

# Une analyse économique de la disposition à payer des consommateurs pour les véhicules électriques

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# What is the Armand Peugeot Chair?

- One Donor (Peugeot-Citroën-DS)
- Two institutions :
  - CentraleSupélec & ESSEC Business School
- A team :
  - Professors in Management (J Lepoutre, C. Donada & D. Attias)
  - Professor in Engineering (M. Petit)
  - One Economist !
  - 3 PhDs Students (P Codani ; Y. Chen ; O. Borne)
  - 1 Postdoc (H. Idjis)
- International Partners
  - Delaware University and DTU (W. Kempton) => Vehicle to Grid
  - Wharton School (J-P Mc Duffie) => Management studies
  - La Laguna university (F. Ramos-Real) => EV and Islands
- 2011-2016 toward 2021...

# Electric Cars sold in 2015

<http://ev-sales.blogspot.de>

PI	WORLD	Dec.	YTD	%
1	<b>Tesla Model S</b>	8.082	<b>50.366</b>	9
2	<b>Nissan Leaf</b>	3.637	<b>43.870</b>	8
3	Mitsubishi Outlander PHEV	7.058	<b>43.259</b>	8
4	BYD Qin	1.512	<b>31.898</b>	6
5	<b>BMW i3</b>	3.409	<b>24.083</b>	4
6	<b>Kandi K11 Panda EV</b>	4.701	<b>20.390</b>	4
7	<b>Renault Zoe</b>	3.158	<b>18.846</b>	3
8	BYD Tang	5.503	<b>18.375</b>	3
9	Chevrolet Volt (1)	2.398	<b>17.508</b>	3
10	Volkswagen Golf GTE	3.191	<b>17.282</b>	3
11	<b>BAIC E-Series EV</b>	1.696	<b>16.488</b>	3
12	<b>Zotye Z100 / Cloud EV</b>	2.582	<b>15.467</b>	3
13	<b>Volkswagen e-Golf</b>	1.286	<b>15.356</b>	3
14	Audi A3 e-Tron	1.578	11.962	2
15	Roewe 550 PHEV	1.611	10.711	2
16	<b>JAC i EV</b>	1.581	10.420	2
17	Ford Fusion Energi	1.067	9.894	2
18	Ford C-Max Energi	1.127	9.643	2
19	<b>Kandi K10 EV e)</b>	1.000	7.665	1
20	<b>Kia Soul EV</b>	1.225	7.510	1
	<b>TOTAL</b>	86.434	548.210	

Blue for BEV

# TOP 20 EV manufacturer

PI	WORLD	Dec.	YTD	%
1	BYD	10.925	<b>61.726</b>	11
2	Tesla	8.275	<b>50.574</b>	9
3	Mitsubishi	7.498	<b>48.204</b>	9
4	Nissan	3.960	<b>47.671</b>	9
5	Volkswagen	7.024	<b>40.148</b>	8
6	BMW	6.029	<b>33.412</b>	6
7	Kandi e)	6.201	<b>28.055</b>	5
8	Renault	4.234	<b>27.282</b>	5
9	Zotye	4.297	<b>24.516</b>	4
10	Ford	2.294	<b>21.326</b>	4
11	Chevrolet	2.551	<b>20.233</b>	4
12	BAIC	1.747	<b>17.040</b>	3
13	Chery	2.792	<b>14.162</b>	3
14	Audi	1.596	<b>12.123</b>	2
15	SAIC Roewe	1.730	<b>11.123</b>	2
16	Mercedes	2.133	<b>10.870</b>	2
17	JAC	1.581	<b>10.420</b>	2
18	Volvo	3.902	<b>10.161</b>	2
19	Kia	1.341	<b>7.626</b>	1
20	Porsche	687	<b>6.532</b>	1

Actual EU leaders for BEV

PI	Europe	Dec.	2015	%
1	Mitsubishi Outlander PHEV	6.475	31.340	16
2	Renault Zoe	3.114	18.670	10
3	Volkswagen Golf GTE	3.191	17.282	9
4	Tesla Model S	3.124	16.455	9
5	Nissan Leaf	839	15.515	8
6	BMW i3	1.718	11.820	6
7	Audi A3 e-Tron	1.514	11.711	6
8	Volkswagen e-Golf	677	11.124	6
9	Volvo V60 Plug-In	1.906	6.952	4
10	Kia Soul EV	975	5.800	3
11	Mercedes C350e	1.624	5.069	3
12	Volkswagen Passat GTE	2.357	4.686	2
13	Renault Kangoo ZE	742	4.328	2
14	Porsche Cayenne Plug-In	381	3.350	2
15	Nissan e-NV200 / Evalia	270	3.049	2
16	Volkswagen e-Up!	182	2.769	1
17	Mercedes B-Class ED	182	2.760	1
18	Volvo XC90 T8 PHEV	1.633	2.653	1
19	Renault Twizy	118	1.917	1
20	BMW i8	115	2.027	1
21	Smart Fortwo ED	56	2.013	1
22	BMW X5 40e PHEV	838	1.649	1
23	Peugeot iOn	189	1.566	1
24	Ford C-Max Energi	538	1.230	1
25	Bolloré Blue Car	83	1.166	1
26	Citroën C-Zero	41	1.118	1
27	Mercedes S500e	108	807	0
28	Mitsubishi i-Miev	23	708	0
29	Toyota Prius Plug-In	39	704	0
30	Porsche Panamera Plug-In	46	606	0
	<b>TOTAL</b>	33.717	193.439	100

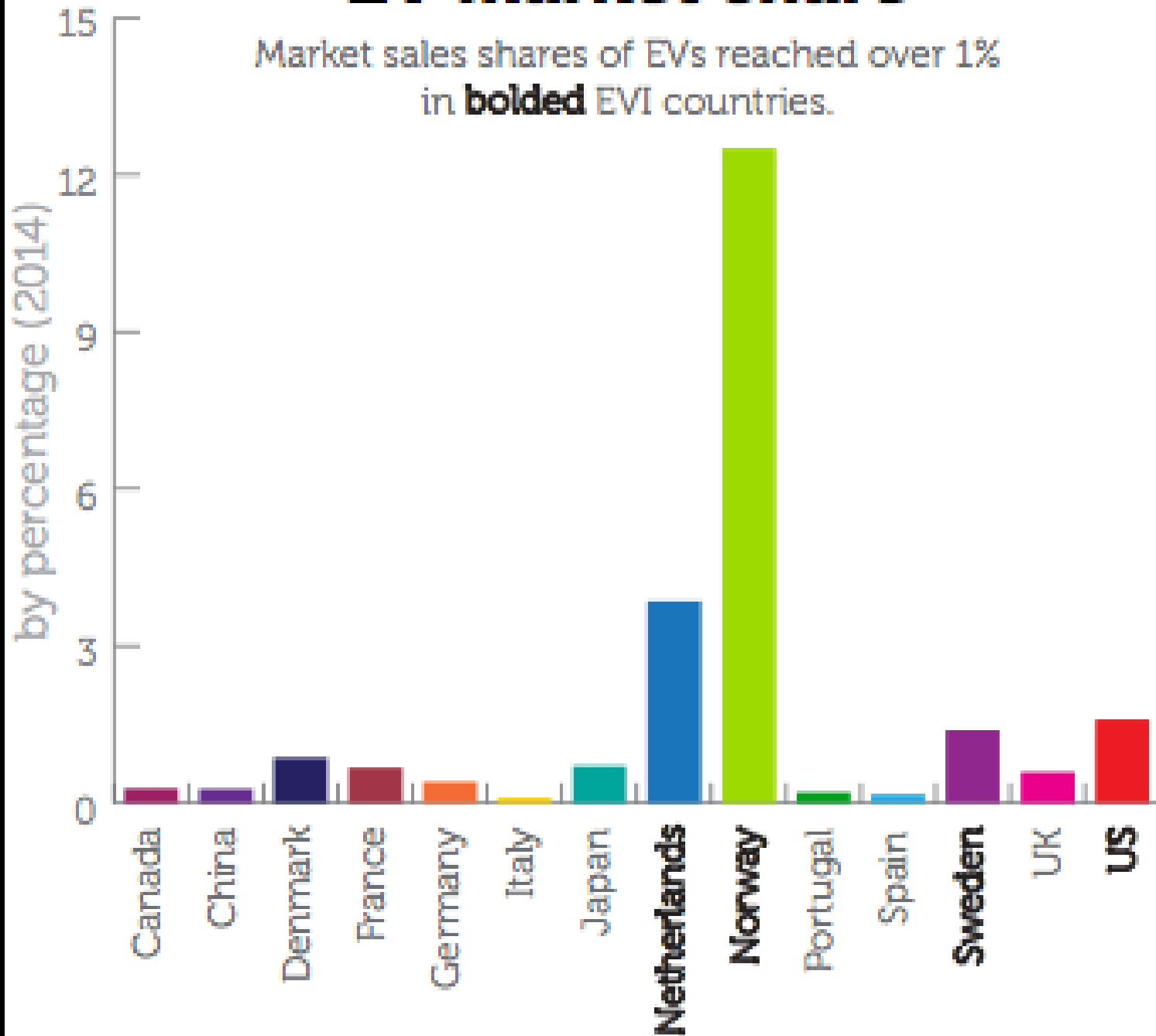
Blue for BEV



Per country

# EV market share

Market sales shares of EVs reached over 1%  
in **bolded** EVI countries.



# The main problem with EVs sales

The chicken and egg issue for BEVs

# What is the BEV « Chicken and Egg » problem ?



- Average BEV can not run for more than 150-200 km (real ones...)
- So little sales
- So no need to build a charging network for Evs
- So EVs can not be largely sold...

# 3 models for BEV developpement in Europe

NISSAN – RENAULT

VS

TESLA

VS

BOLLORE

# The NISSAN RENAULT strategy

# How NISSAN deal with C&E?

- Small batteries to sell or to rent.
- R&D for increasing the size of the batterie
- Looking for cooperation with Energy providers to build efficient charging stations (ENDESA)
- Looking for joint investments to develop a fast charging station safety network around big cities (Paris Exemple) => intense public lobbying

# BP-NISSAN and city of Paris: 1st fast charging station 10 dec 2013



boulevard Victor  
5€ per charge





# The TESLA strategy

# How TESLA deal with C&E?

- Large batteries for more autonomy
- Massive investments in the development of very fast charging stations
- No cooperation with local electricity actors but Vertical Integration between Grids and EVS



Superchargers today (120kW) for 30 m charging for 170 miles for free (+ wifi)



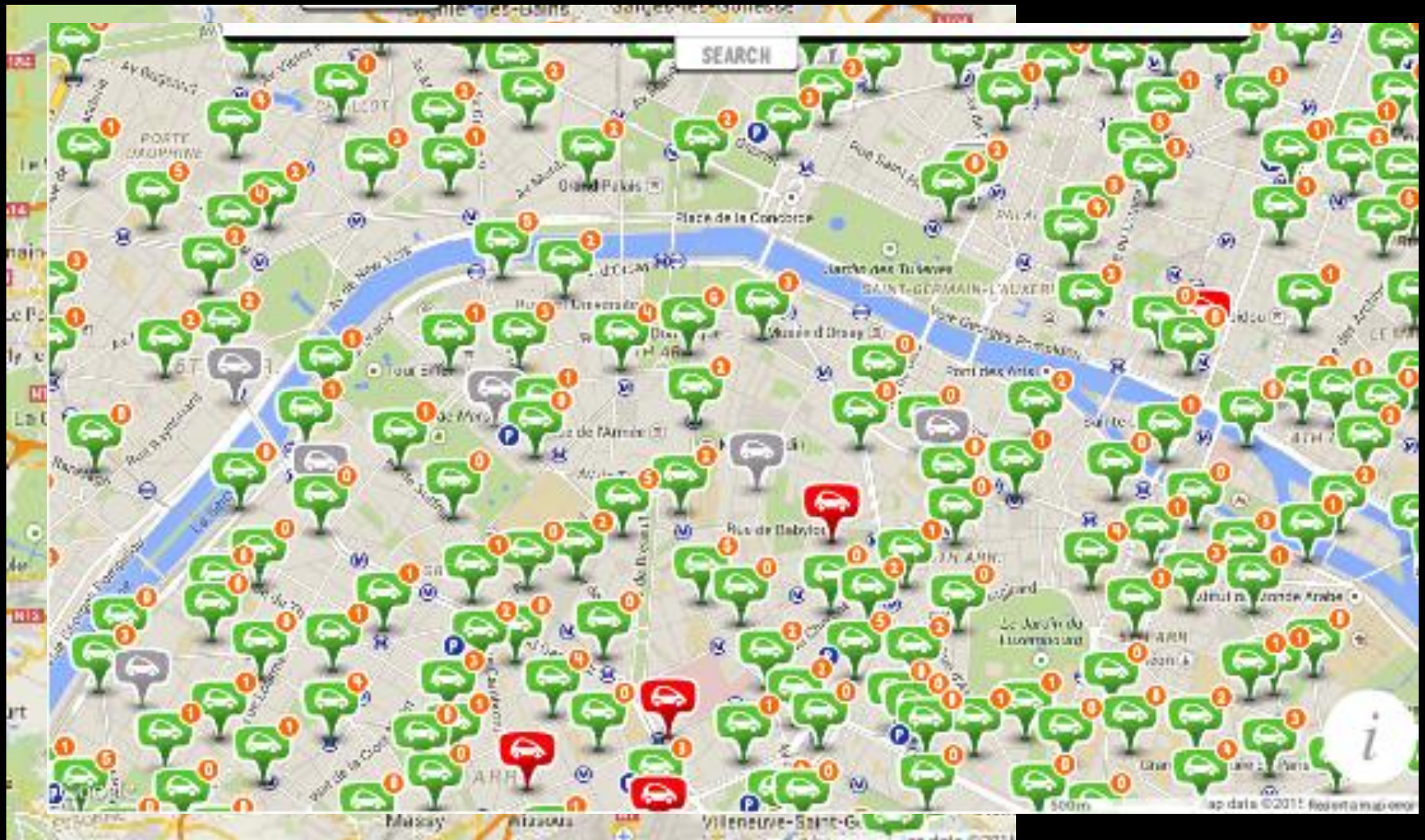
# The EV Carsharing strategy

# How EV Carsharing deal with C&E?

- A public private partnership with municipalities : Risk is shared
- Renting solution for EVs => intensive use on small distances... with IT management
- Using an EV not possessing it.
- The Autolib example



# Smart app overview



# New business model

- New cities are buying Bolloré like solutions
  - In EU
    - Paris
    - Bordeaux
    - Lyon
    - London (UK)
    - Hanzu (China)
    - Mineapolis (USA)
  - 2 cities per year (Rio de Janero, Los Angeles...)  
Licencing strategy to industrialize the process

# Partial conclusion

No empirical nor theoretical solution  
to solve the C&E issue from business  
models



Yurong Chen



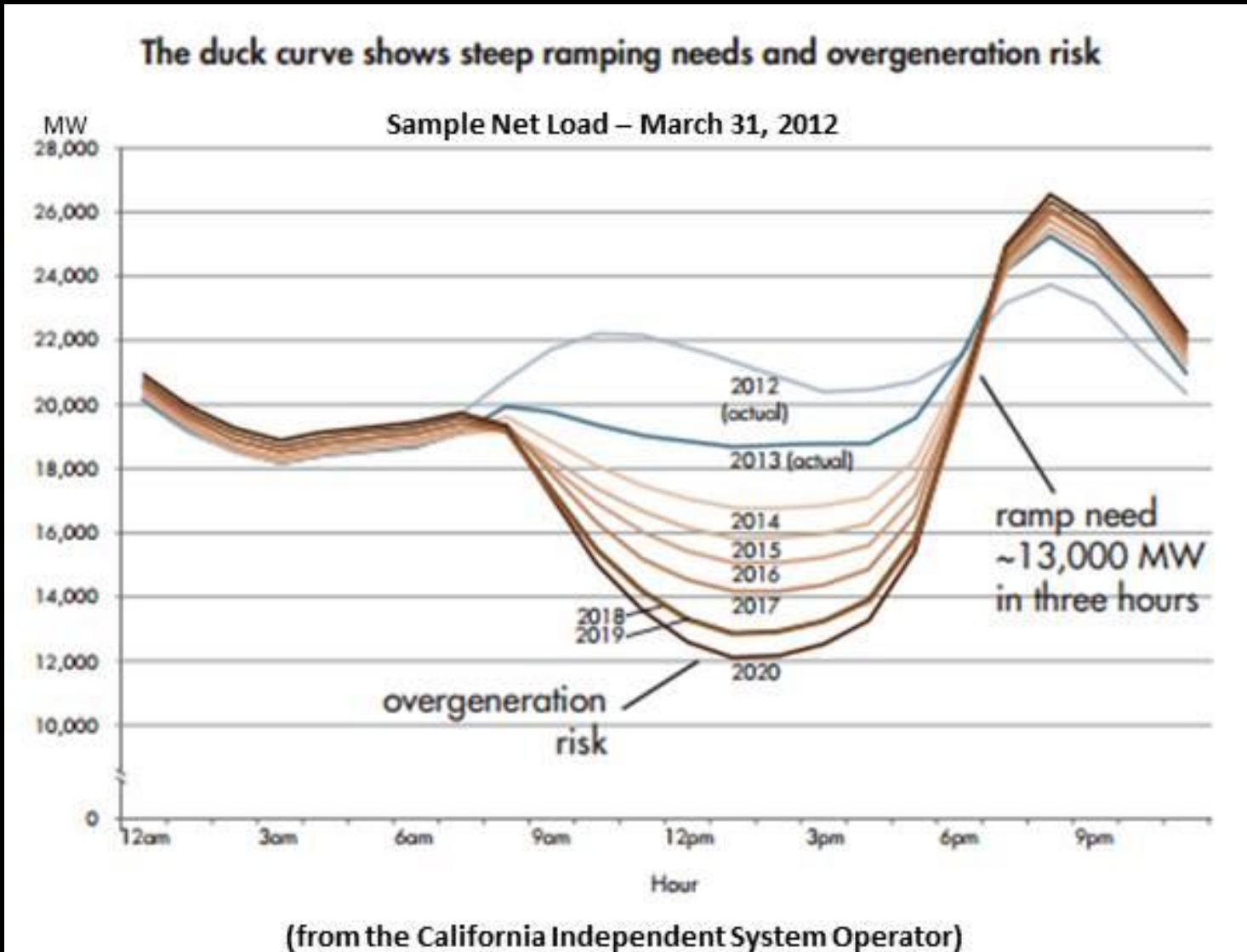
# Renewables energies challenge



# Grids Issues with renewables



# More PV => more Duck issues



More wind => more flexibility  
required

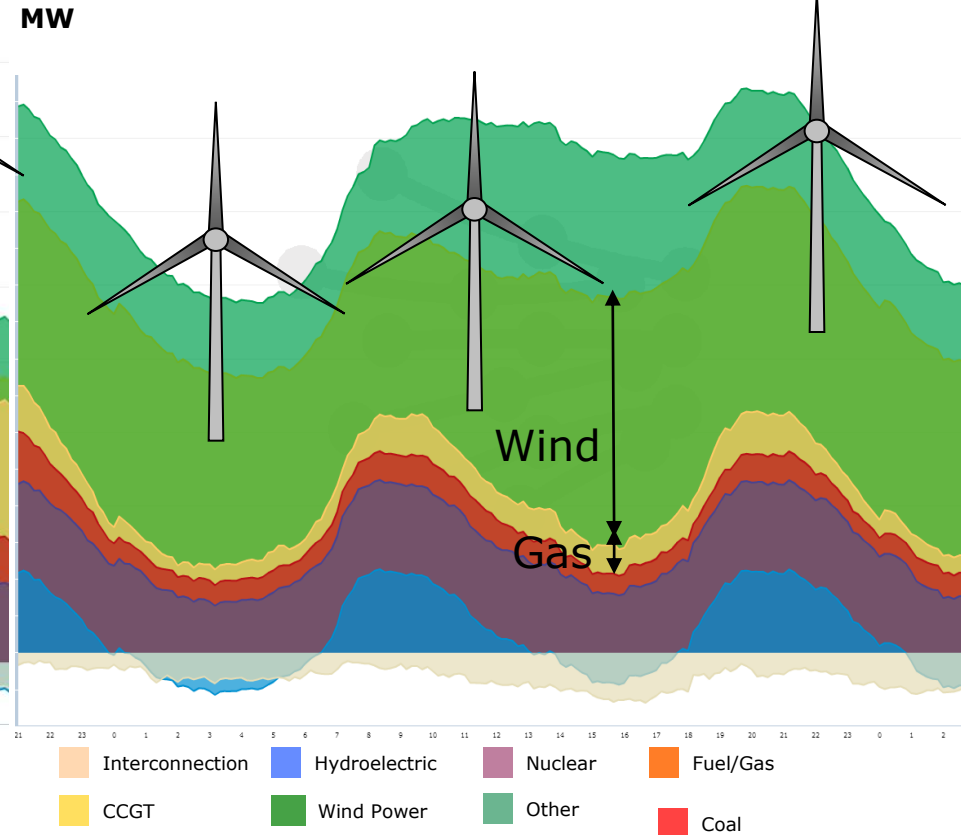
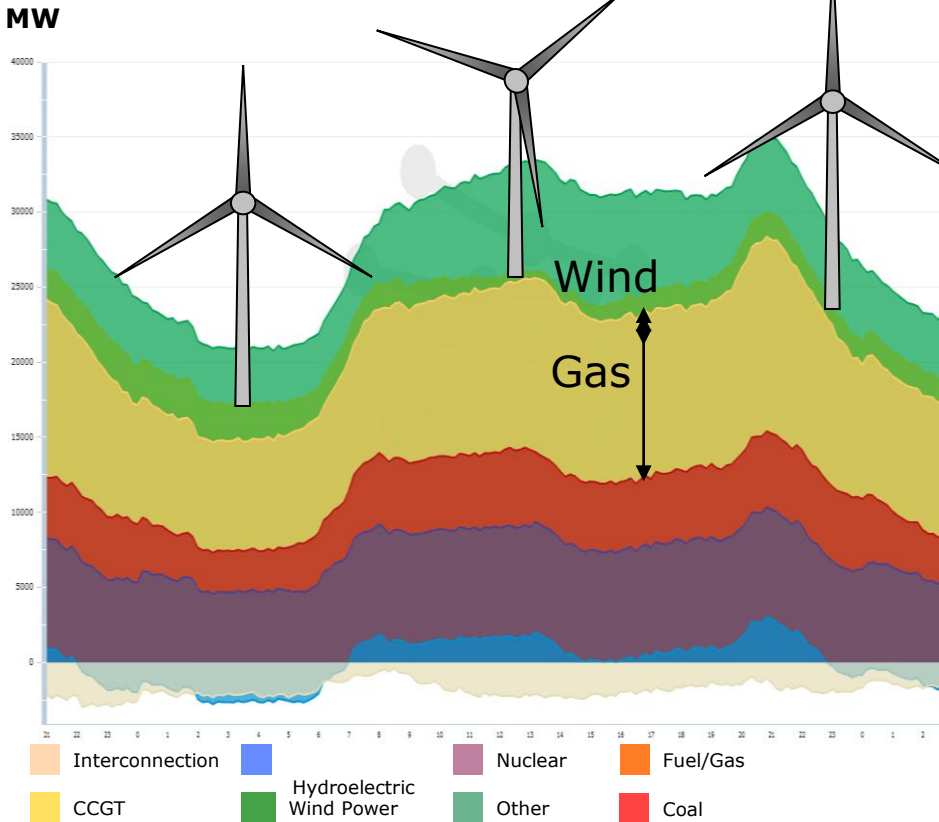
# The Spanish example

30-september-2010

Wind 1%  
17:45h

6-Februray-2013

Wind 66.5%  
15:50h



Source REE, ENAGAS

« Electric Vehicle to grid »  
can provide « storage – flexibility »  
solutions and brings revenues

To???

Car owner?

Storage providers?

Mobility provider?

Car manufacturer?

# How to manage an EV fleet?

- Not perfectly done yet in practice...
  - VtoG experiment around the world (US / Denmark...)
  - Majors success with frequency control on the Transmission grids.
  - PSA and the chair are involved in the Nikola => Parker projects with 2 EV cars



# THE NIKOLA PROJECT



Paul Codani

Conclusion

# More studies are needed !

- Public policy, PPP or business models for charging infrastructure deployment?
- Coupling renewables and EV fleets at :
  - Transmission grid?
  - Distribution grid?
  - District / communities?
  - Household?
- Autonomous cars and allocation of responsibilities in case of an accident ?

## 2 conferences organized by AP Chair in October in Paris Dauphine

### **CONFERENCE ON THE IMPACT OF ELECTRIC VEHICLES ON THE ELECTRICITY SYSTEM**

**A Conference of the Chaire European Electricity Markets (CEEM) at the  
Université Paris-Dauphine co-organised with the Chaire Armand Peugeot at  
CentraleSupélec.**

**Monday, 17 October 2016, 9h00 to 13h30  
Université Paris-Dauphine**

*Salle Raymond Aron, 2nd Floor*

**ATTENDANCE IS FREE BUT PRIOR REGISTRATON IS REQUIRED:**

# 2 conferences organized by AP Chair in October in Paris Dauphine



ELECTRIC  
VEHICLE  
IMPLEMENTING  
AGREEMENT

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**Expert Workshop:**  
V2X User perception, Business Models and  
Regulatory Framework

26-28 October | Paris, France

**Local Organisers:**  
Chaire Armand Peugeot Chair



**Operating Agent:**



**IREC<sup>R</sup>**  
Institut de Recerca en Energia de Catalunya  
Catalonia Institute for Energy Research

# 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?





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