Les véhicules électriques connectés : opportunités et contraintes

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Outline

1. The electromobility challenge in energy markets : Coordination issues
2. Coordination by markets
3. Coordination by contrats
4. Conclusion

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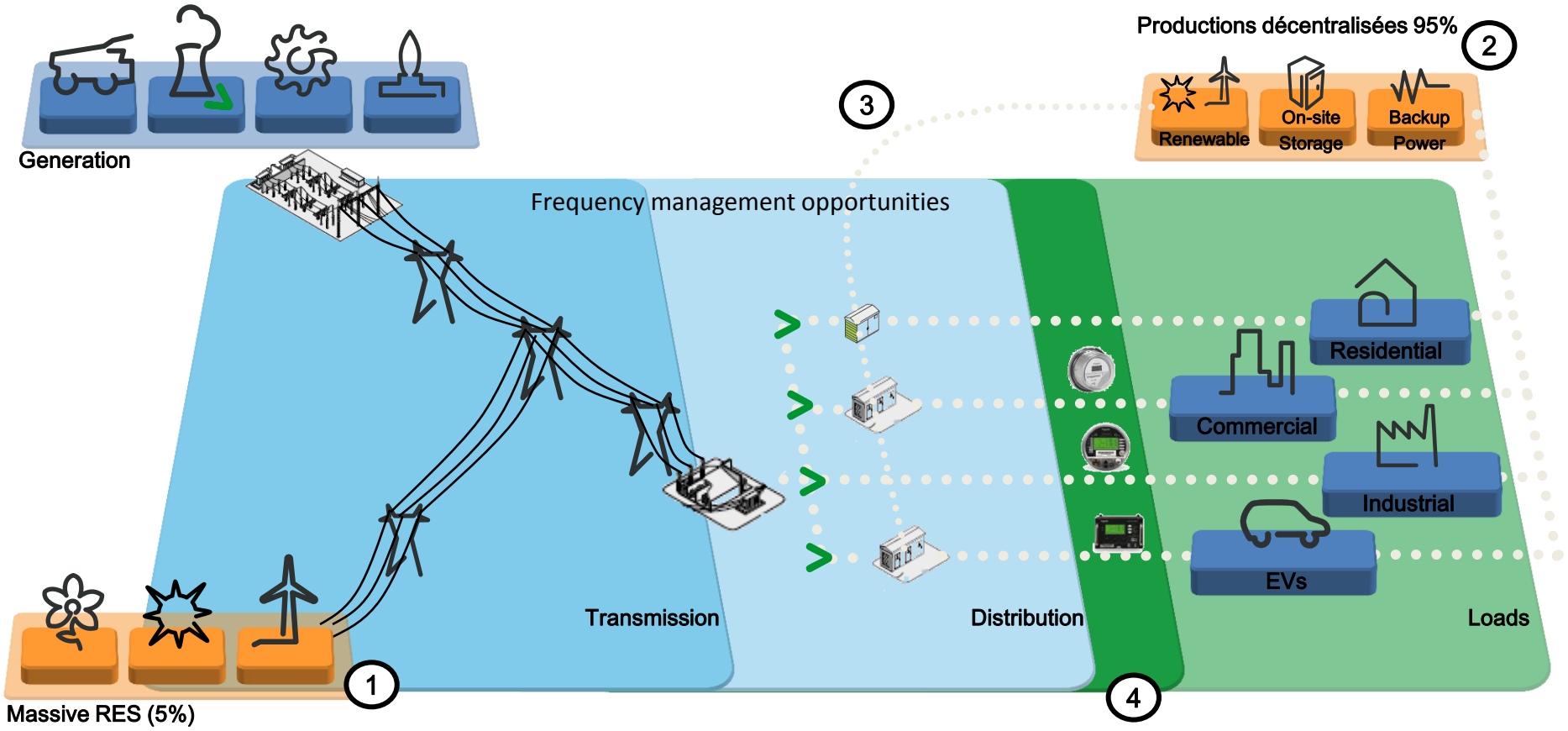
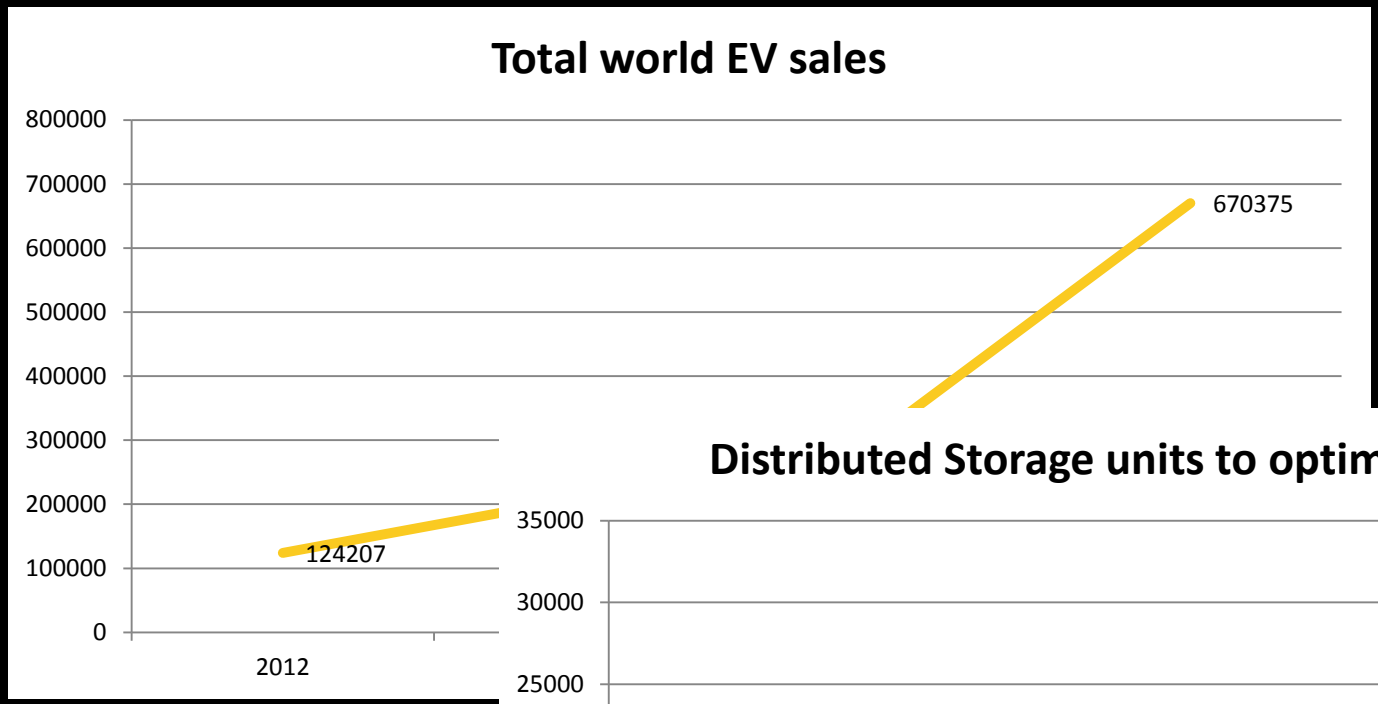
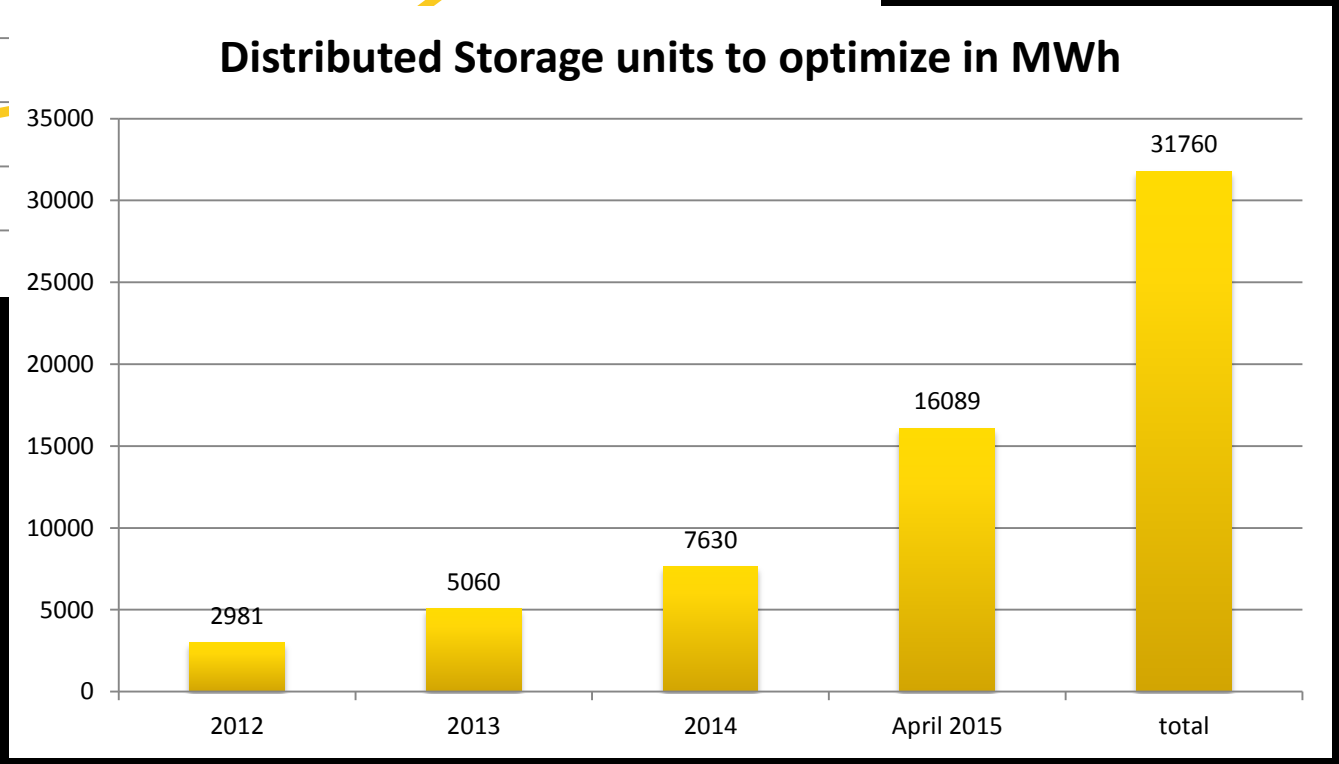
From Old days to EV smart grids issues



Voltage issues and management opportunities

Today EV market & storage of energy seems…





Energy or Capacity issue ?

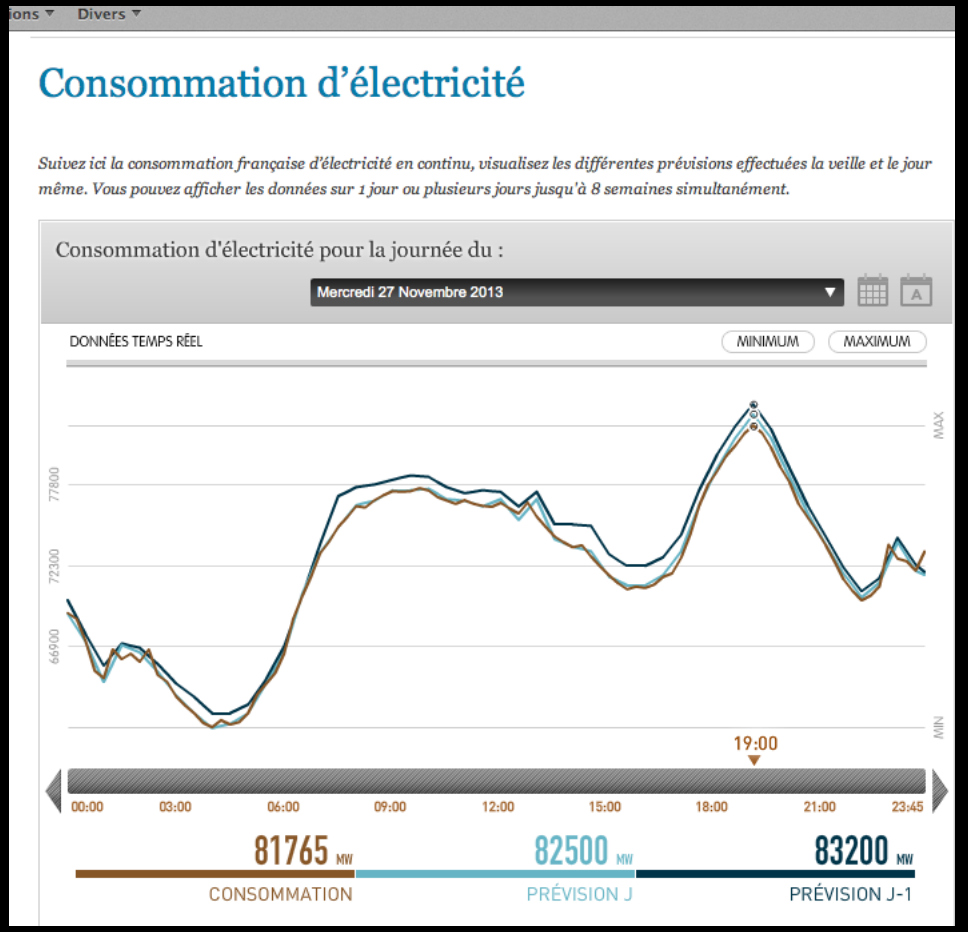
In energy (TWh)

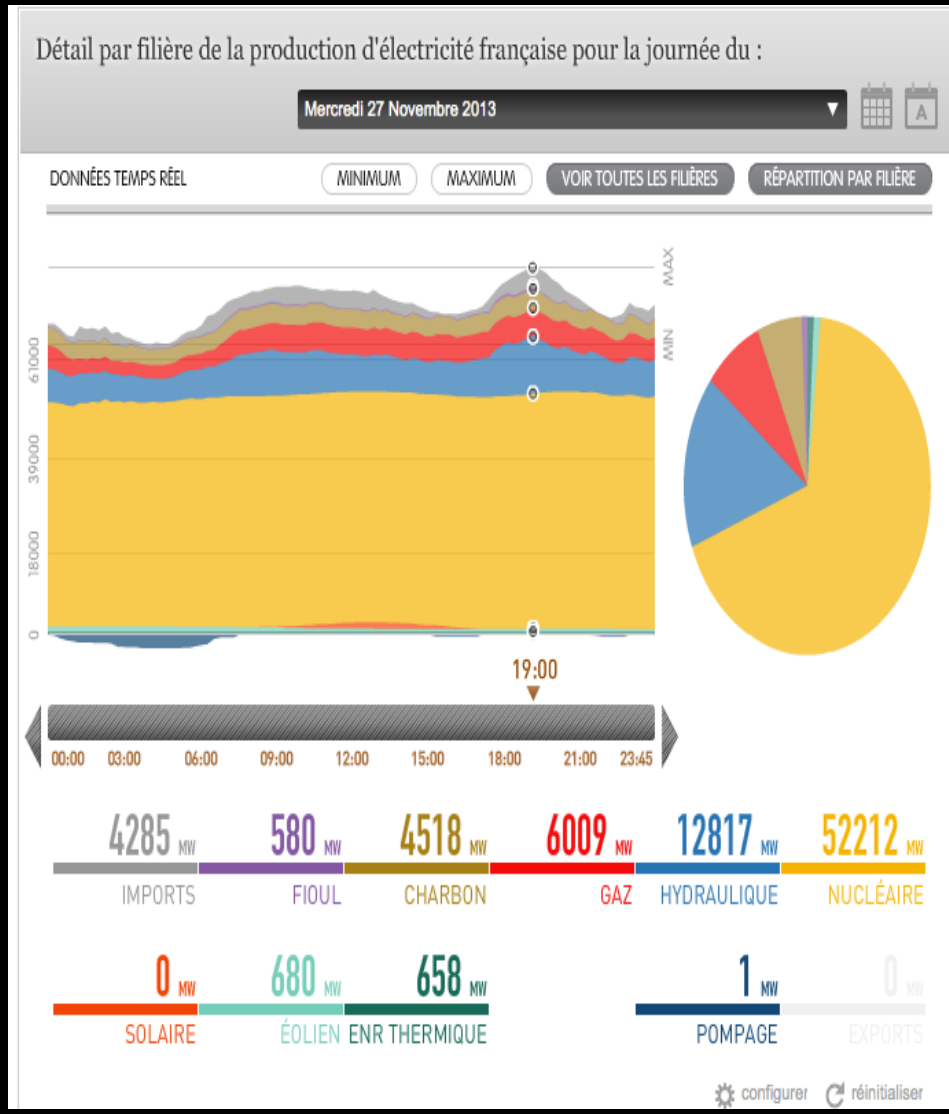
- 2013 in France
  - 476 TWh
  - 40 000 VE
- 2020 : 525 000 VE – VHR
  - = 1,3 TWh (source : RTE)
  - 0,2% of the total
  - => no energy problem

In capacity (MW)

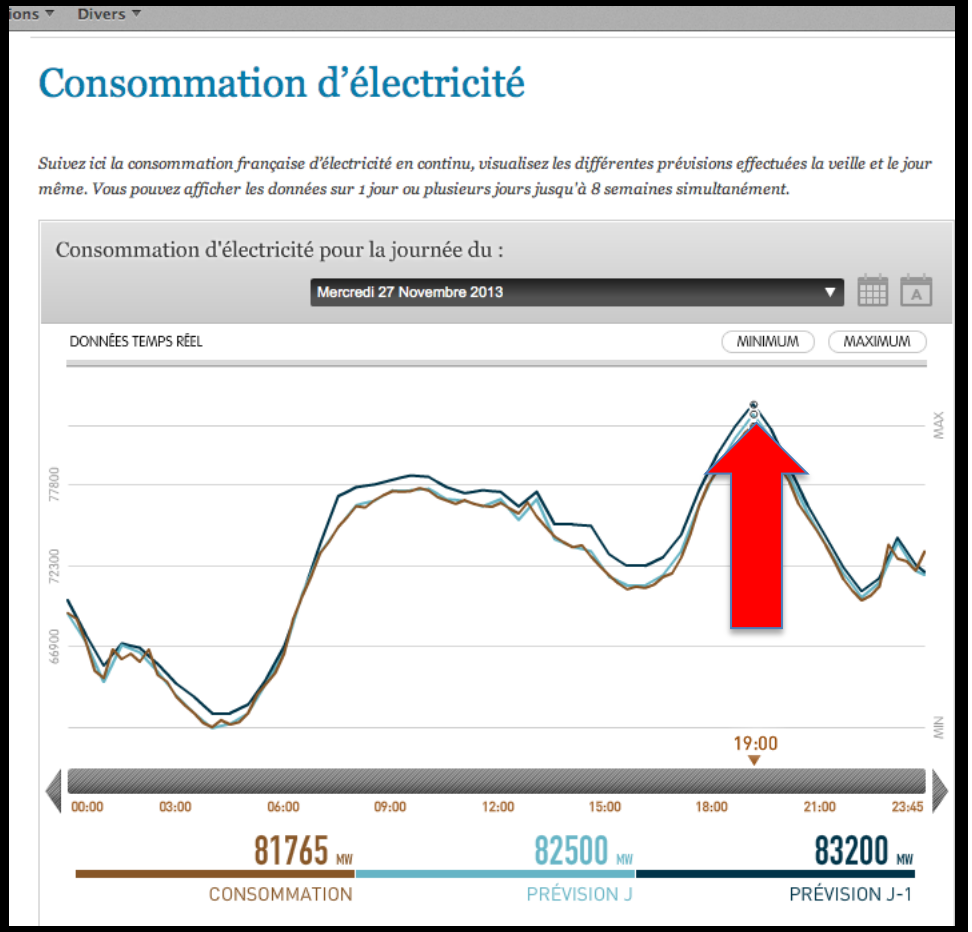
- Max peak consumption:
  - 100.5 GW (7 feb 2012, 19h)
  - 3% per year
  - + 28% in 10 years
- 2020 : 525 000 VE-VHR
  - No coordination with 3 kW → 1,5%
  - No coordination with 22 kW → 11,5%
  - + local issues with distribution grid / RES

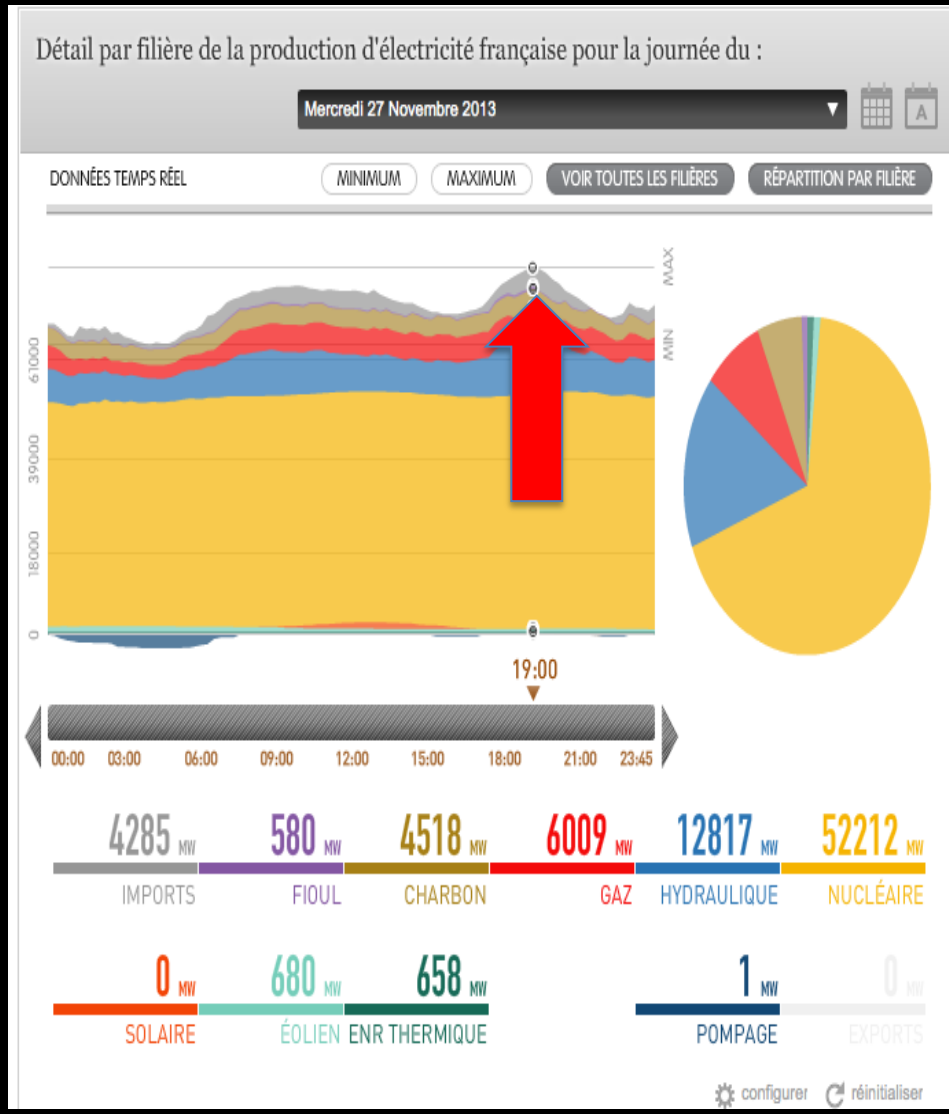
Uncoordinated EV Fleet: a capacity issue





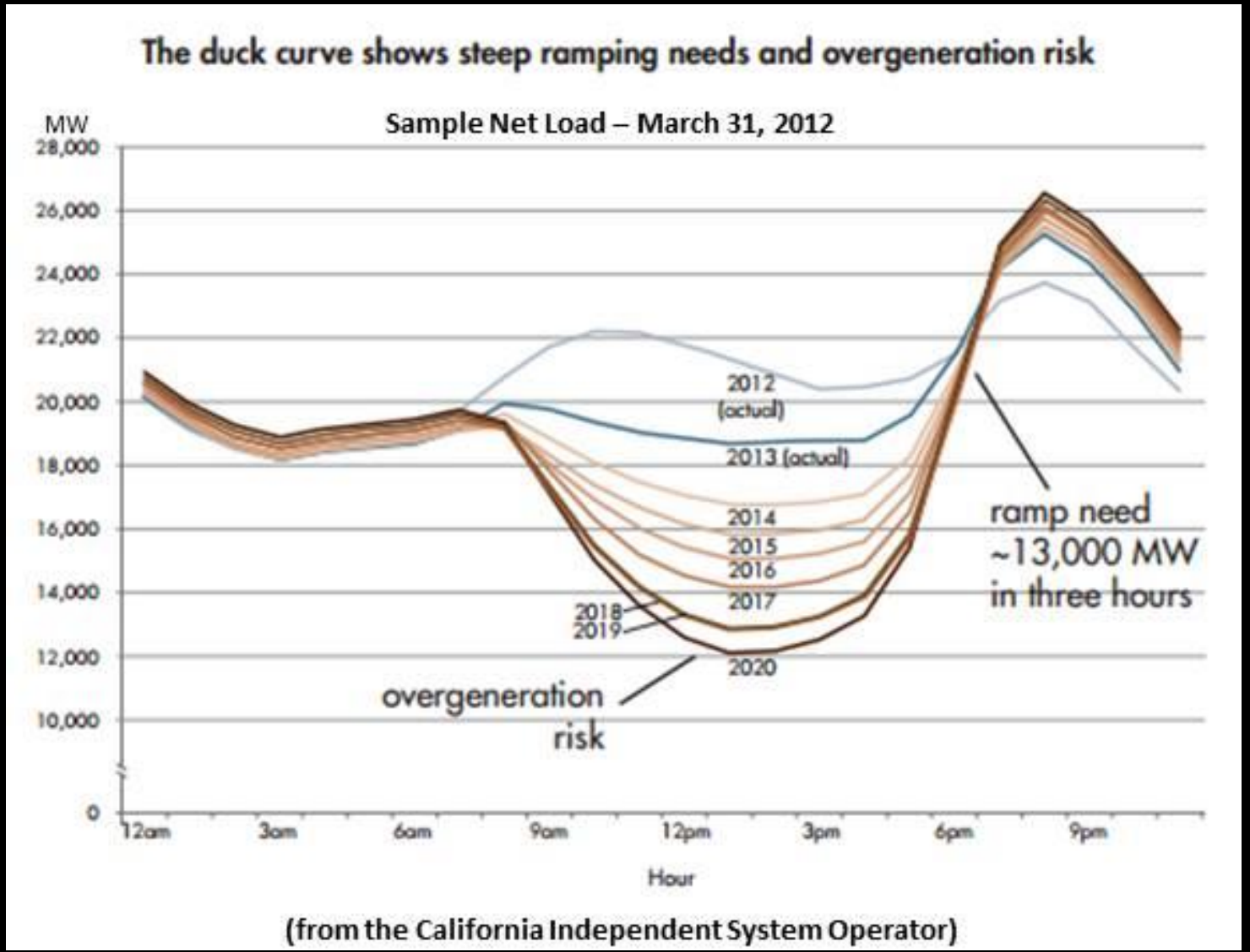
Uncoordinated EV Fleet: a capacity issue






DUCK
SEASON

More PV => more Duck issues => coordination issues

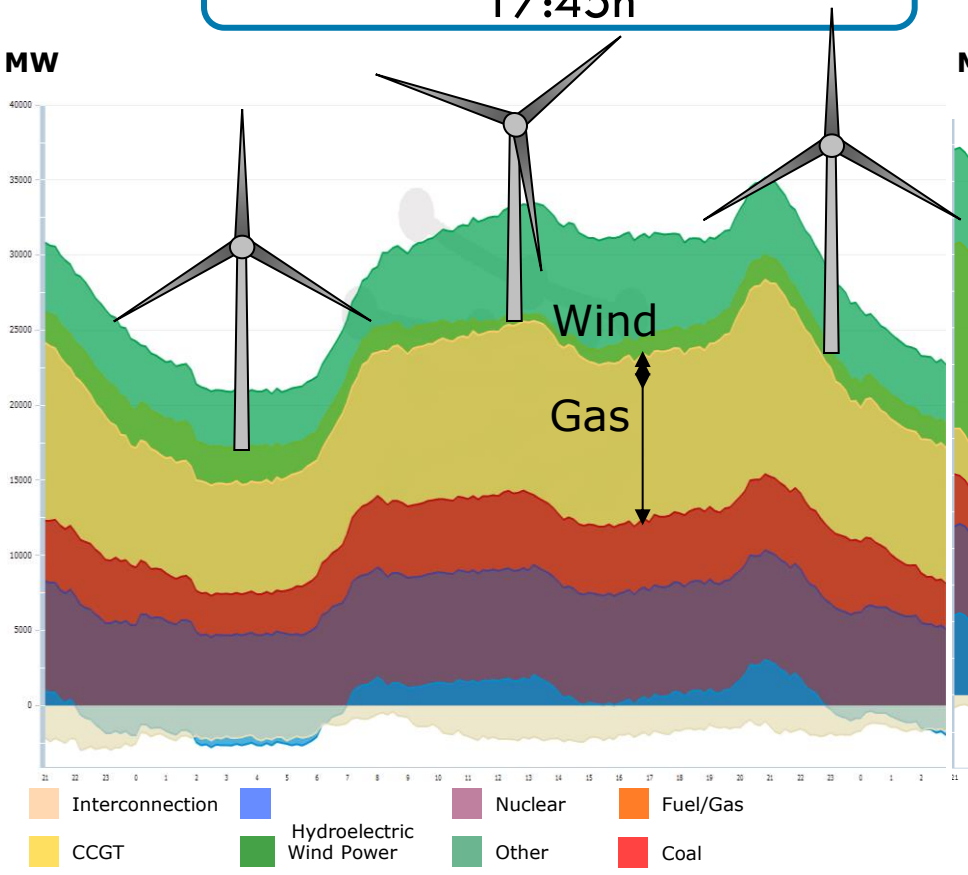


More wind => more flexibility required
=> coordination issues

The Spanish case

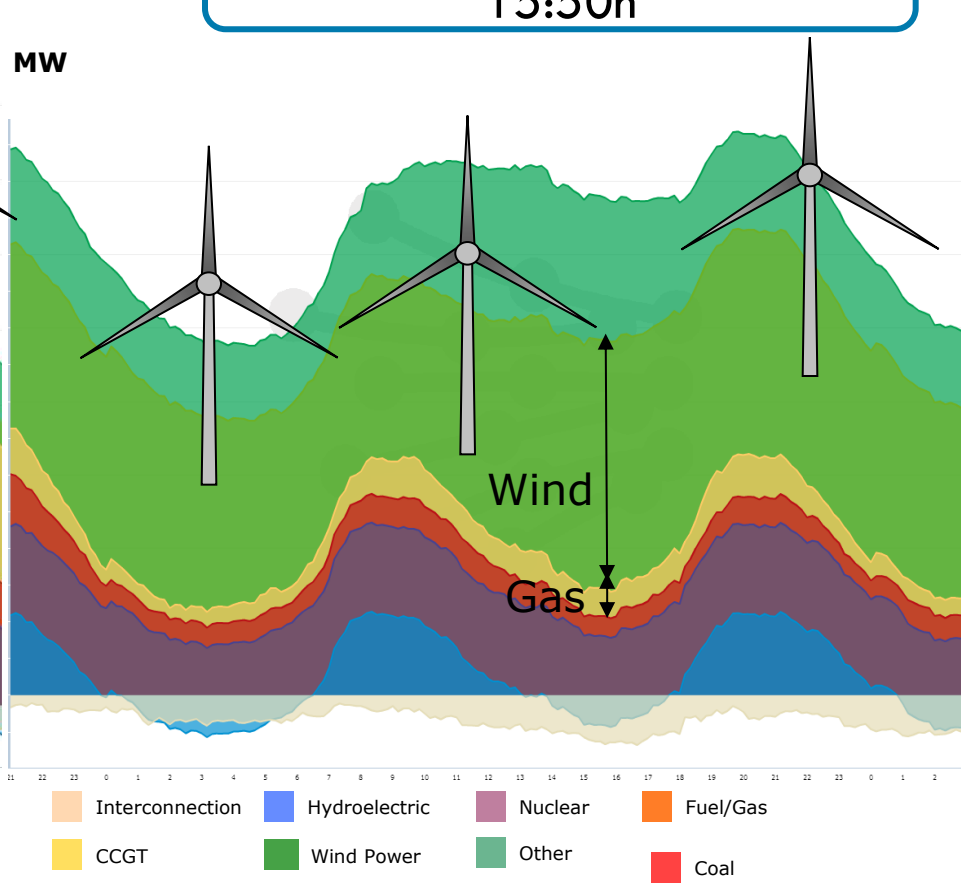
30-september-2010

Wind 1%
17:45h



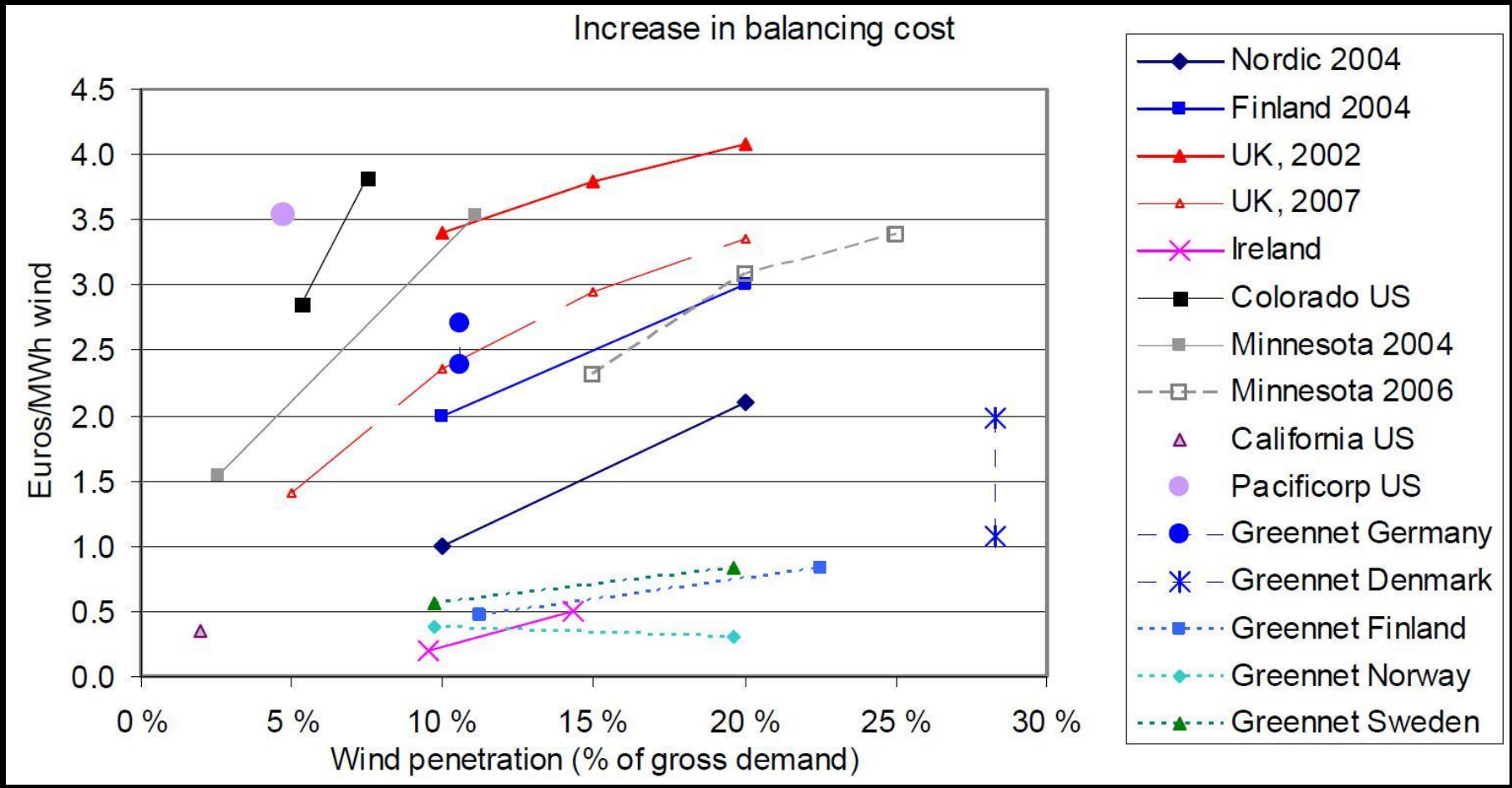
6-Februray-2013

Wind 66.5%
15:50h



Source REE, ENAGAS

More wind => more costly flexibility required => coordination issues?



Source: Holttinen et al. (2011)

The electricity sector needs more flexibility provision

Connected EV Fleets are very flexible ressources

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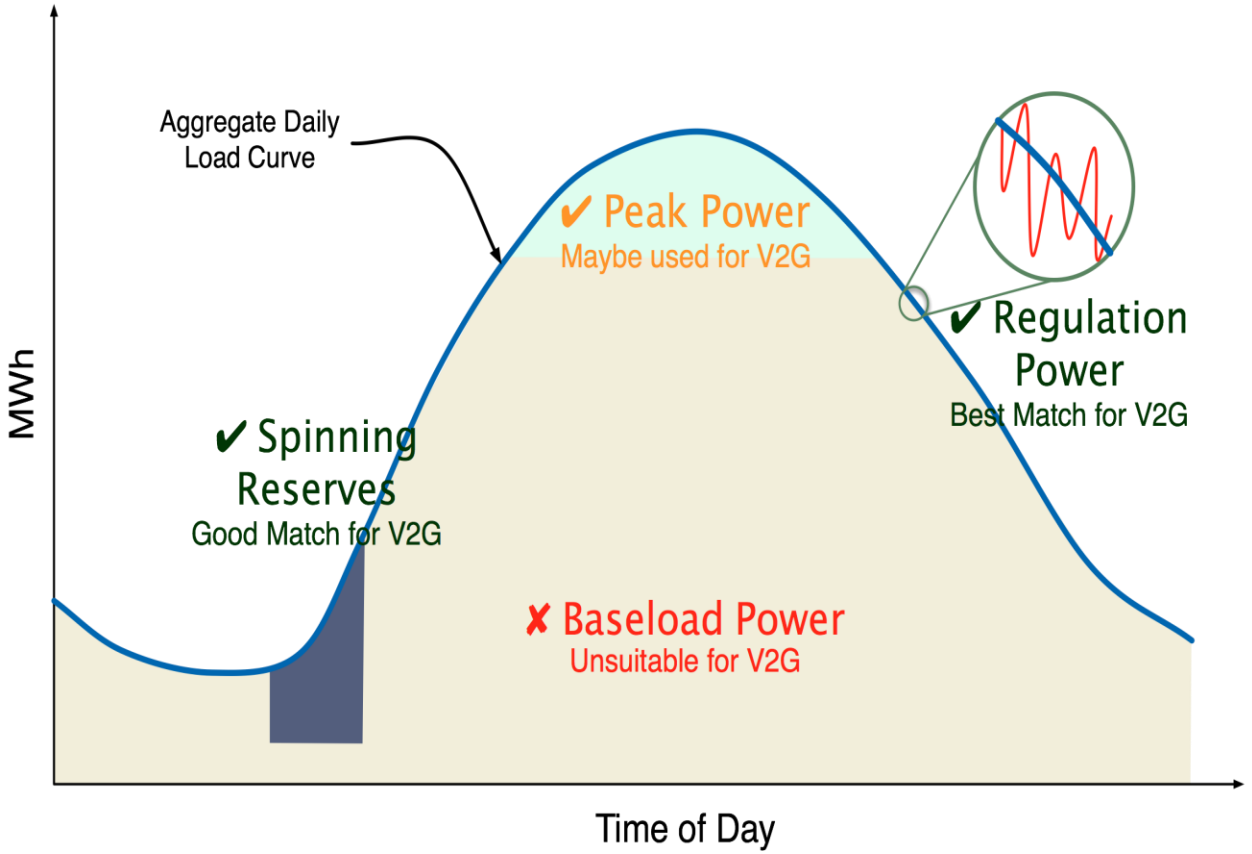
EV fleet for one Market or for Markets?

Profitable markets for EVs:

- little amount of energy, quick responsiveness
- remuneration based on availability and not utilization



How to coordinate disperse storage unit as valuable ressources?

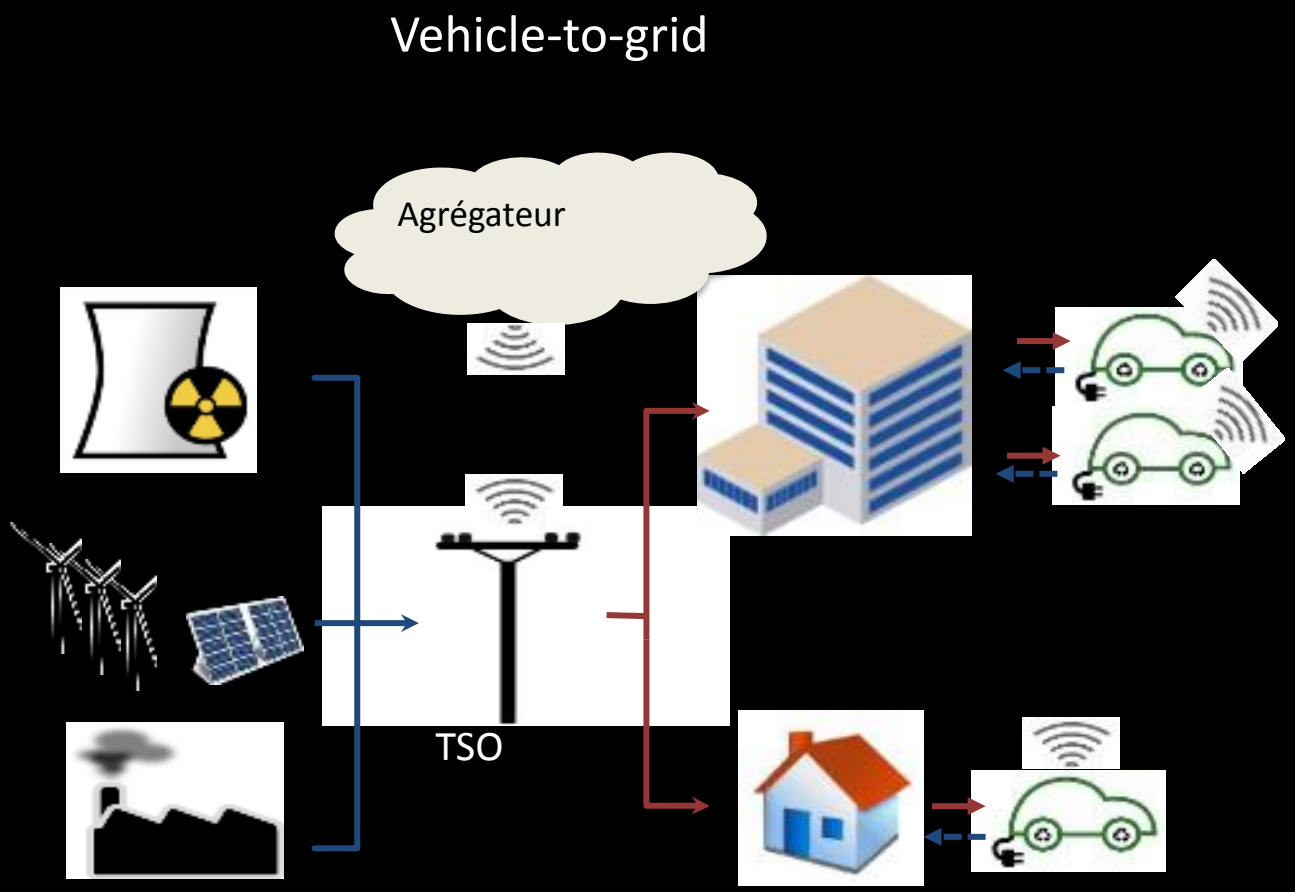
Combination of data

1+2+3

Into new algorithms (to be tested)

to deliver « market like products to be traded on energy markets »

Input 1: Definition of EV resources provision

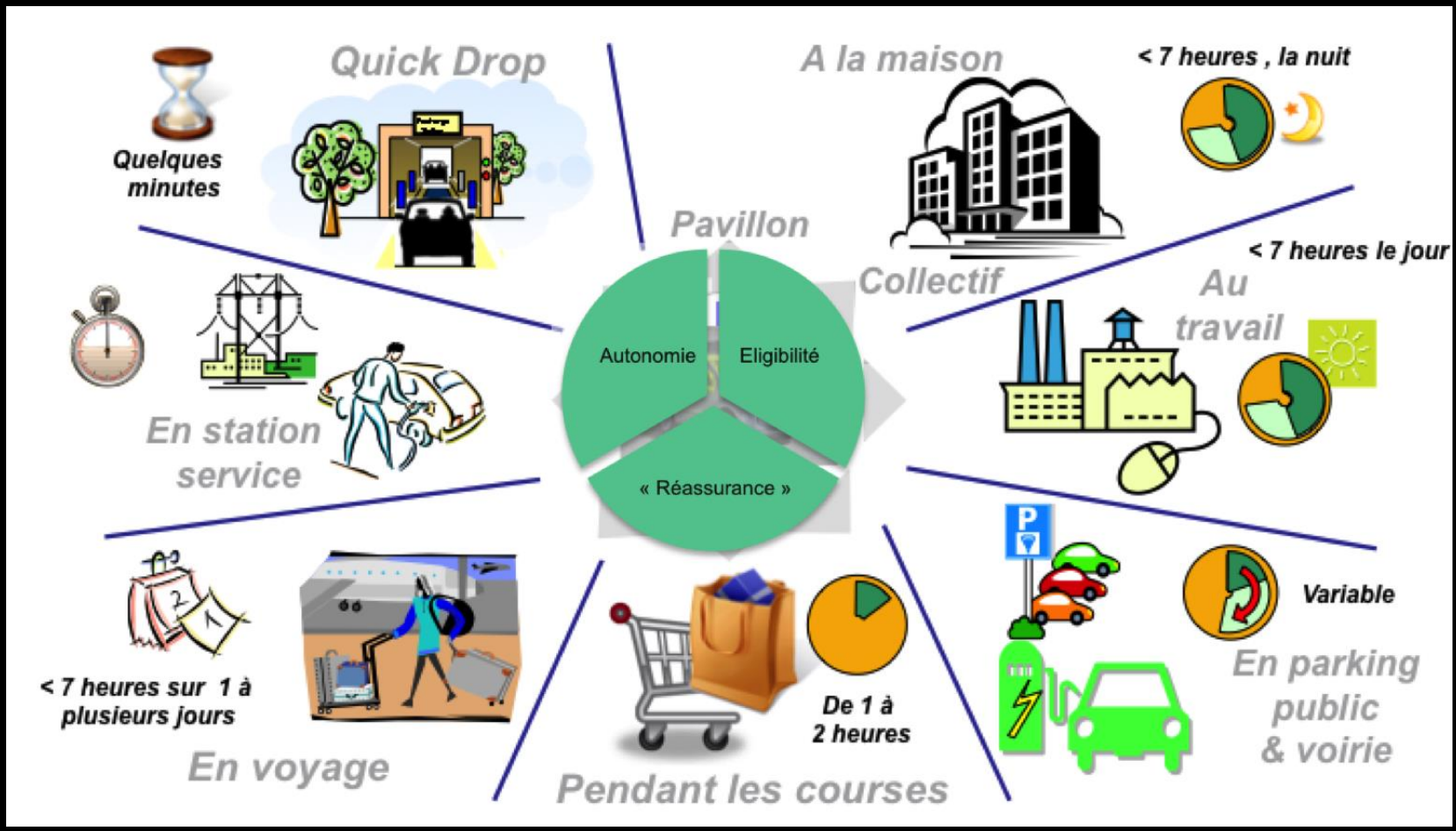


Input 2: Definition of EV Trips & needs

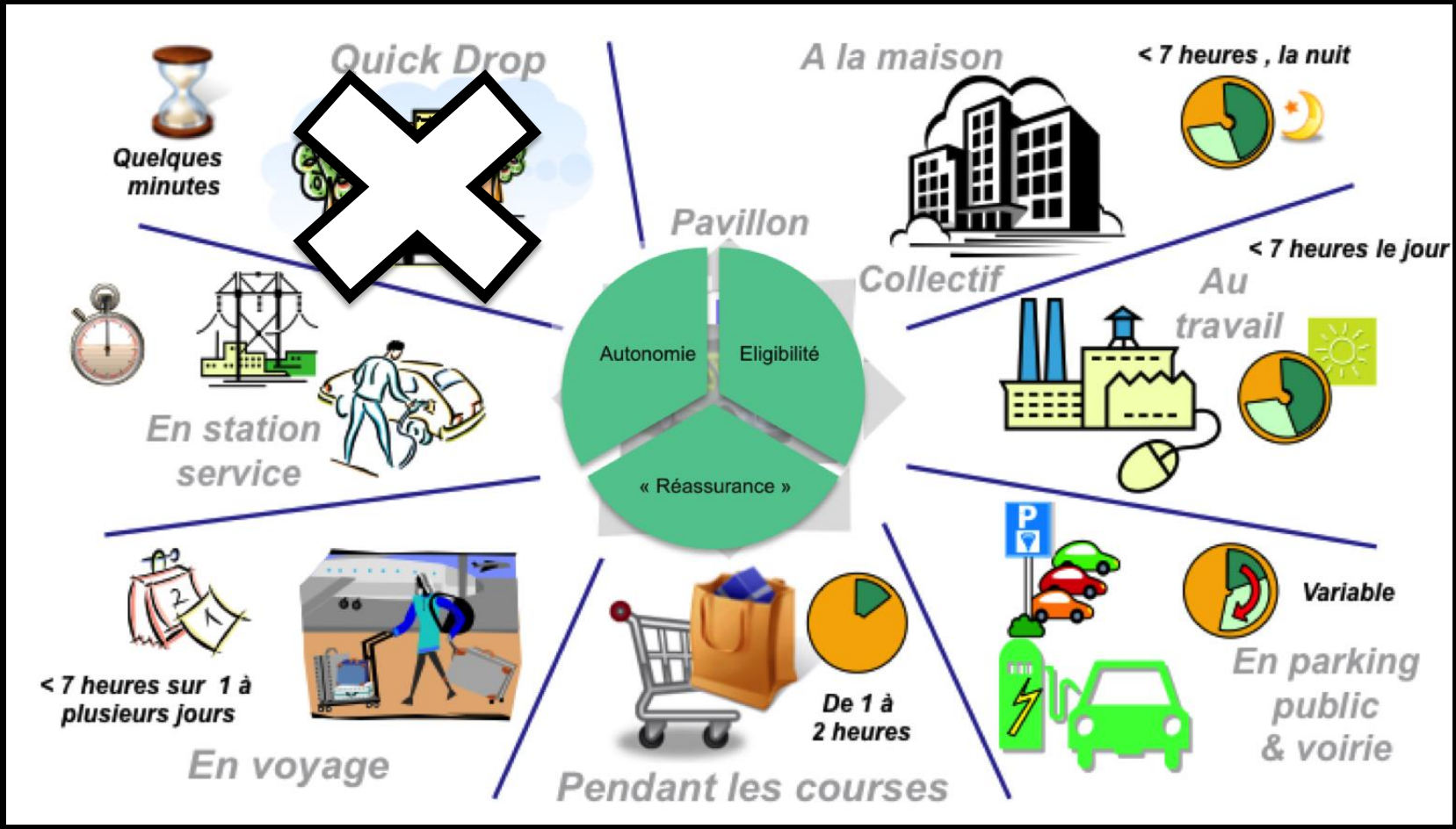
1. Commuting Privately owned Fleet
   - You go to work and return home: very predictable and easy to capture.
2. Collective fleet
   1. used in a coordinated way
      - Postal / delivery services fleet / Last mile delivery
   2. used in a uncoordinated way
      - Companies cars given to staff
      - Renting cars companies

=> Trip definitions: when, how long, risk…

Input 3: design of Charging infrastructure



Input 3: design of Charging infrastructure



Combination of 3 inputs to create "bundle of valuable resources" for the energy markets

Times	MW or MWh	Services on market base if exist
Second	MW	- **Frequency regulation** - **Voltage regulation** - **Quality of delivery**
Hour	MW Or MWh	- Terciary reserve market - Demand respons - Balancing services - Congestion management - **Intraday-market** - **Coupling With RES** - ...
Block orders	MWh	- Day head market - Effacement - Time of Use - Couplage avec les EnR - ...

Case Studies

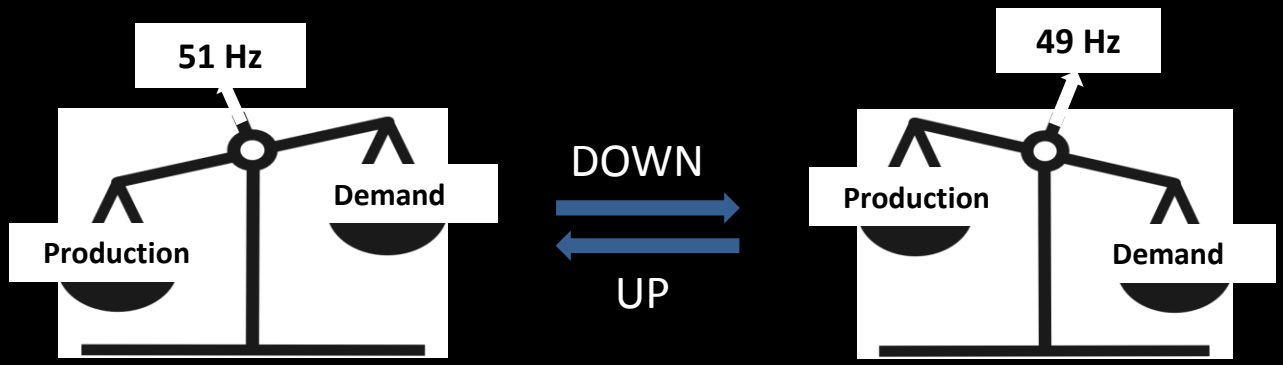
Frequency regulation

Frequency Regulation market revenus

Revenus from grid services for EV

EV as frequency control resources

- Why do we need a steady frequency?
  - material performances
  - risk of saturation for devices with magnetic circuits
- Who is responsible?
  - TSOs
- How?
  - Balancing production and demand at each moment



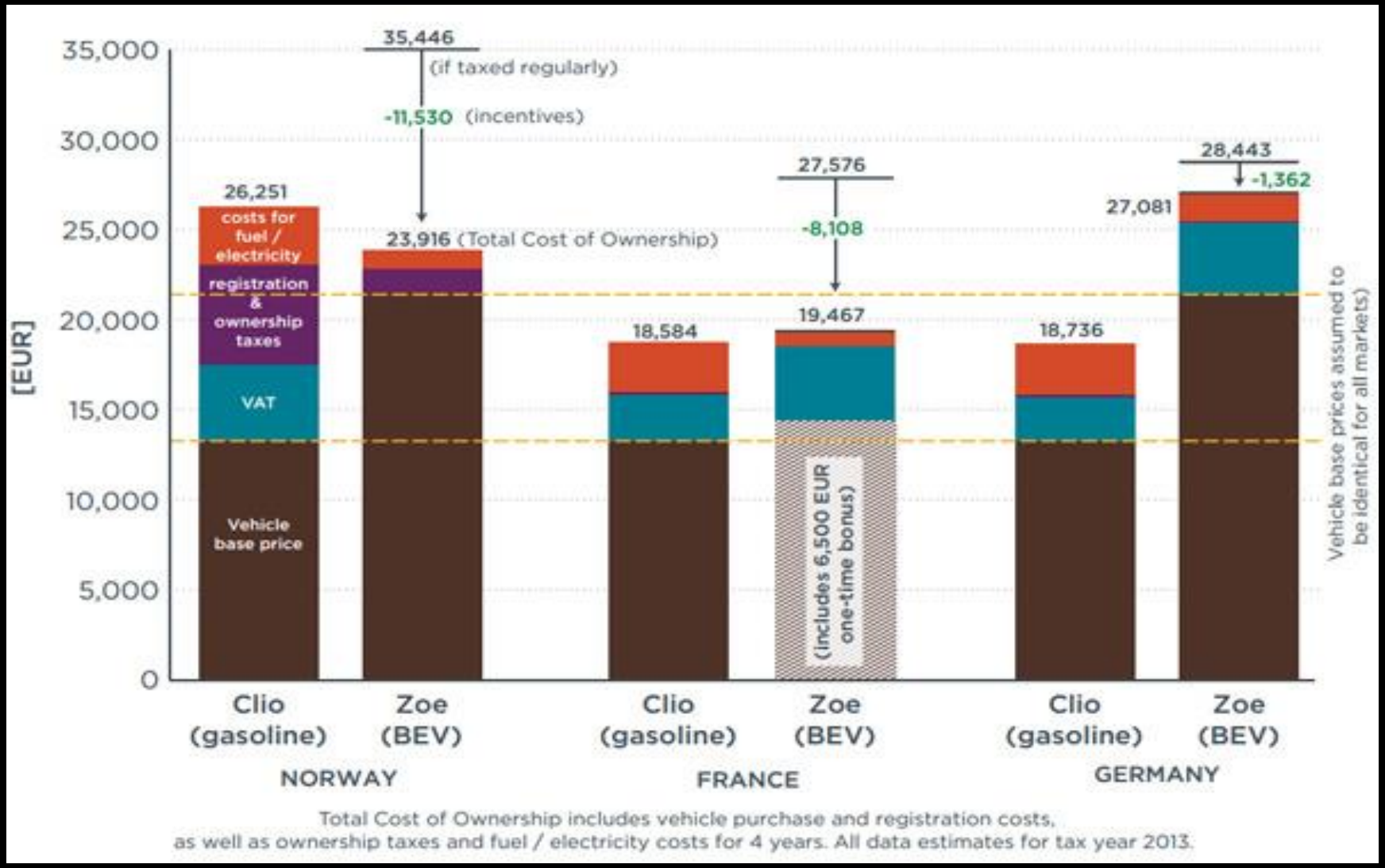
Frequency remunerations for EV : PJM real case / France exploration

1500 €/ year and per car in PJM Zone for only « frequency regulation market base Provision »

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 2015

A very nice contribution to TCO



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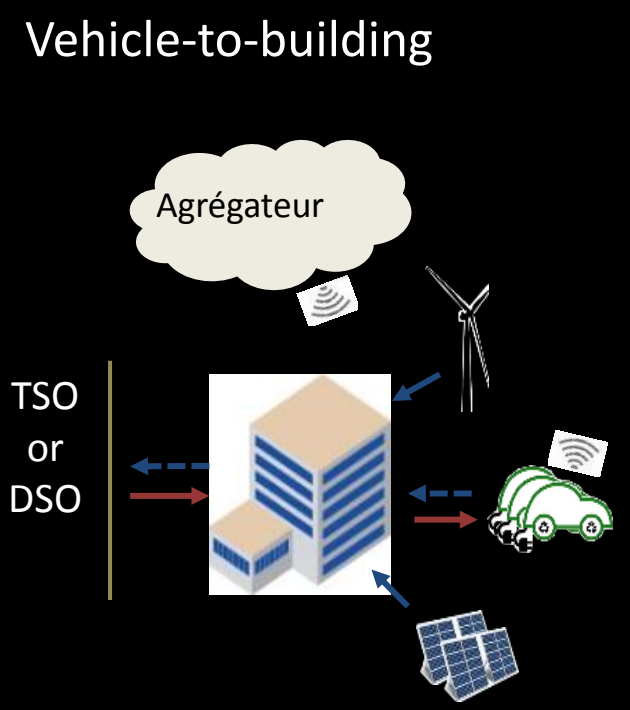
Contractual solutions for VtoH

- Objectives of the House manager
  - Minimizing energy cost over time
  - Maximizing auto consumption of local renewable energies if incentives are aligned
  - Distribution grid services provision (optional)
- Sharing potential benefits with the consumers

Contractual solutions for VtoB

- Objectives of the site manager
  - Minimizing energy cost over time
  - Maximizing auto consumption of local renewable energies
  - Minimizing the peak demand toward networks
  - Limiting the investments in networks reinforcements
- Sharing potential benefits with the consumers / networks managers



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Comparison of coordination mechanisms

	Coordination by Markets	Coordination by contracts
Fleet size	Thousands or more	Single to Hundred
Regulations to be changed	Regulation need to be redesign to allow VtoG (Codani et al. 2015)	None
Collaboration with the energy sector	Creation of a two-sided market	Simplified with the local aggregator / Building energy manager

Electromobility solution is

- Not perfectly done yet…
  - VtoG experiment around the world (US / Denmark…)
  - Majors success with regulation power : mainly frequency control.
- Expected benefits from coordination :
  - Costs savings / resources provision
  - Capacity reduction need (Less peak demand investment)
  - RES coupling: less grid stress
  - Demand response resources
- Main problems to overcome
  - Rules and Market regulation to adapt for EV Fleets
  - Communication standards (15118 / CHAdeMO…) to clarify
- Coordination via hydrids are probably part of the solution (spin-offs…)