# EV & Electrical System

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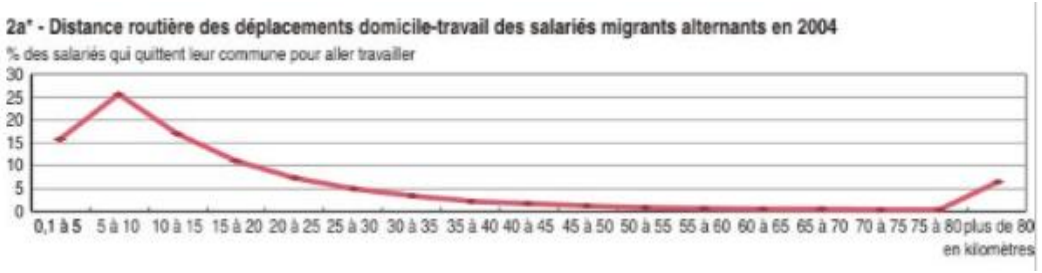
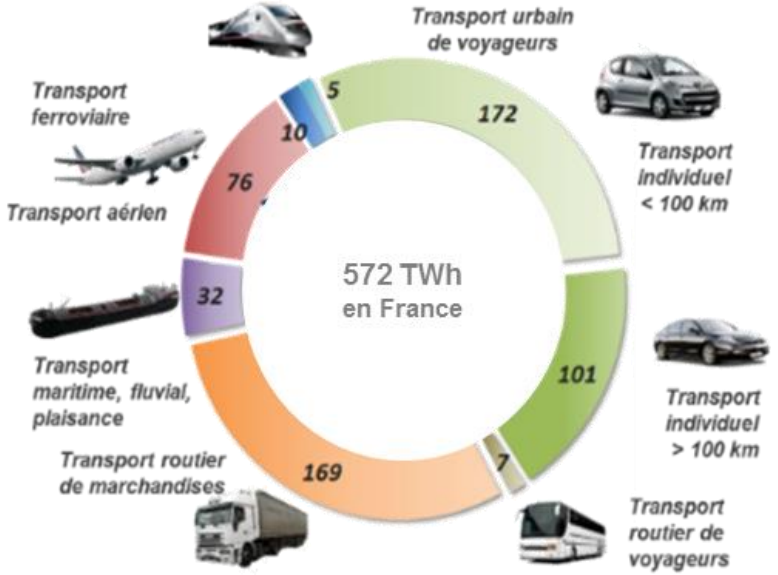
# An increasing need of light duty vehicules

- **Increasing need of light duty vehicule trips**


- **Average daily driven distances less than 30 – 40 km in France**
  - ➢ Less than 5 km per trip




- **A huge energy impact France : 1/3 energy consumption**
  - ➢ 80 % account for road transportation
  - ➢ 50% for light weight vehicules (individual transportation)




572 TWh d'énergie consommée dans les transports en France

- **25 % of CO2 emissions**
  - ➢ 95 % for road transportation

# EVs : an emerging market

- **Over 1% market share since September 2015**
  - + 60% between 2014 and 2015
  - +35 % between 2015 and 2016 (9 months)
  - 20 000 EVs sold  in 2016

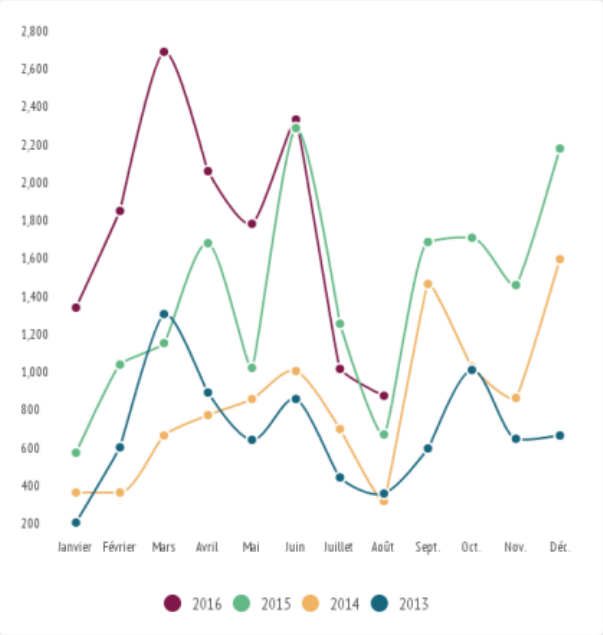
- **The major carmarkers have developped EV lines-up**
  - Mondial Auto 2016 : high B2C visitor interest
  - New models with increased ranges: ZOE, Leaf, e3 …
  - Increased battery performances along with price reductions announced

- **National and European incentives**
  - **Europe**:  TEN-T/CEF  funding frameworks, Directive on alternative fuels  …
  - **National** : « Purchase » Bonus – TECV law, ADEME program for public charging infrastructure implementation

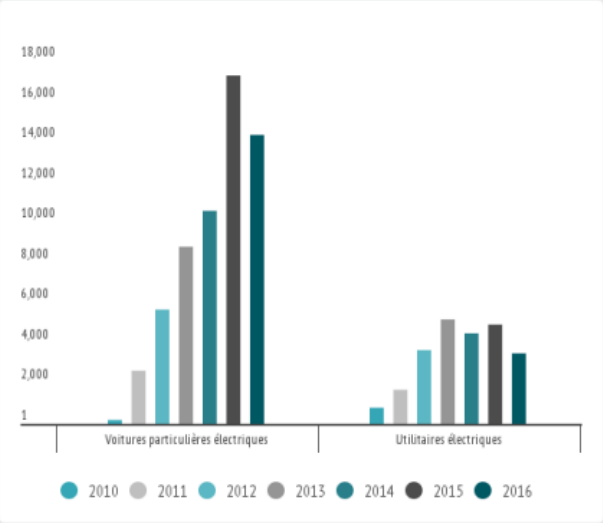
Over 100 000 EVs in France

Towards  400 000 EVs in France in 2020 ?

Evolution des immatriculations de voitures électriques particulières entre 2013 et 2016




Evolution des immatriculations de véhicules électriques entre 2010 et 2016



# Advantages of e Mobility

- No noise
- An electricity cost of less than 2 € (w/o tax) per 100 km in France
- Positive  well-to-wheel balance
- Zero greenhouse gas emissions_( NOx,$CO_2$, CO,…), no local particulate emission
- Lowered fossil fuel dependance

CO : 0

HC : 0

NOx : 0

Fumées : 0

Odeurs : 0

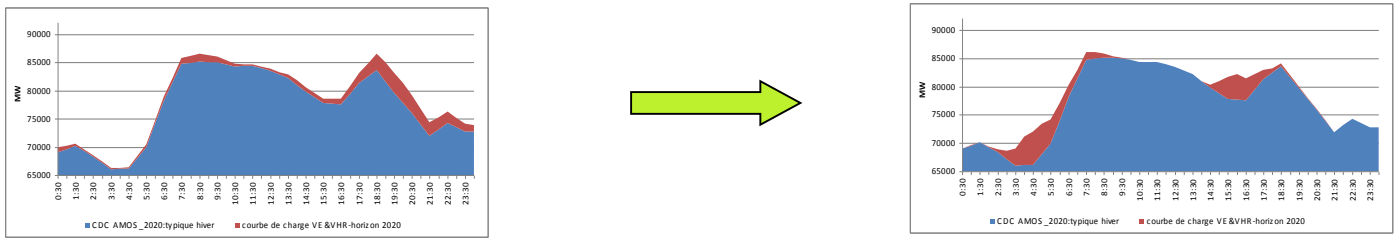
| Energy Mix | Well to tank | + | Tank to wheel | = | Total emissions |
|---|---|---|---|---|---|
| Diesel / Petrol | 20 à 35 | | 120 à 180 | | 140 à 210 |
| Electricity 95% N+EnR | 15 à 20 | | **0** | | **15 à 20** |
| Electricity 50% N+EnR | 90 à 110 | | 0 | | 90 à 110 |
| Electricity 35% N+EnR | 120 à 140 | | 0 | | 120 à 140 |

g $CO_2$/km

# EV charging : impact on electrical system

- **No major electricity production issues (Energy) foreseen in France :**
  - 2 million EVs (2025 to 2030) => 5 to 6 TWh consumption
    - 1% of French electricity production
      - 546 TWh produced and 475 TWh used in France in 2015
  - EV ⇔ electric water heater in term of yearly electricity consumption

- **Impact on the electrical grid (Power) to take into account but :**
  - Limited power capacities likely met at different scales : home, building, city & territories, distribution grid
  - Solutions are available but must be cost efficient and competitive
    - Off peak tariffs
    - Assessing local grid stress to avoid reinforcement, differ investment …
    - Smart charging (e.g. defer charge in off-peak period), V2H/V2G to manage power demand




Source: ERF R&D, November 2009

# Charging features

- **Power subscriptions are over 70 % at 6 kW rate at home in France**

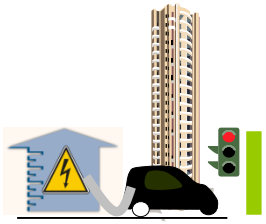
| Charging mode | Normal | Accelerated | Fast |
|---|---|---|---|
| Power | 3kW – 7kW | 22kW | 43kW ou 50kW |
| Charge duration (e.g. ZOE) | 4 - 8h | 2 h | < 30min (80 %) |

| Equivalence | 1h charging | 8h charging | 40 km |
|---|---|---|---|
| 10A | 11 km | 88 km | 3h30 charging |
| 16A | 18-20 km | 150-160 km | 2h charging |

**22 kW (“accelerated”) / 50 kW (fast)**

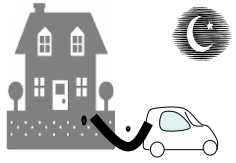
**Locations :**
- Streets
- Parking lots, gas stations
- Highways, …

**Features :**
- Fast charging (towards higher power , > 100 kW ?)
- Only a few
- Expensive



5%

**Normal charging < 8 KW**



95%

**Locations :**
- Home
- Work
- Streets
- Public parking lots

90 %

5 %

**Features :**
- Generally 3-4 kW
- Available everywhere
- Low cost

# EVs : an opportunity  or a burden for the electrical system ?

- **A new electrical usage increasing electricity consumption  and power demand**
  - + 3 kW  charging power a minima at home during peak hours
  - 3 MWh a year @ 10000 km/year
- **A battery storage tool which can help manage the power demand**
  - Load levelling, Peak shedding, Adjustment mechanisms …
  - V2H, V2G
  - Stationnary uses of affordable « second life » EV batteries (backup, buffering, power quality) ?
- **Need a customer approach : not only constraints but new  business opportunities**
  - End customer : Optimised  charging spot at home, in co-owned buildings (condominiums), specific prices …
  - Cities, emobility operators : public charging infrastructures networks, micro-grids, …
  - Energy suppliers : optimization of energy purchase,
  - Distribution system operators (DSOs) : management of the grid and investments…
- **Need to match together the mobility request of the end user, the goal of limited impact on the grid, cost reduction and optimised prices**
- **ICT solutions help take advantage of the EV charging flexibilities**

# EVs at home and condominiums, in cities or highways …

- **Garantee a safe charging installation**
  - Dedicated circuit with 30 mA RCD
  - Avoid damages of household appliances (harmonics of EV chargers)


- **Help reduce global energy costs and power demand on the grid**
  - Management of the home electricity demand : e.g. SOWEE by EDF
    - Off peak tariffs, power modulation, …
    - Daily EV range ensured …
  - Smart charging and metering
    - Limited overcost linked to the increase of the power subscription thanks to smart metering and demand side management : e.g. Linky

- **Help develop EV charging spots in condominiums**
  - Cost effective charging infrastructures
  - Compliant with the « shared » power subscription (lights, lifts, …)
  - Smart charging : power shedding switch, balanced charging …

- **Help reduce the power demand of public charging infrastructure clusters**
  - Global power limitation of charger clusters with charging spot balancing : e.g. < 36 kW
  - Power buffering via battery storage : e.g. 150 kW fast charger …

# Utilities : Electricity suppliers, DSOs

- **Opportunity of new integrated services**
  - Home management of the electricity demand : e.g Sowee
  - Integrated « EV charging » packages : smart plug, installation, Renewable energy , optimised tariffs
  - Upstream study of sites in term of  power connection capacity


- **Opportunity to investigate new technical solutions and business models**
  - Smart charging
  - Agregation of the charging flexibility of charging stations clusters
  - V2H, V2G
  - « 2d life » EV battery storage
  - Electricity roaming

EV is an opportunity more than a threat