conventional cars



- With the 2010 carbon intensity, a typical EV emits about 66g CO_2/km
- EVs will be even cleaner in the future as the power sector continues to decarbonise by 2050

EURELECTRIC smart charging paper, 2015

The electricity sector needs more flexibility provisions

Connected EV Fleets are potentialy very flexible ressources…

Electromobility : Energy or Capacity issue ?

In energy (TWh)

- In France
- 2020 : 525 000 VE
  - = 1,3 TWh (source : RTE)
  - 0,2% of the total
  - => no energy problem

In capacity (MW)

- Max peak consumption:
  - + 100 GW
  - 3% per year
  - + 28% in 10 years
- 2020 : 525 000 VE
  - No coordination with 3 kW → 1,5%
  - No coordination with 22 kW → 11,5%
  - Today Fast charger technologies are booming : 120 kW to 350 kW
  - + local issues with distribution grid / RES

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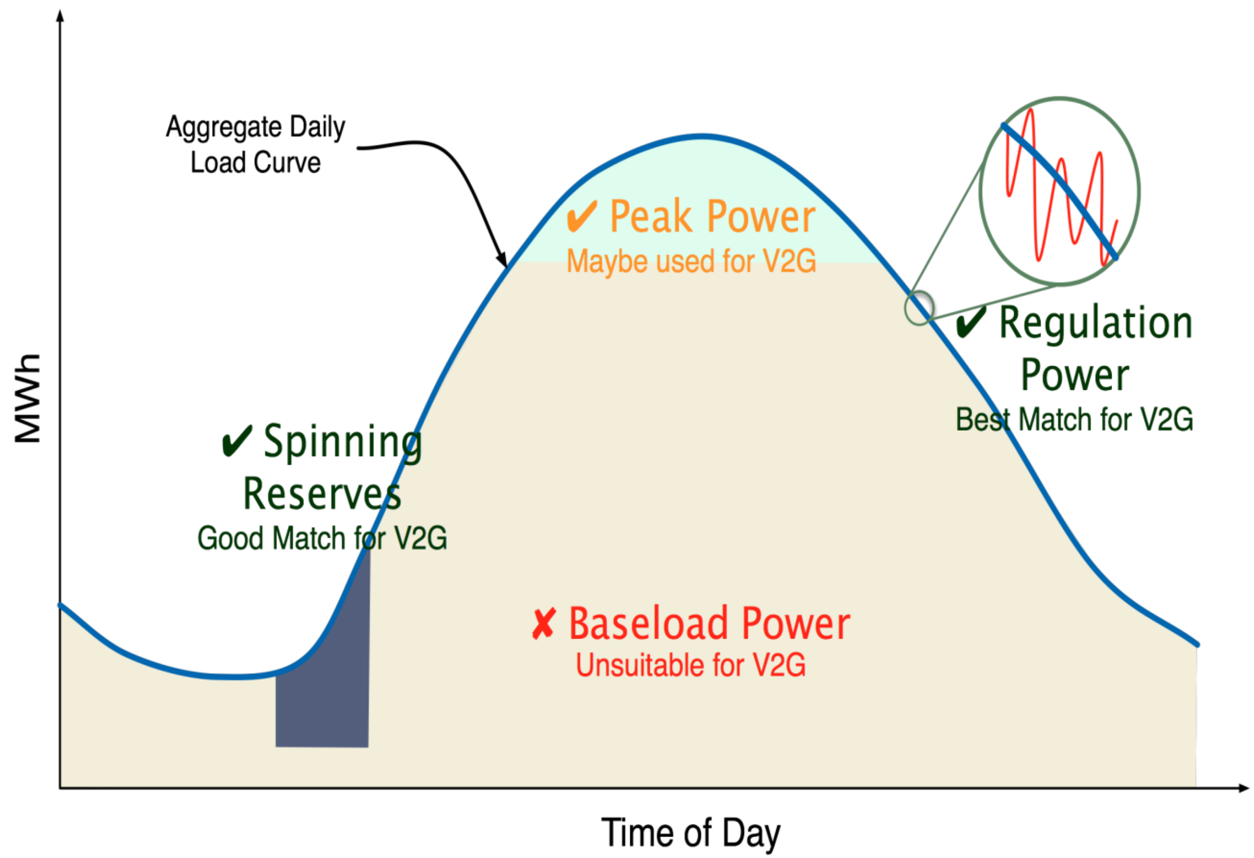
EV fleet for one Market or for Markets?

Which possible markets?

Profitable markets for EVs:

- little amount of energy, quick responsiveness
- remuneration based on availability and not utilization unless high number of EVs



Step 1: Proof of concept
Frequency regulation participation with EV fleets:

PJM – Denmark – Netherlands… (France : Launching phase for reserves + balancing market)

1500 €/ year and per car in PJM Zone
For « frequency regulation market base Provision »
Kempton (2016)

Charging point capacity (kW)		Revenus /VE/ year
Primary	Secondary	
3	0	179,4 €
3	3	310,7 €
3	7	505,7 €
3	22	1346,8 €
7	0	474,5 €
7	3	543,4 €
7	7	780 €
7	22	1448,2 €

Sources: Codani, Petit & Perez (2016)

But

Rules of the game are created for previous technologies

Size of the bids / Time granularity...

and

they act as barrier to entry for new tech

See Borne et al. (2018 a and b)

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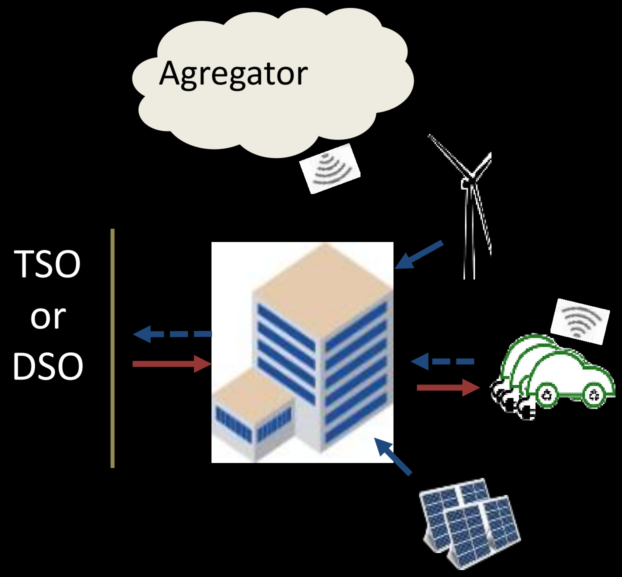
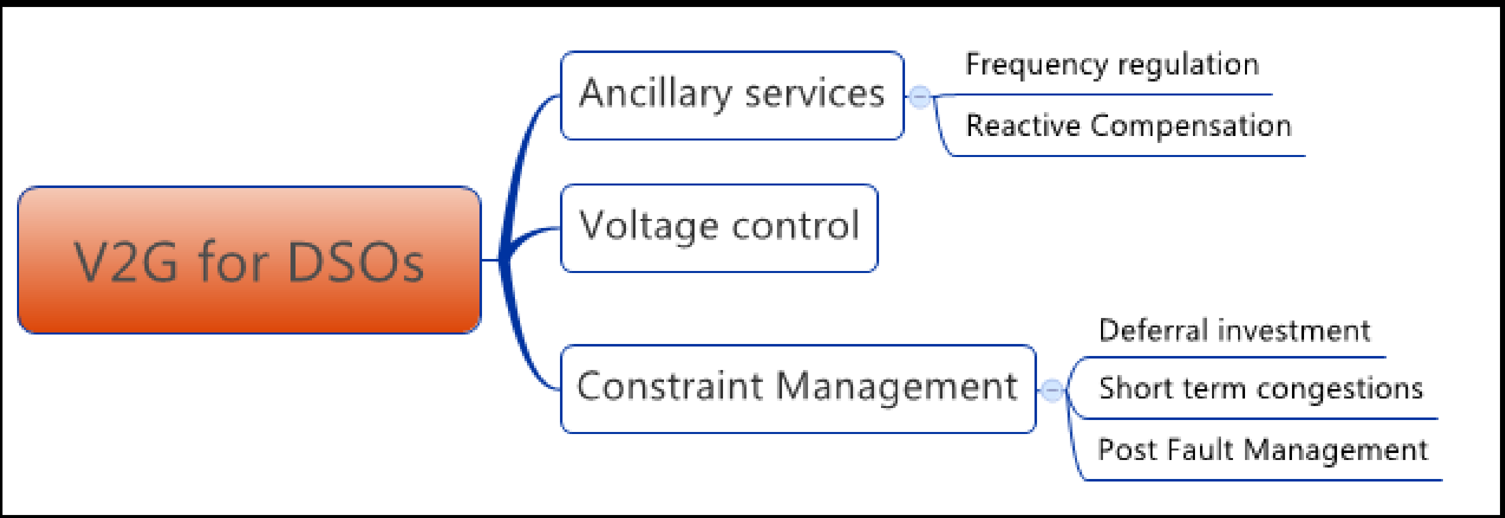
Contractual solutions for VtoB

- Objectives of the site manager
  - Minimizing energy cost over time
  - Maximizing self consumption of local renewable energies
  - Reducing connexion charge
  - Peak shaving
- Sharing potential benefits with
  - the building consumers (of course !)
  - And DSO ?

Vehicle-to-building



Contractual solution with the Distribution Service Operator (DSO)



If V2G avoids investments, at least the value of V2G has to equals CAPEX and OPEX of the avoided reinforcement.

Contractual solutions for VtoH

- Objectives of the House manager
  - Minimizing energy cost over time
  - Maximizing self consumption of local renewable energies if incentives and tariff designs are well done
  - Providing some DSO services (optional)

And the off-grid « solution » VtoL

- “Tesla-Solar City” proposes implicitly “off grid - green” solution
  – Home Storage Solution + Solar Roof + EV with 100kWh batteries…

Conclusions

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If cooperation

If no cooperation

3 Main problems to overcome

1. Regulations are barrier to entry for EV Fleets in most markets

   => To date 2 strategies are played : POC + NC

2. Communication Standards war (15118 / CHAdeMO…)
3. Building cooperation between Electricity and automotive industries
   1. for optimal charging infrastructure deployment
   2. For Grid service provision
   3. With few habits to do it…

Predicting the future of EV is hard

If you were asked in the 1980s about having a camera in your phone…

what would you have imagined?


Kodak

Selected Literature

- Borne Olivier, Korte Klaas, Perez Yannick, Petit Marc and Purkus Alexandra 2018, *Barriers to entry in Frequency-Regulation Services Markets: Review of the status quo and options for improvements,* **Renevable and Sustainable Energy Review**. Volume 81, Part 1, January 2018, Pages 605–614
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