



**A way to 100% ZEV,
on time to save the climate !**

Stéphane Dupré la Tour
EDF R&D
IEA/EPRI Workshop
Paris, 10/10/17



EDF Lab Saclay

136 years of Electric Vehicle history, 136 years of dreams !

DOCUMENT DE TRAVAIL – NE PAS DIFFUSER

1881 : first electric car



Fig. 13 : Tricycle électrique de Trouvé
(Alexis Clerc, Physique et chimie populaires, vol. 2, 1881-1883).

Gaston TROUVE

1890-1929 : Golden Age of EV



38% of cars were electric
in NY in 1890 !



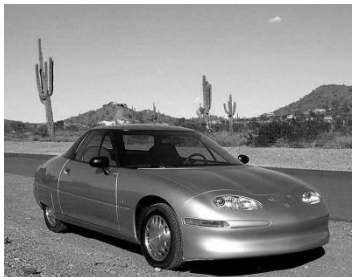
New Era of Electric Mobility awaited for long



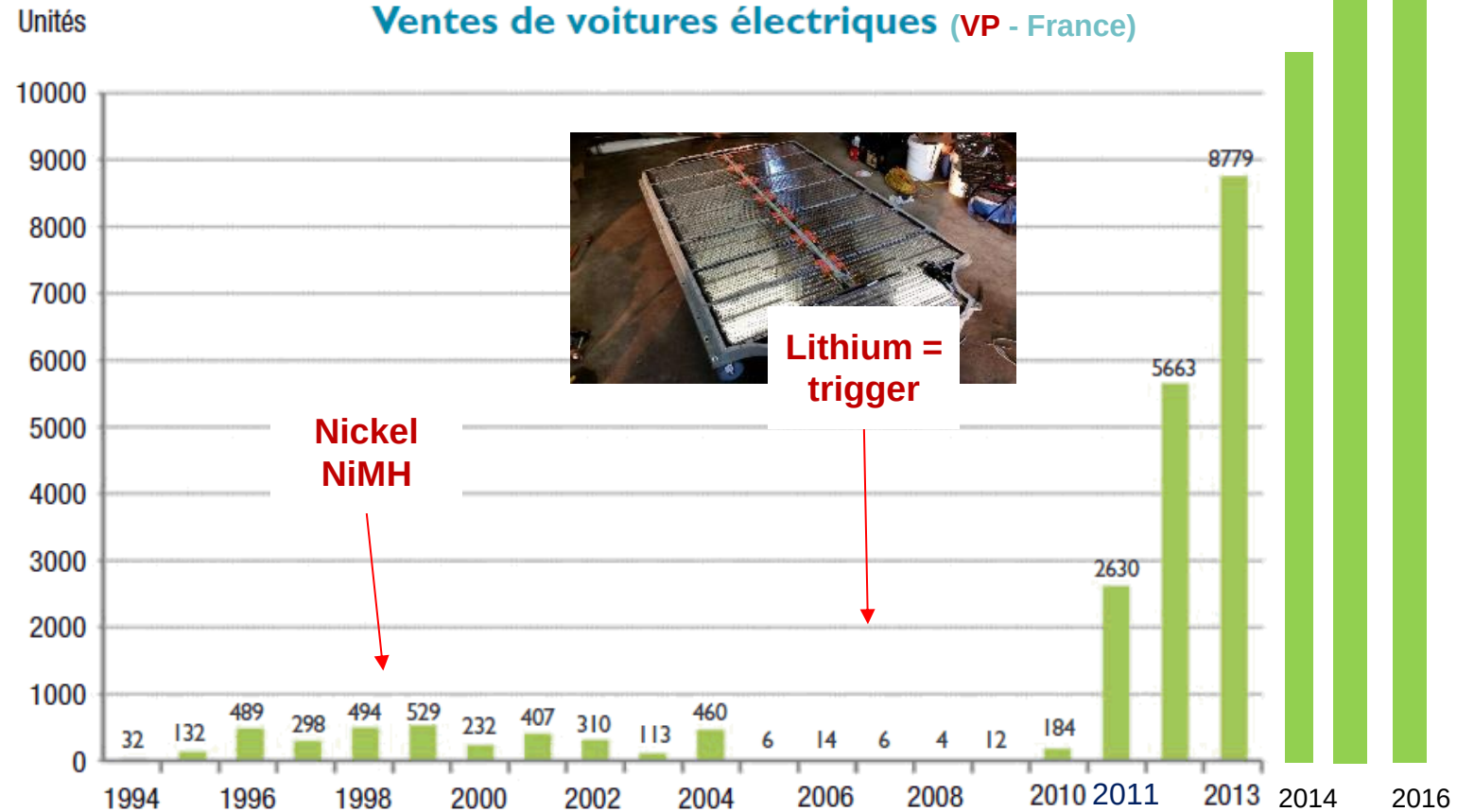
FRANCE : 20 years of EV sells

~17266

~18974



Ventes de voitures électriques (VP - France)



❑ Will the 5th try to deploy EV since 136 years be the good one ?

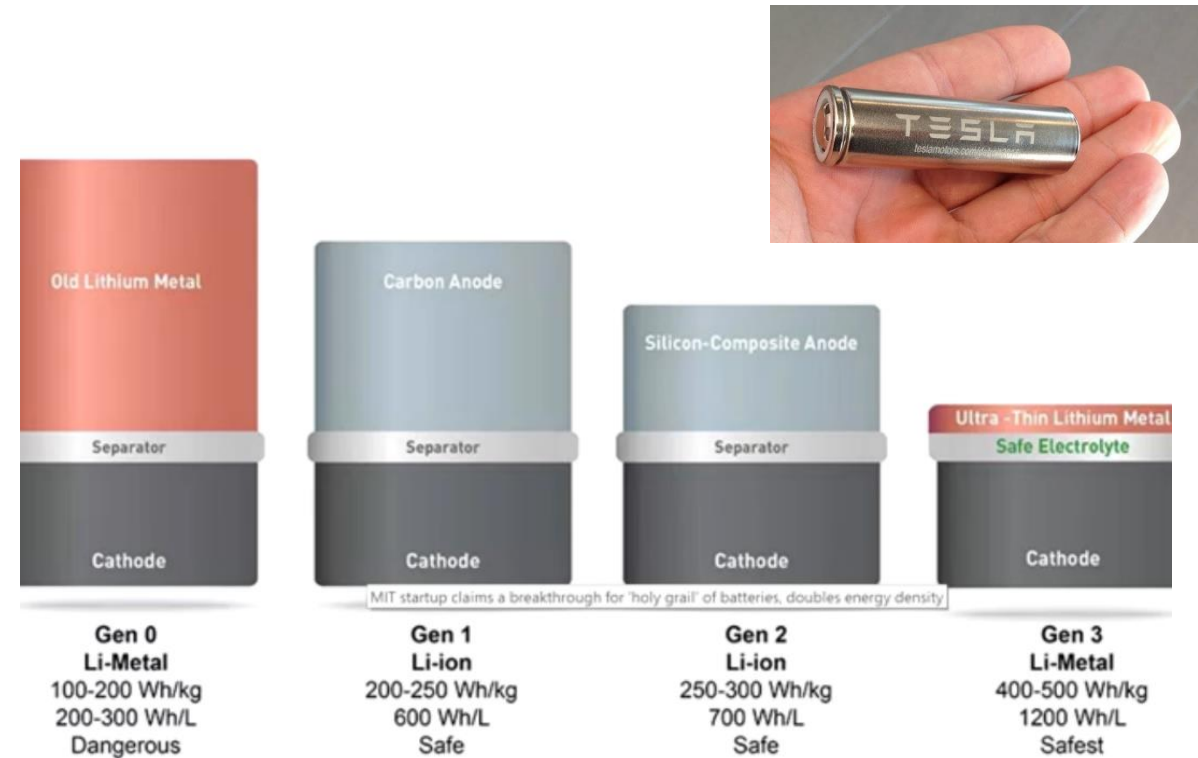
A revolution is coming



Eugène Delacroix, La liberté guidant le peuple

A revolution in 1830

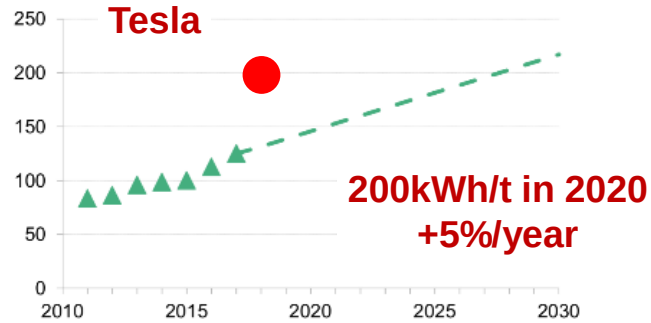
Incremental improvement



The « quiet revolution » in 2017

Lithium batteries at the start of a big change in the car and electricity business ?

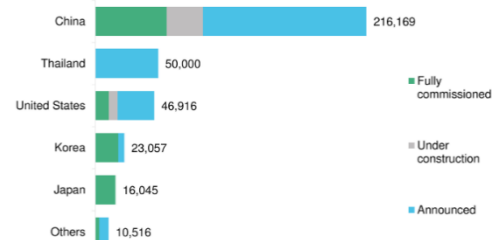
Battery energy density, 2011-2030 (Wh/kg)



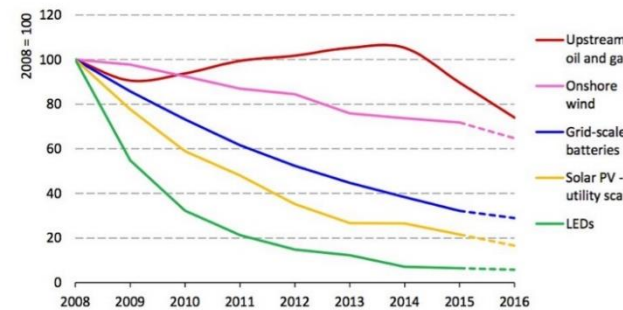
2170 : 3,6V 4,85Ah 63g : 280Wh/kg ?



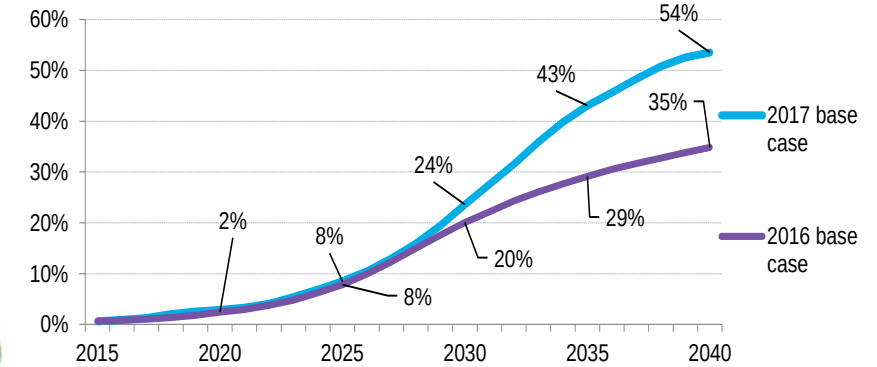
Lithium-ion battery manufacturing by country (MWh)



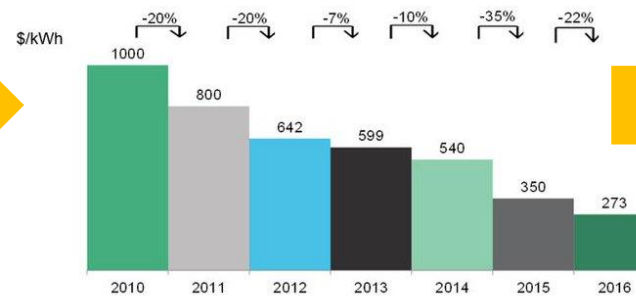
Cost developments across the energy spectrum



EV % of new car sales

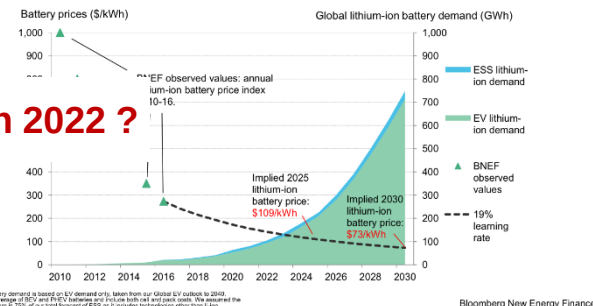


BNEF lithium-ion battery price survey, 2010-16 (\$/kWh)



Note: This includes cells plus pack prices
Source: Bloomberg New Energy Finance

100\$/kWh in 2022 ?



Supply Chain Alignment

Lithium batteries enable to consider electrification of nearly all means of transport



Audi Sportback e-tron 95kWh



Connected Autonomous Shared Electric cars may be a game changer

Uber/Carnegie Mellon,
Pittsburgh, sept 2016



Lyft/GM/Cruise (2020)



Tesla Network



Google/Waymo/Chrysler



Nissan

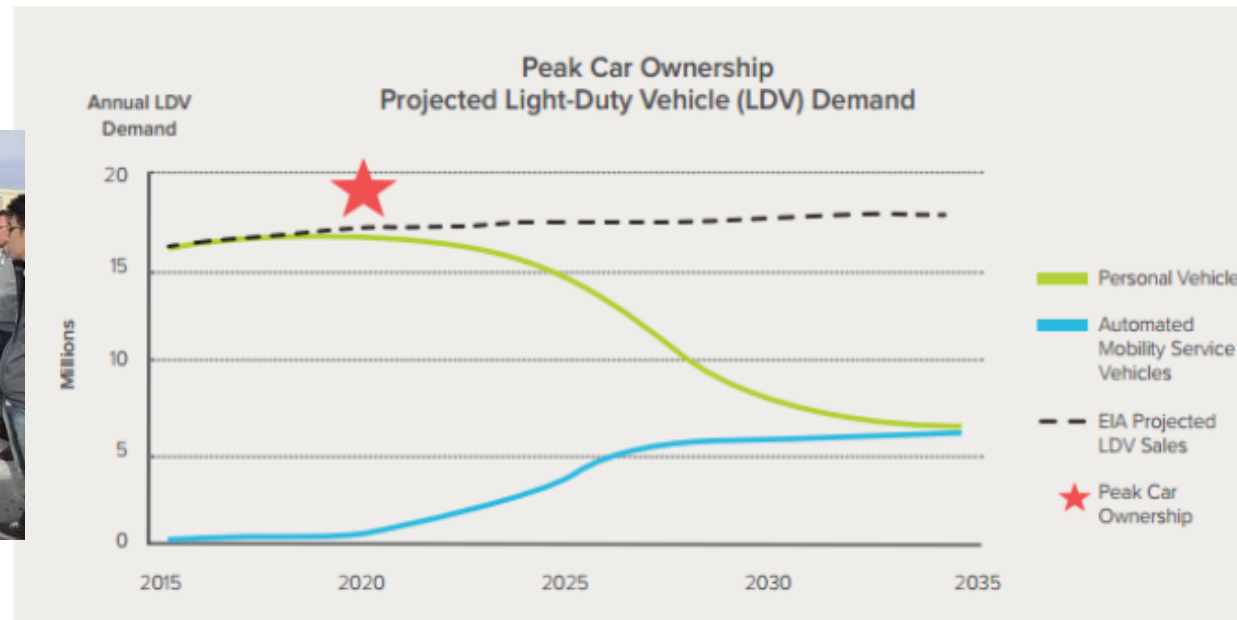
Nissan reveals plans to launch a driverless ride-hailing service to rival Uber and Lyft

Naomi Tajitsu, Reuters
© Jun 22, 2017, 12:05 PM ET

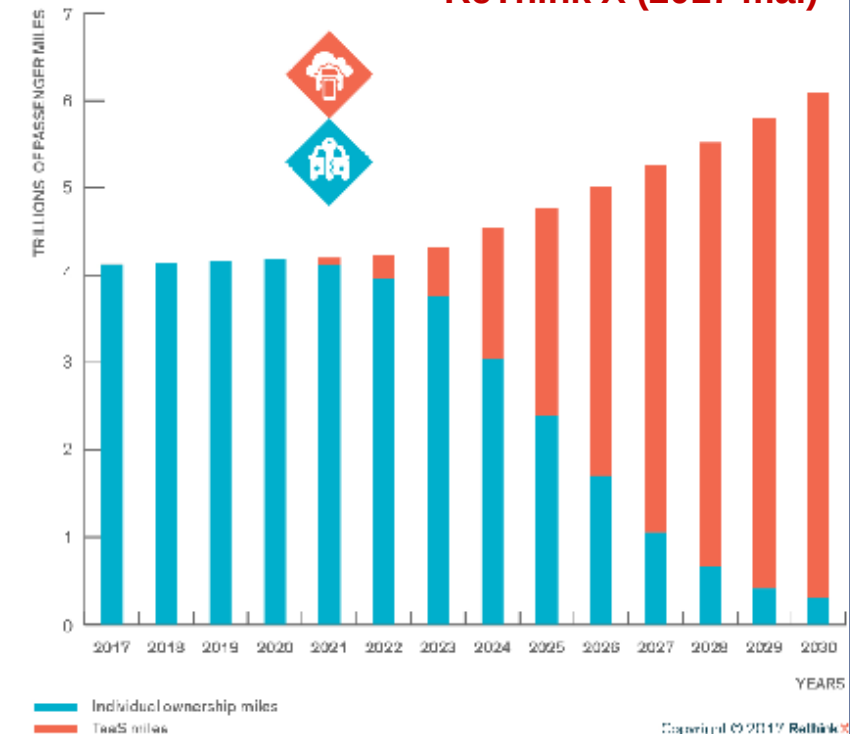
Navya



PROJECTED LIGHT-DUTY VEHICLE DEMAND



» Speed of TaaS adoption



Will the EV story follow the renewables one ?

//

The EV industry looks a lot like renewables did 5 years ago, but in many ways the stakes are even higher.

- Colin McKerracher | Head of Advanced Transport

Bloomberg
New Energy Finance

#EVrevolution

“

Electric cars are roughly where solar power was 10 years ago in terms of their impact on commodity markets [...] Today, solar is a multibillion-dollar business which has a significant impact.

Laszlo Varro
IEA Chief Economist



Will the lithium technology act as a « lock in » for others technologies ?

The idea of 100% ZEV vehicles is becoming credible, but when ?



Oil-rich Scotland wants to go all-electric with phase out of new petrol and diesel cars by 2032

Fred Lambert - Sep. 5th 2017 1:38 pm ET
@FredericLambert



BloombergNEF @BloombergNEF · 1h
Terje Søviknes, Norway Minister of Petroleum & Energy: By 2025 we think 100% of new car sales will be EVs or plug-in hybrids #BNEFSummit



Nicolas Hulot, french minister for ecology
« end of diesel and gasoline cars in 2040 »



End of Internal Fossil Combustion Engine for cars :

- In 2025 (Norway) ?
- In 2030 (Sweden India) ?
- In 2032 (Scotland) ?
- In 2040 (France, UK) ?
- In 2050 (Japan) ?
- In ??, Chine, Allemagne ?

The (proposed) RoadMap to 100% ZEV on the roads

❑ To get :

- 80% of road fleet is ZEV in **2050** (Factor 4)
- 100% is ZEV in **2055**



Paris Agreement (2015)

❑ set collective goals that 100% of vehicles sold should be ZEV in :

- **2025** for 2-cycles, 3-cycles and light 4-cycles
- **2030** for light duty vehicle (<3.5t)
- **2035** for cars
- **2040** for medium trucks (<40t)
- **2045** for heavy long haul trucks (>40t)

A (nice) job for IEA ?

Charging EV by connecting them to the grid is an opportunity for Utilities

//

In Italy, Enel is enabling e-mobility with 10,000 charging points - so next year, Germans can come with their electric cars and go everywhere.

- Francesco Starace | CEO and General Manager, Enel
and Eurelectric President

Bloomberg
New Energy Finance



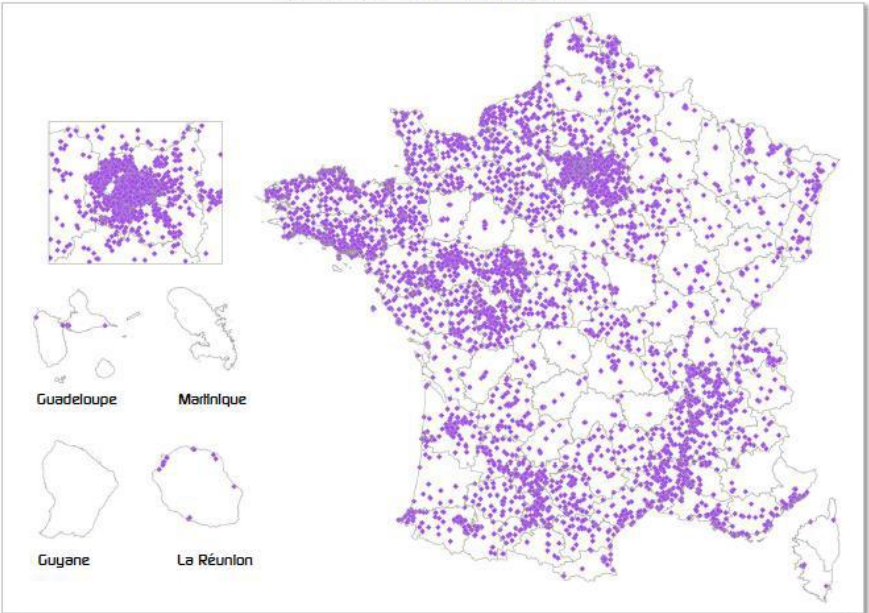
BloombergNEF @BloombergNEF · 4h

Utilities can profit from EVs by creating infrastructure, becoming part of the industry, "being there" [@EnelGroup](#) CEO Starace at [#BNEFSummit](#)

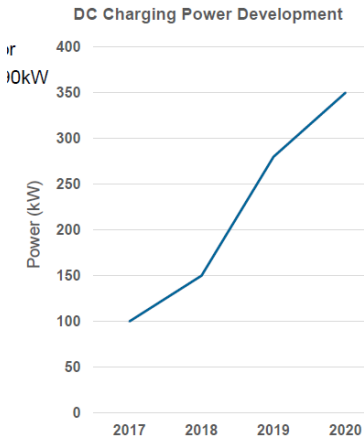


Open access charging infrastructure

Stations de recharge ouvertes au public
7242 stations représentant 20048 points de recharge
situation au 15 septembre 2017



Sourc



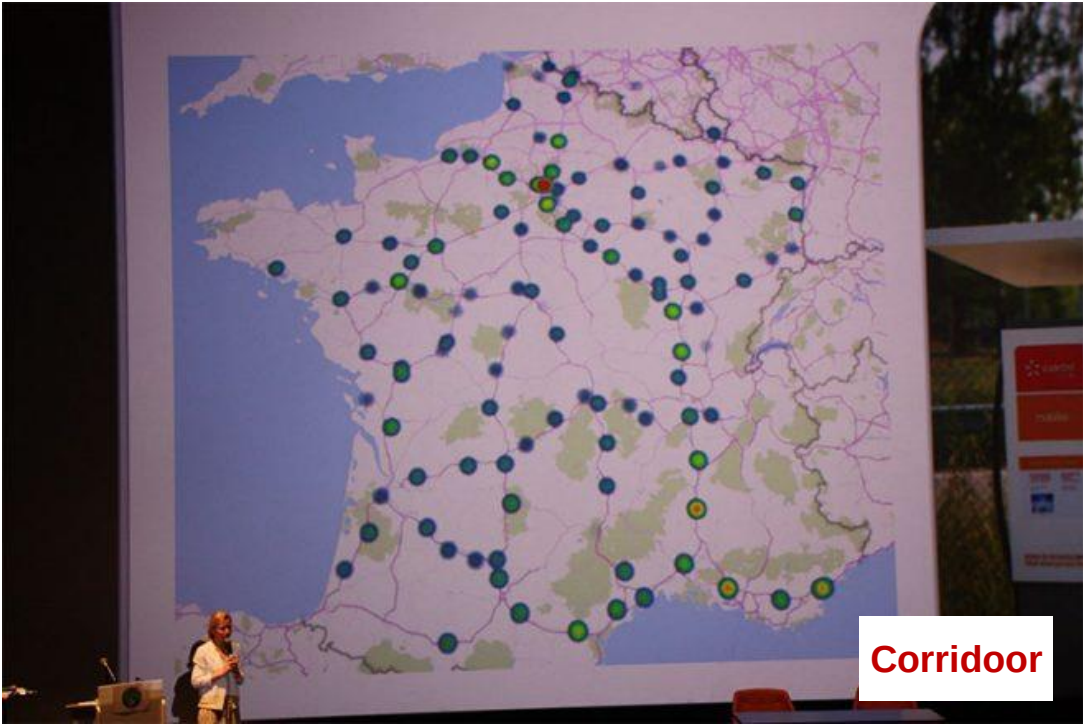
Robotic



Dynamic inductive



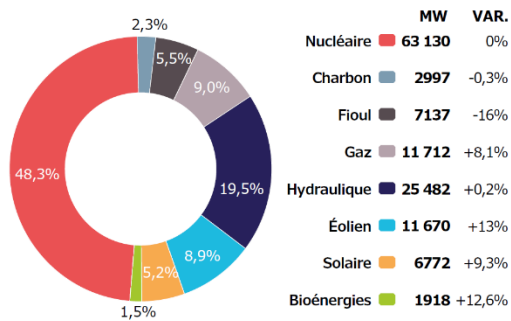
Dotted Electric Highways



Corridor

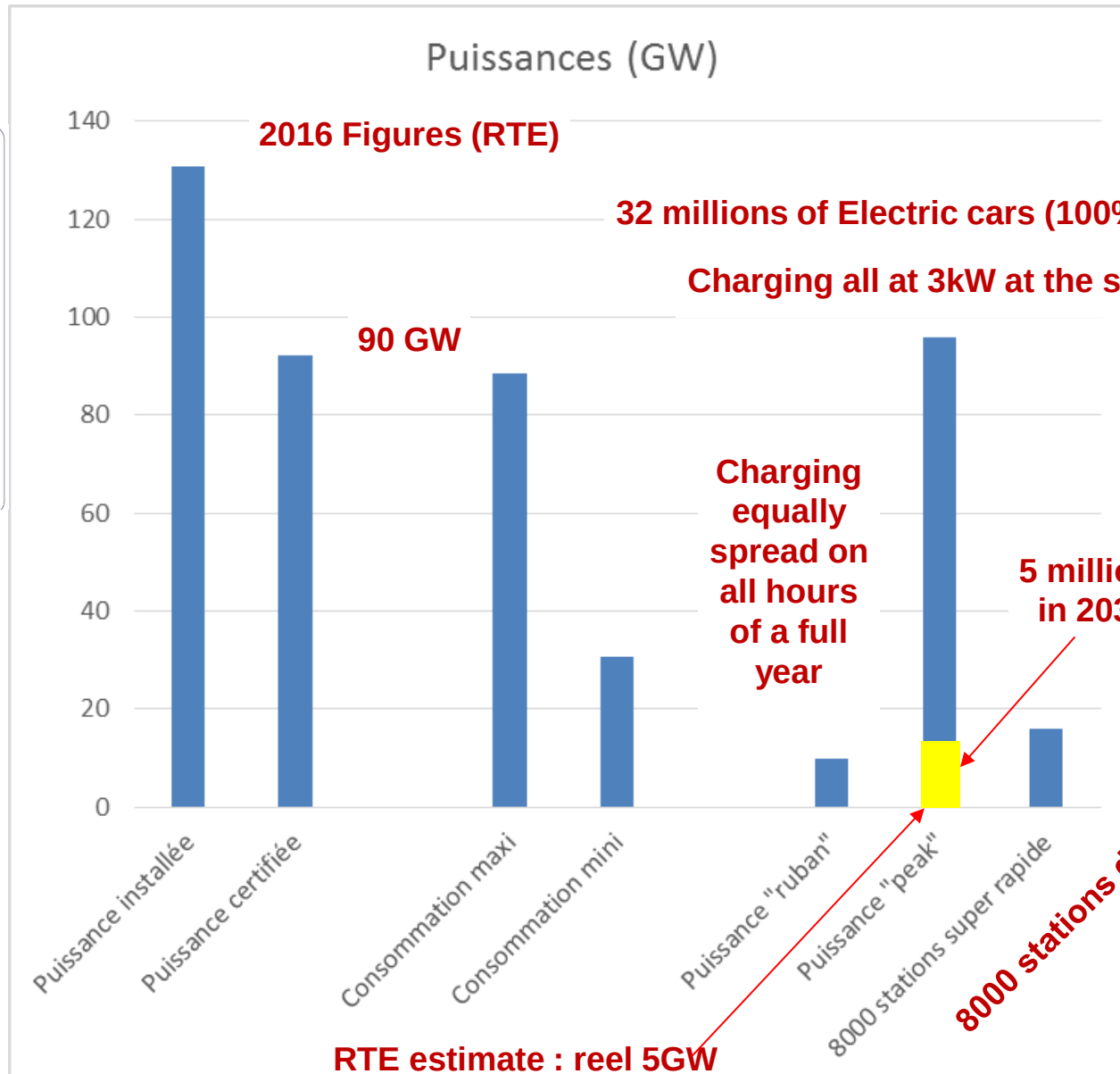
Power impact on the french grid of private charging

Puissance installée au 31/12/2016 : 130 818 MW
(+1,3% par rapport à 2015)

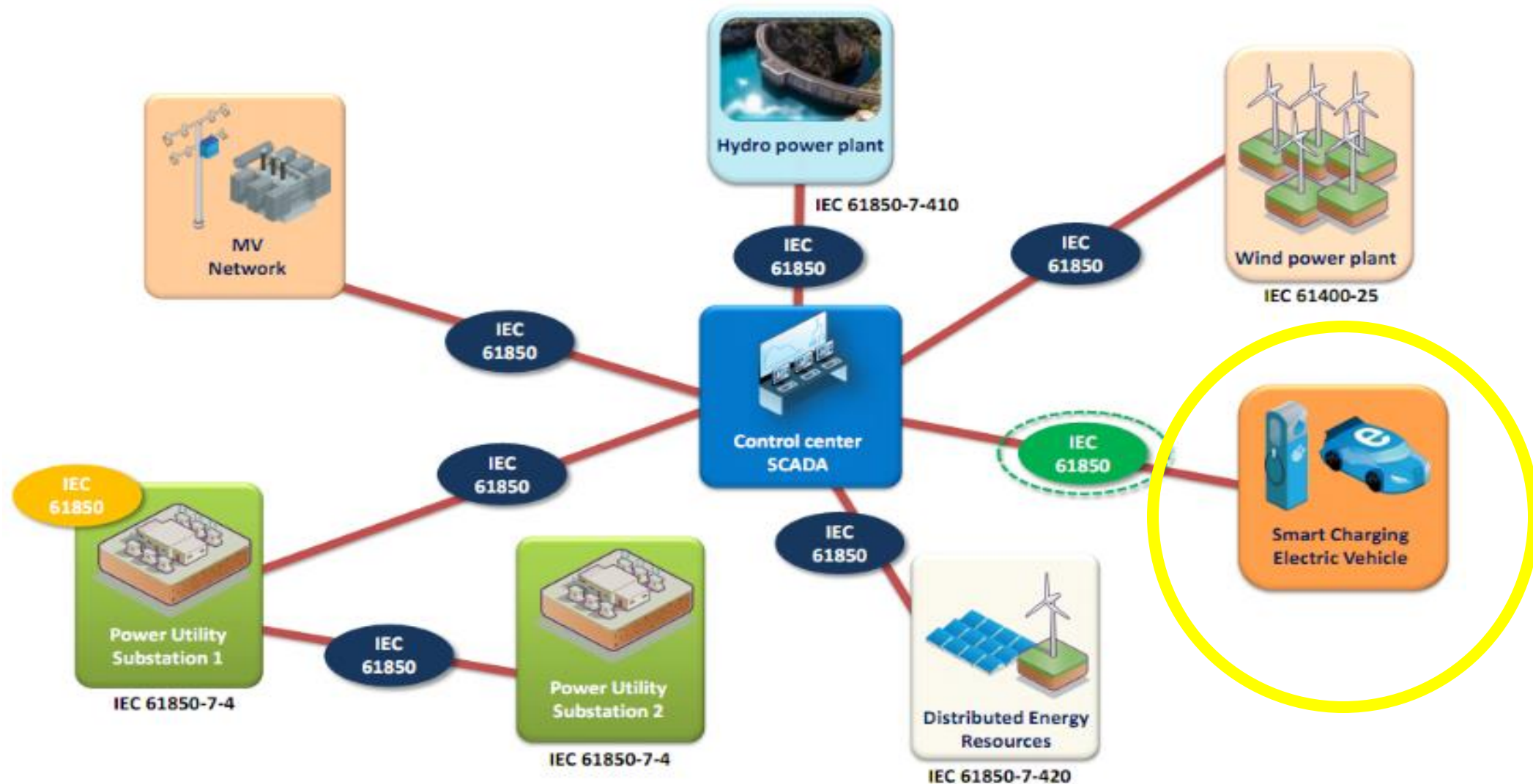


Répartition des capacités certifiées
par filière au 31/12/16t

Nucléaire	54 147 MW
Thermique classique	11 014 MW
Hydraulique	14 333 MW
Solaire	219 MW
Eolien	1 873 MW
Autres	8 687 MW
Effacement	1 875 MW
TOTAL	92 148 MW



Solution : Include charging operations inside the smart grids

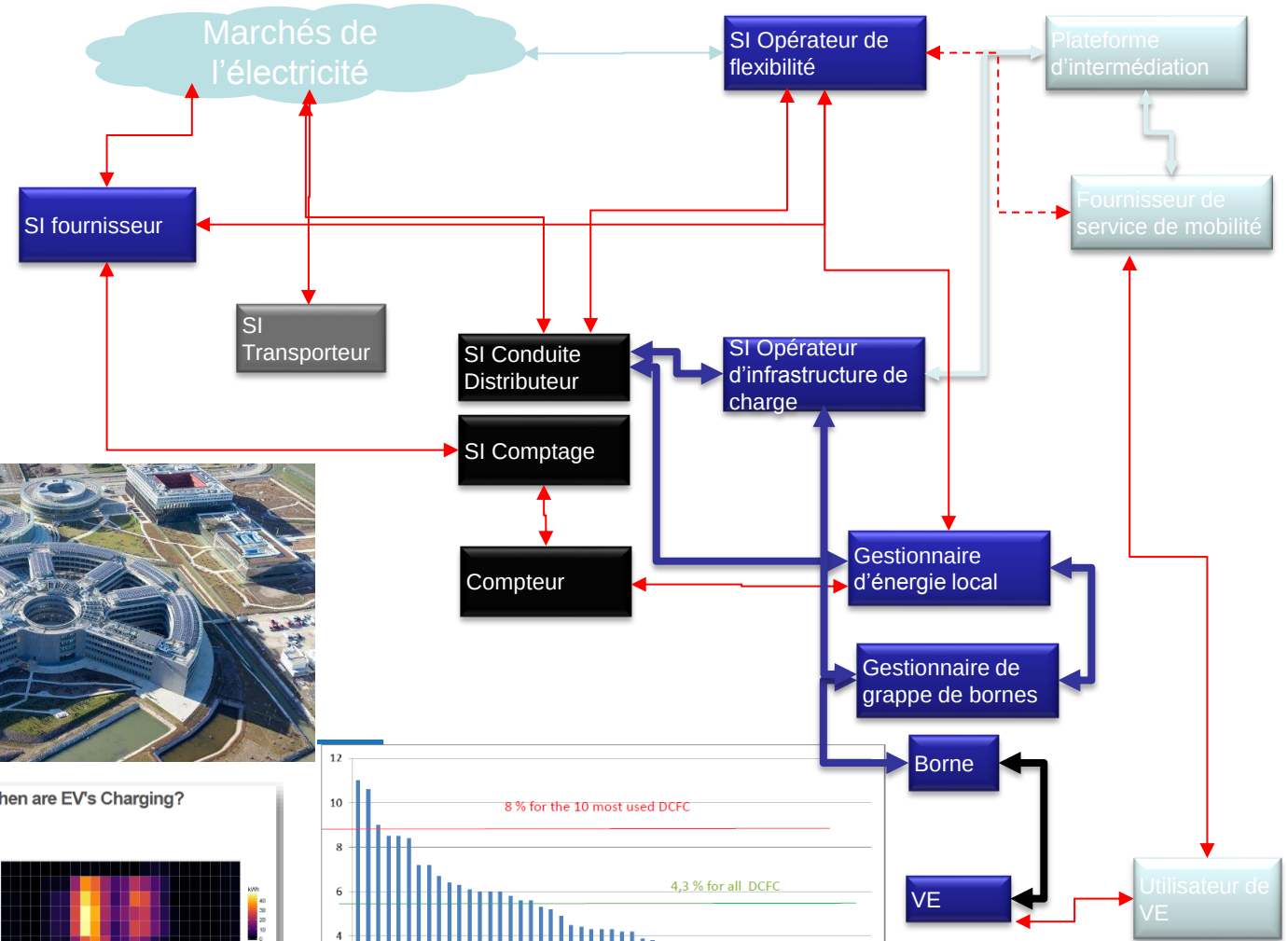
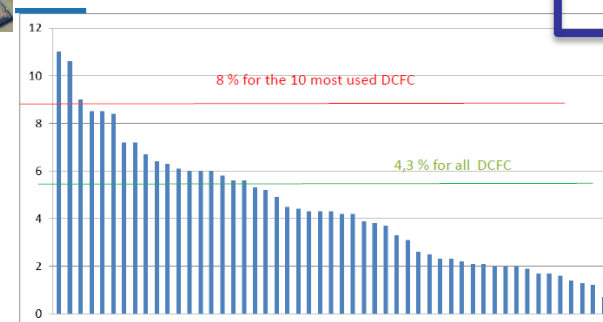
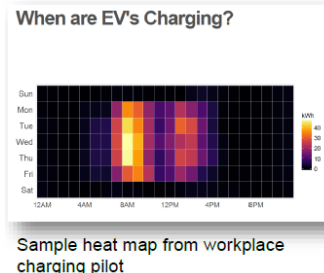
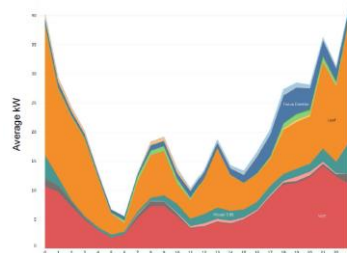
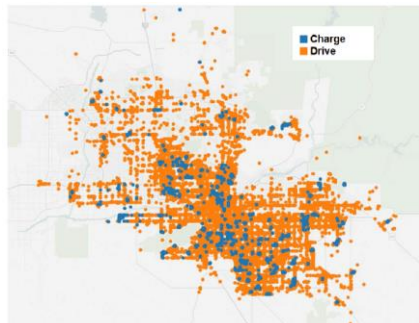


Solution : Include charging operations inside the smart grids

Time of use tarification
Storage at the charging point
Overall planification and optimisation of charging
Charging/discharging as a decentralised energy resource : with requirements for

- cybersecurity,
- latency time,
- availability rate
- smart grids compatibility (IEC 61850)

Standardisation in progress (IEC 63119, IEC 63110 (EDF leadership))



Thank you for
your attention

Tesla Model 3

7/7/17

~50 kWh 220mi 350km EPA

~75 kWh 310mi 496km EPA

Pack 200kWh/t

Cells 280Wh/kg

Cx : 0,21

35.000\$

44.000\$

