China New Energy Vehicles
中国电动车

法国华人汽车工程师协会
Association des Ingénieurs Chinois de l'Automobile en France

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FONDATION TUCK
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Government policies

Market

Brands and models

Other vehicules

Energy aspects

Industrial aspects

Ecological aspects

What to expect next ?

A few definitions

BEV : Battery Electric Vehicle

→ Renault Zoé / Tesla / Nissan Leaf …

Renault Zoé (2012)

HEV : Hybrid Electric Vehicle

→ Toyota Prius, Yaris, Auris, Peugeot 3008, Honda Jazz …

Toyota Prius (1997)

PHEV : Plug-in Hybrid Electric Vehicle

→ Golf GTE / Toyota Prius rechargeable / Opel Ampera …

Chevrolet Volt (2010)

FCEV : Fuel Cell Electric Vehicle

→ Toyota Mirai / Hyundai Nexo / Honda Clarity

Hyundai Nexo (2018)

NEV : New Energy Vehicle (notion chinoise)

→ PHEV, BEV ou FCEV

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Government policies

2000 : Wan Gang makes a strategic proposal to the state council of China :

"Regarding Development of Automobile New Clean Energy as the Starting Line for Leap-Forward of China's Automobile Industry"

2004 : CEVA

中国电动车协会
CHINA ELECTRIC VEHICLE ASSOCIATION

2009 : 60 000 元 subsidies for BEV and 50 000 for PHEV

中华人民共和国工业和信息化部
Ministry of Industry and Information Technology of the People's Republic of China

2012 : plan for a market of 500 000 NEV in 2015 and 2 millions in 2020

Sources :
https://en.wikipedia.org/wiki/Wan_Gang
https://en.wikipedia.org/wiki/New_energy_vehicles_in_China
https://en.wikipedia.org/wiki/Electric_vehicle_industry_in_China
https://en.wikipedia.org/wiki/Pollution_in_China#Impact_of_pollution

Government policies

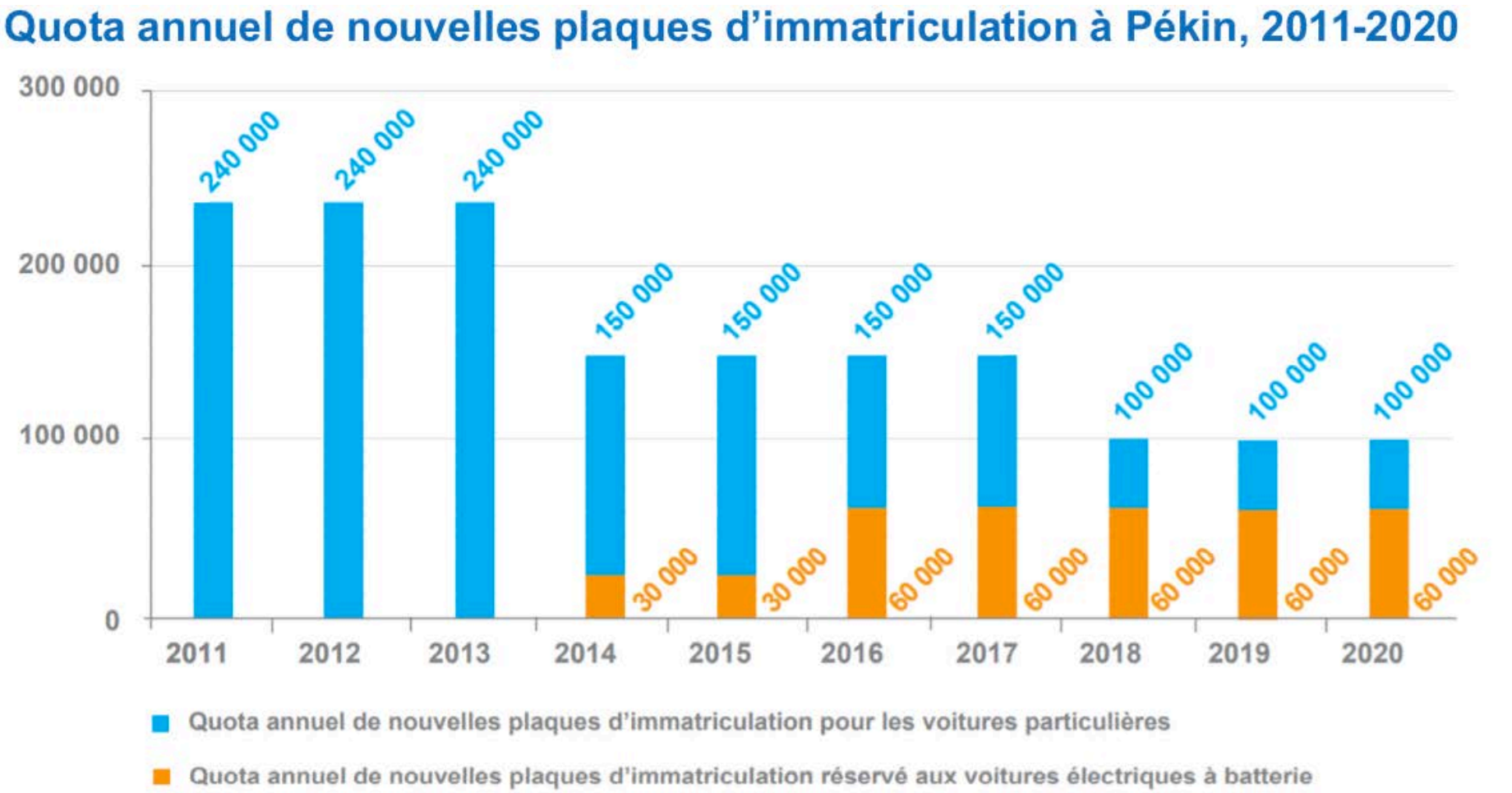
2015 : Plan for a charging point network for 5 millions NEV in 2020

Local incentives (2015) :

City	Adopt national MIIT catalog for local subsidy qualification?	Local subsidy matches national NEV subsidy 1:1?	Local subsidy difference from national standard
Beijing[1]	✗	✓	• PHEV exclusive • Total subsidy less than 60% of the retail price
Shanghai[2]	✗	✗	• 40/30 thsd. RMB for BEV/PHEV
Shenzhen	✓	✓	• N/A
Chongqing	✓	✓	• Total subsidy less than 60% of the retail price
Guangzhou	✓	✓	• Total subsidy less than 60% of the retail price
Hangzhou	✓	✗	• 30/20 thsd. RMB for BEV/PHEV
Hefei	✓	✓	• BEV with range>150km: match national subsidy 1:1 • Other NEV: 20% of national subsidy
Nanjing	✓	✗	• 35/20 thsd. RMB for BEV/PHEV
Tianjin	✓	✓	• N/A
Wuhan	✓	✓	• Total subsidy less than 60% of the retail price

Sources :
https://www.theicct.org/sites/default/files/publications/ICCT_China-NEV-mandate_policy-update_20180111.pdf
https://www.bloomberg.com/news/articles/2018-07-06/china-is-said-to-weigh-further-cuts-in-electric-car-subsidies
http://www.mckinseychina.com/wp-content/uploads/2015/04/McKinsey-China_Electric-Vehicle-Report_April-2015-EN.pdf

Beijing



Source : Beijing Municipal Commission of Transport

Sources :
https://webikeo.fr/public/media/100031632/181220-webconference-quelle-place-pour-la-voiture-electrique-dans-la-mobilite-de-demain.pdf

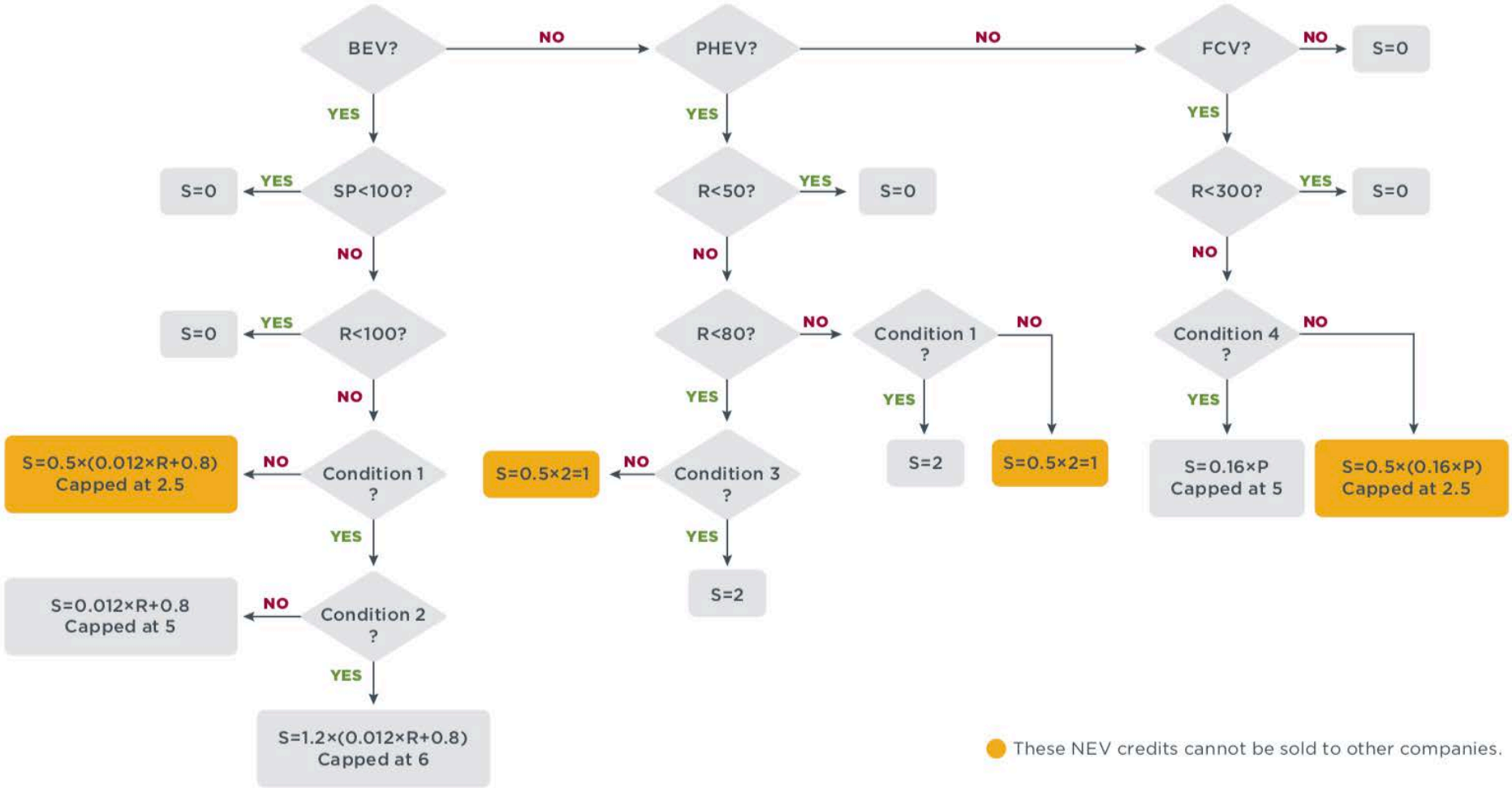
Vehicle credits

2017 : quotas ! 10% NEV in 2019, 12% in 2020

Item	Interim Proposal	Final Rule	Max credit
Techinical thresholds for NEV credit qualification	BEV: Electric range ≥ 80km	Electric range ≥ 100km Maximum vehicle speed ≥ 100km/h	
	PHEV: Electric range ≥ 50km		
	FCV: Electric range ≥ 250km	Electric range ≥ 300km	
Per-vehicle credit for BEV	Electric range (km) / Per-vehicle credit 80-150 / 2 150-250 / 3 250-350 / 4 ≥ 350 / 5	(0.012 × electric range + 0.8) × adjustment factor,* capped at 6	6
Per-vehicle credit for PHEV	2	2 × adjustment factor*	2
Per-vehicle credit for FCV	Electric range (km) / Per-vehicle credit 250-350 / 4 ≥ 350 / 5	(0.16 × fuel cell system rated power) × adjustment factor,* capped at 5	5

Sources :
https://www.theicct.org/sites/default/files/publications/China-NEV-mandate_ICCT-policy-update_20032018_vF-updated.pdf

Vehicle credits



Sources :
https://www.theicct.org/sites/default/files/publications/China-NEV-mandate_ICCT-policy-update_20032018_vF-updated.pdf

Government policies

MIIT targets are :

- Reduce dependency on petroleum
- Create a competitive industry
- Reduce urban pollution

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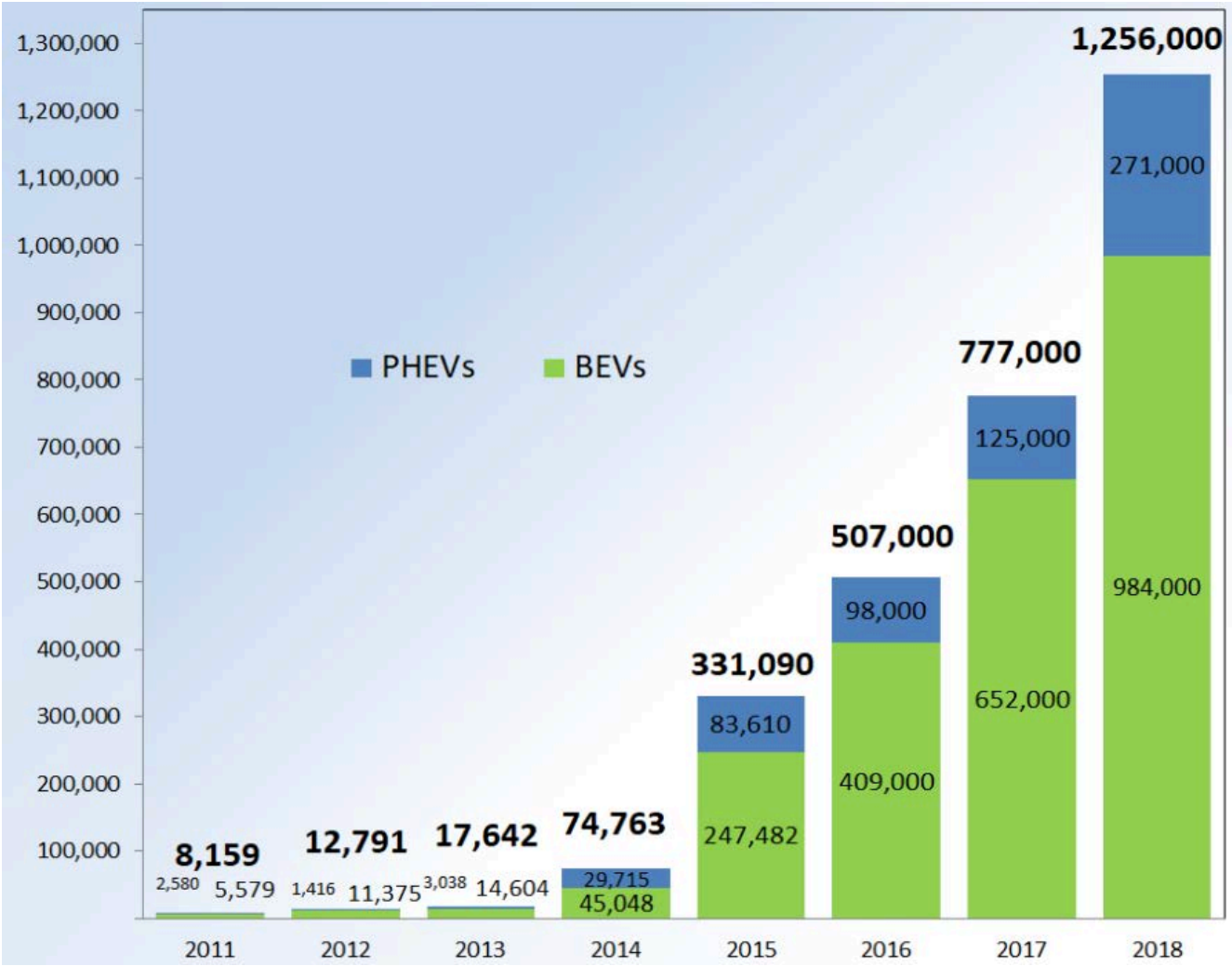
Results

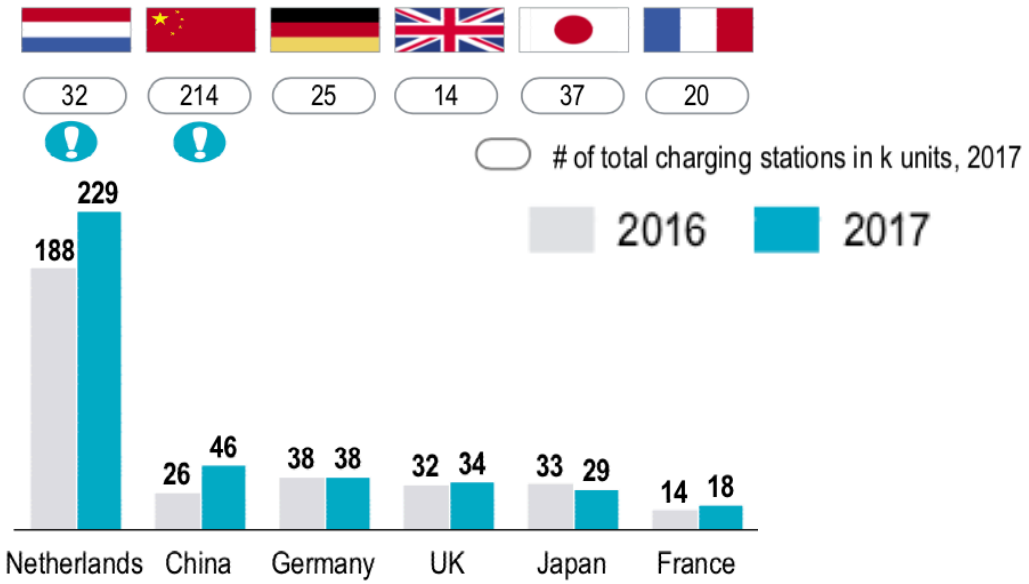


Market share : 0,3% 1,3% 1,8% 2,1% 4,5%

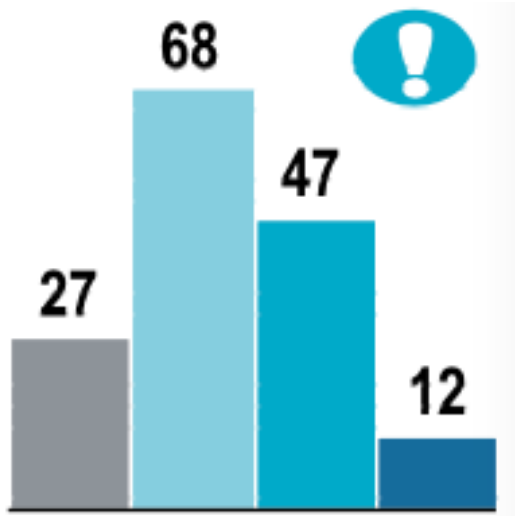
Sources :
https://en.wikipedia.org/wiki/New_energy_vehicles_in_China
http://www.caam.org.cn/AutomotivesStatistics/20180918/1505219478.html
http://www.ofv.no/getfile.php/136094-1512549031/Dokumenter/OFV%20Frokostmøter/EV%20in%20China%20developments%20draft_Robert_Early.pdf

Charging infrastructure

Charging points per 1000 km :



Decision not to buy a NEV (july 2017) :

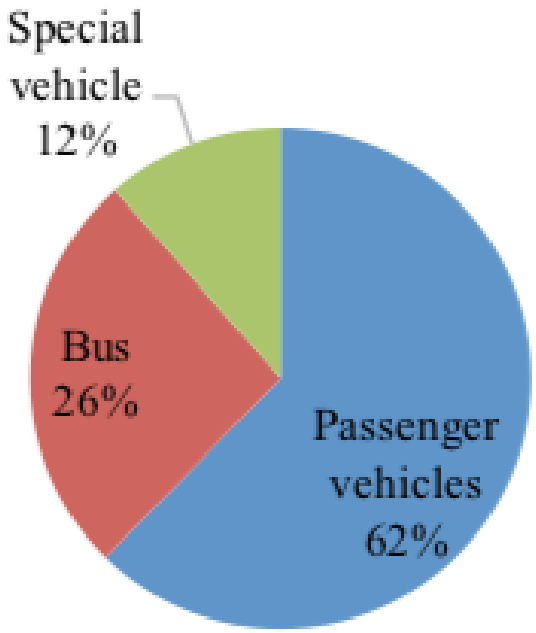


Price too high | Insufficient infrastructure / no place to charge | Low range | No model I like

Source :
Overall Outlook On Powertrain Development. Roland Berger, avril 2018

Vehicule types

NEV sales 2016 :



Distribution of different types of accumulative output in 2016

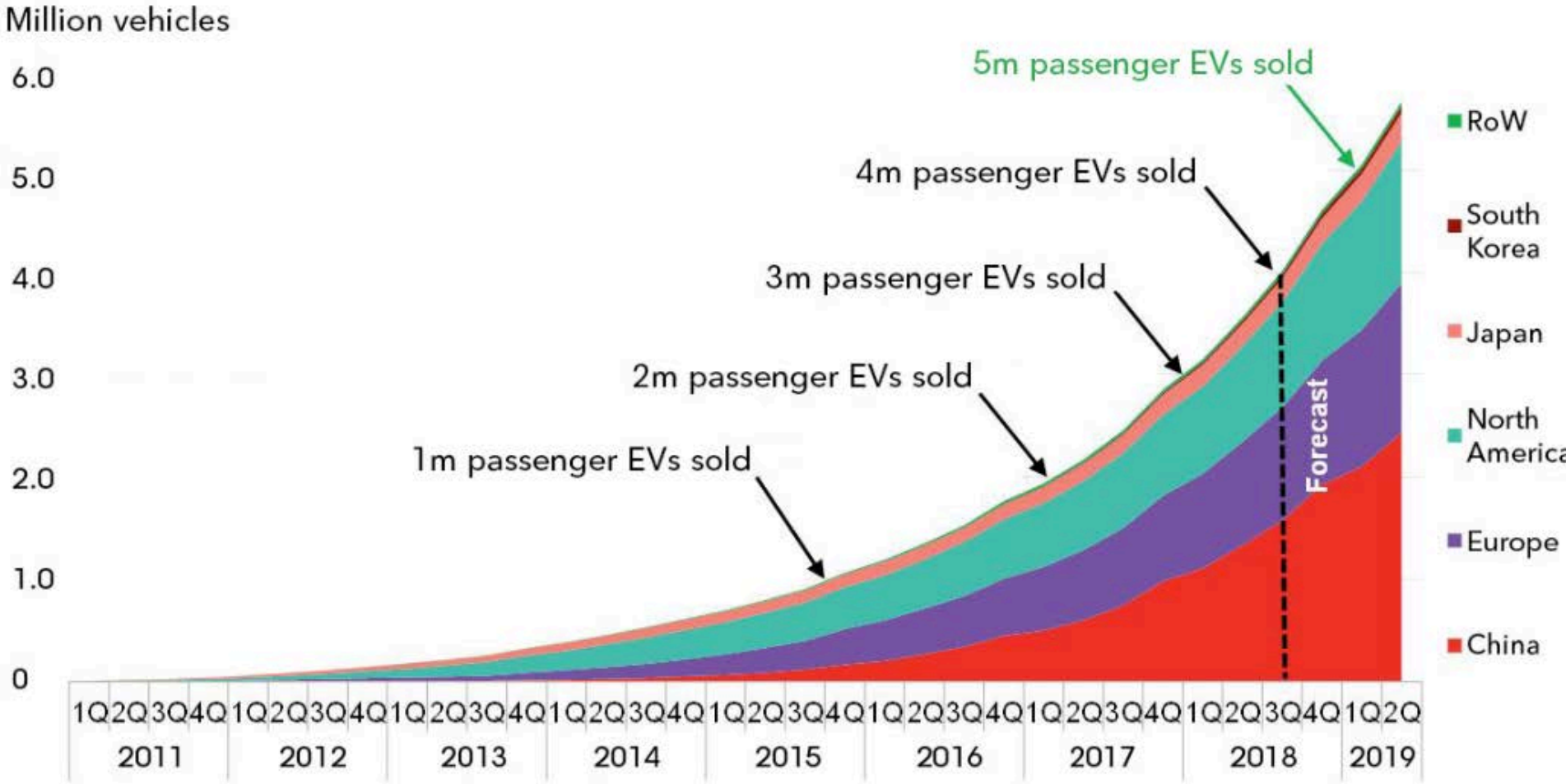
BYD truck

Source :
http://roadmapforth.org/program/presentations17/China-ZhanhuiYao.pdf
https://evobsession.com/500-electric-trash-trucks-to-roll-out-in-shenzhen-china-200-in-indaiatuba-brazil/

Global NEV stock

For passenger cars (BEV et PHEV) :

Figure 3: Cumulative global passenger EV sales, current and forecast



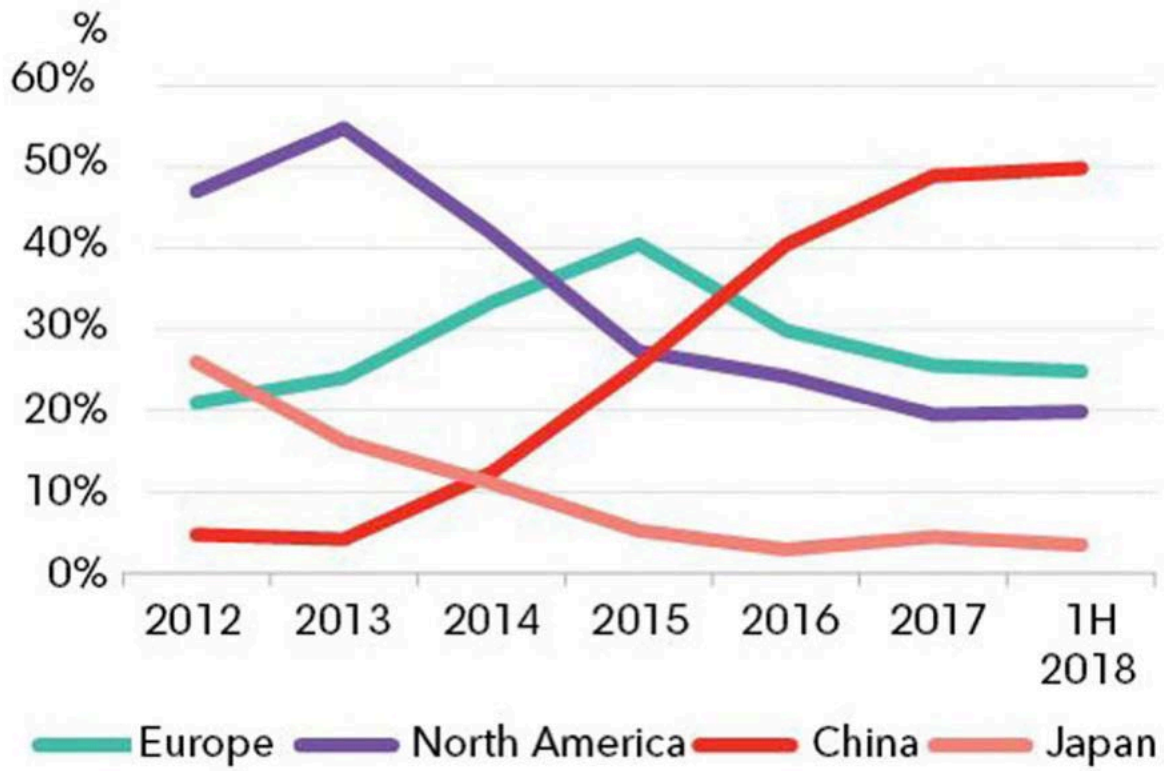
Source: Bloomberg NEF

Source : https://about.bnef.com/blog/cumulative-global-ev-sales-hit-4-million/

Global NEV stock

For passenger cars (BEV et PHEV) :

Figure 4: Regional share of global annual EV sales



Source: Bloomberg NEF, Marklines

Source :
https://about.bnef.com/blog/cumulative-global-ev-sales-hit-4-million/

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Example of passenger cars

BYD F3DM (PHEV)

Price : 149 800 元 (w/o subsidies)

- Electric range : 60 km (battery 16 kWh)
- Hybrid range : 480 km
- Cumulated sales (2008-2013) : 3 284

Source :
https://en.wikipedia.org/wiki/BYD_F3DM

Example of passenger cars

BYD Qin (PHEV)

Price : 189 800 元 (w/o subsidies)

- Sales :
  - 2014 : 14747
  - 2015 : 31898
  - 2016 : 21868
  - 01/2018 – 09/2018 : 55871

Source :
https://en.wikipedia.org/wiki/BYD_Qin

Example of passenger cars

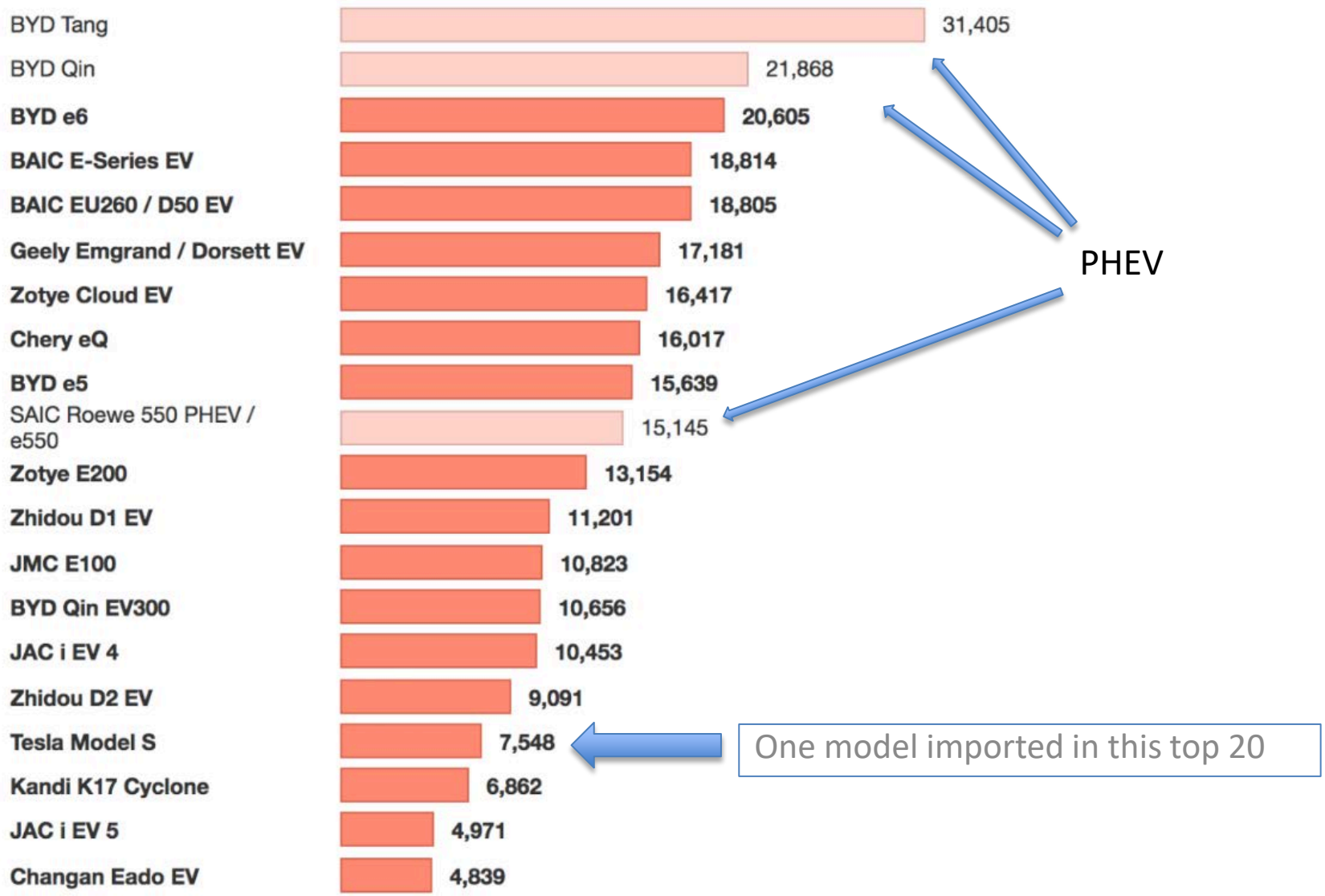
BYD e6 (BEV)

2011 price : 369 800 元

- Range: 300 km (battery 61 kWh)
- Sales :
  - 2010 : 33
  - 2011 : 401
  - 2012 : 1690
  - 2013 : 1544
  - 2014 : 3560
  - 2015 : 7029
  - 2016 : 20605
  - 2017 : 10207

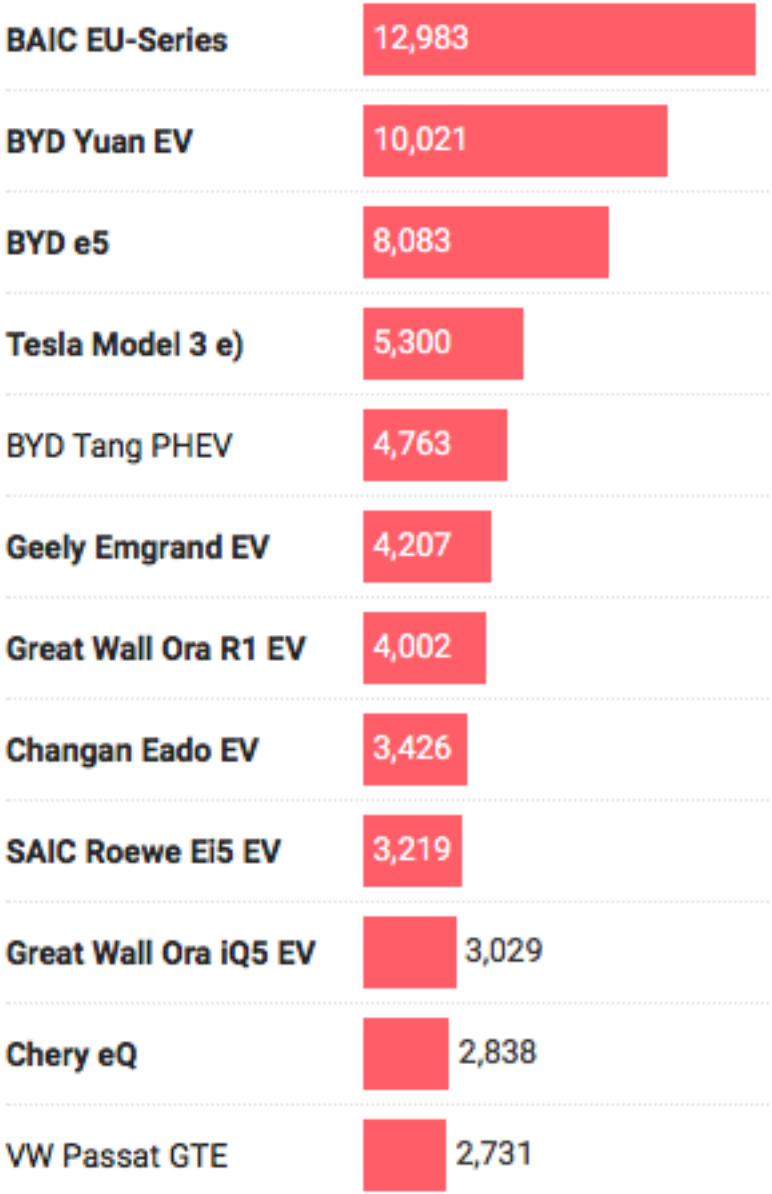
Source :
https://en.wikipedia.org/wiki/BYD_e6

2016 NEV market for passenger cars



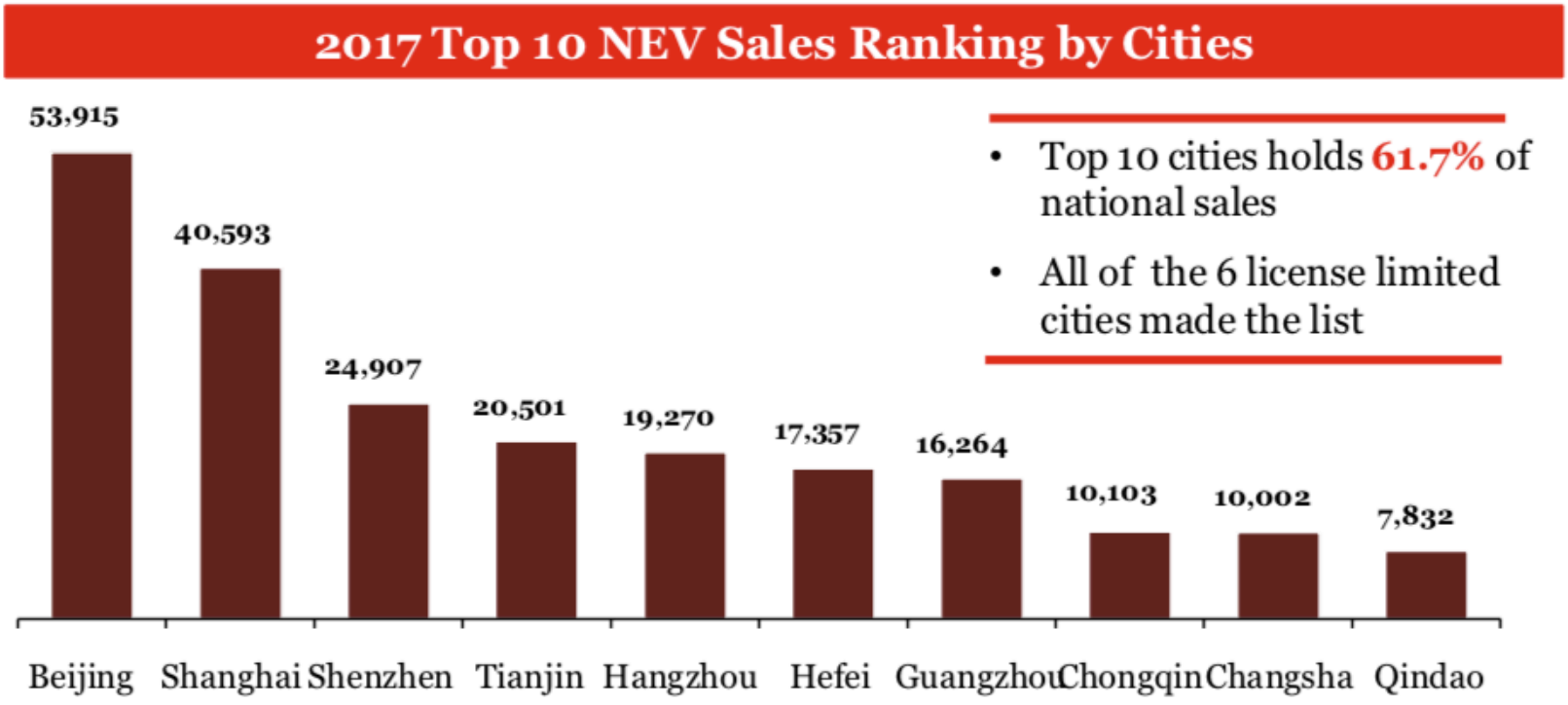
Source :
https://evobsession.com/china-electric-car-sales-byd-wins-2016-geely-emgrand-ev-wins-december/

March 2019 NEV market for passenger cars



Source :
https://cleantechnica.com/2019/05/11/china-baic-eu-series-hit-13000-sales-in-march-tesla-model-3-scored-5000-cleantechnica-ev-sales-report/

2017 NEV market for passenger cars (by cities)



Source :
Automotive Transformation and Mobility Trends. PwC, April 2018

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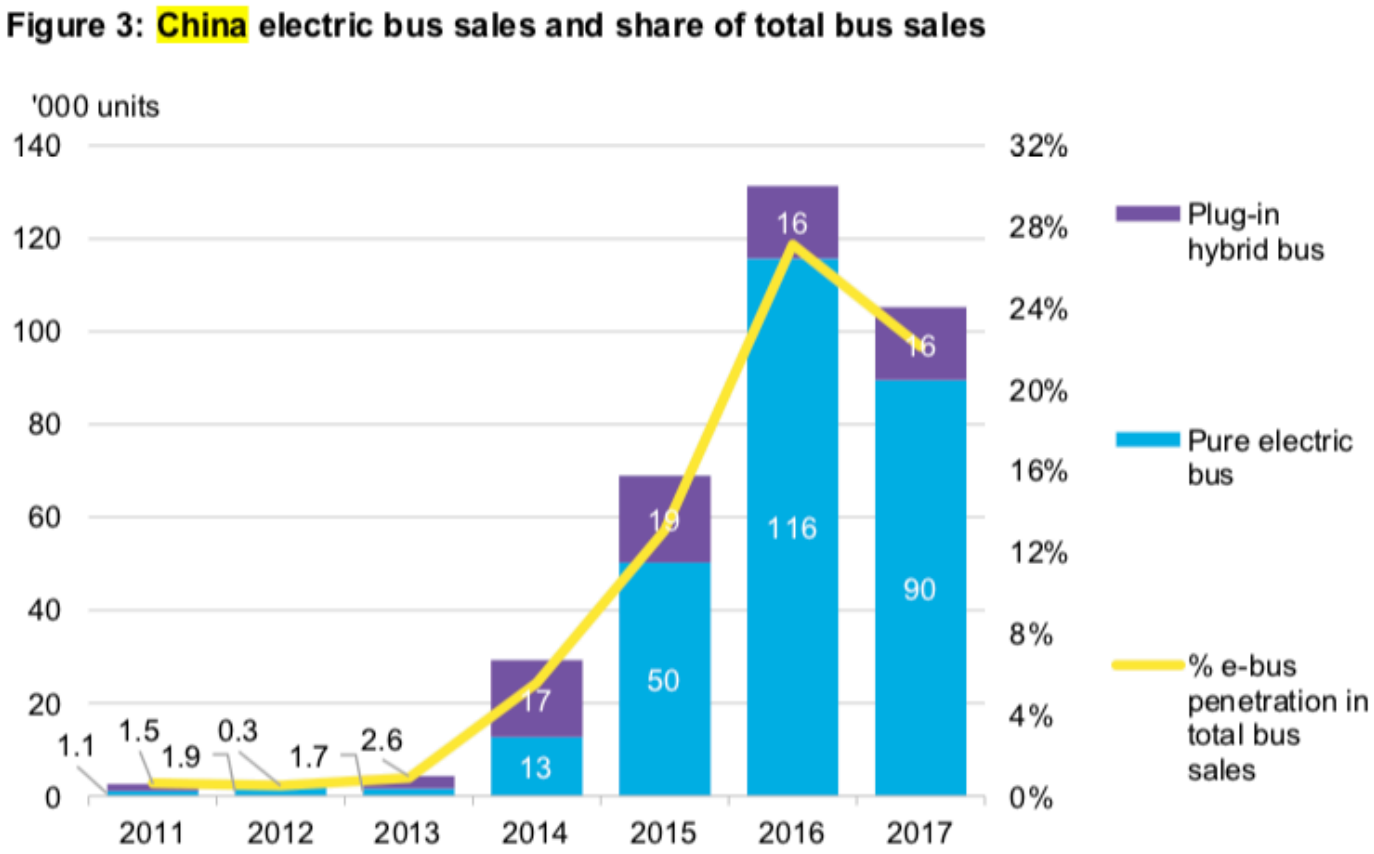
Bus

Source :
https://www.f 5/

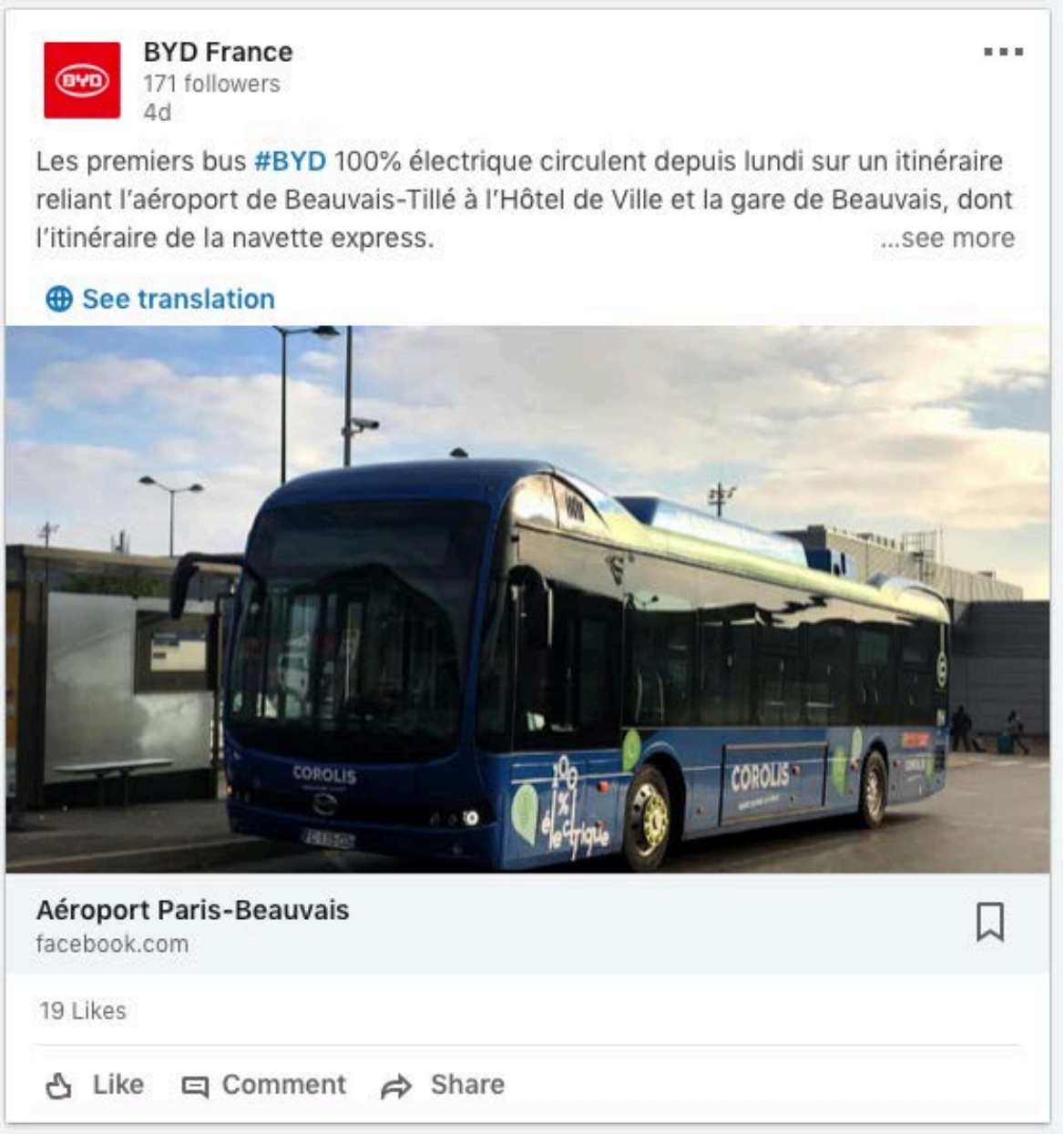
Buses



Source :
https://www.citylab.com/transportation/2018/05/how-china-charged-into-the-electric-bus-revolution/559571/
http://c40-production-images.s3.amazonaws.com/other_uploads/images/1726_BNEF_C40_Electric_buses_in_cities_FINAL_APPROVED_%282%29.original.pdf?1523363881

Buses

10/12/2018 :



Source :
https://www.linkedin.com/feed/update/urn:li:activity:6478284664900448256
http://c40-production-images.s3.amazonaws.com/other_uploads/images/1726_BNEF_C40_Electric_buses_in_cities_FINAL_APPROVED_%282%29.original.pdf?1523363881
http://www.courrier-picard.fr/106412/article/2018-04-27/les-bus-byd-lassaut-du-marche-francais

Not NEV electric vehicles

LSEV (low-speed electric vehicle)

- Sales :
  - 2016 : 1,232 millions
  - 2017 : 1,744 millions
- Stock > 5 millions !

T-King Oujia

Speed : 35 km/h

Range : 100 km

Weight : 715 kg

Price : 23000 元

Source :
https://www.researchandmarkets.com/research/hf6pnf/china_lowspeed
http://main-info.site/2017/01/10/la-chine-est-t-king-va-volvo-pour-de-nouvelles-lsev/
https://carnewschina.com/tag/lsev-china/

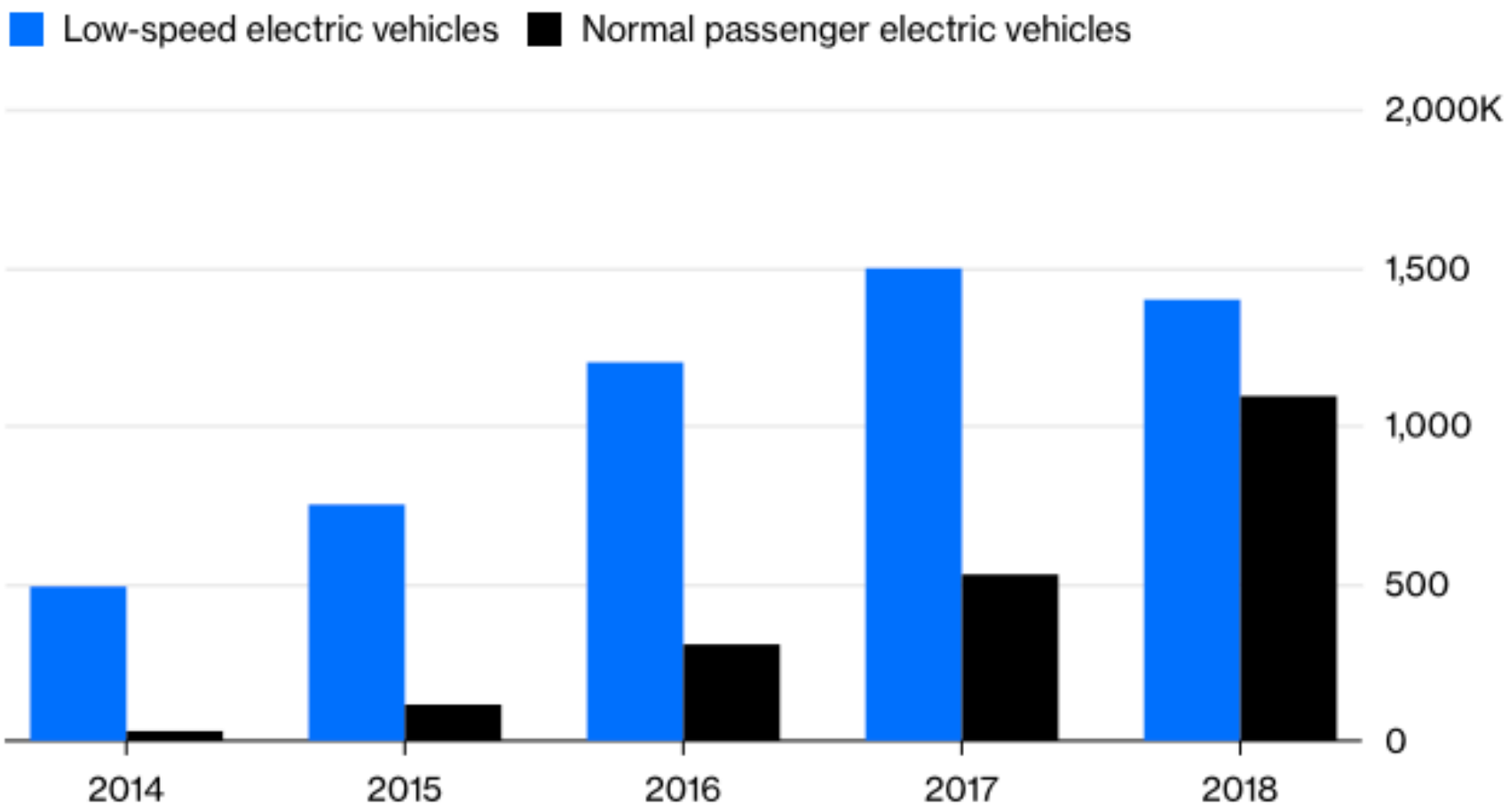
Not NEV electric vehicles

LSEV style can be very fancy !

Source :
https://carnewschina.com/2018/05/14/bugatti-chiron-gets-lseved-in-china/
https://carnewschina.com/2017/03/16/the-luxing-istar-lsev-is-not-a-mercedes-benz/

Not NEV electric vehicles

Sales :



Source :
https://www.bloomberg.com/opinion/articles/2019-02-08/china-s-electric-vehicles-put-traditional-engines-on-notic

New generation EV

LSEV now must compete with affordable NEV from mainstream OEM

Great Wall ORA R1

7500 €

Range 300 km

Honda Urban EV

? €

Range 200 km

Renault Kwid EV

< 9000 €

Range 250 km

Not NEV electric vehicles

2 wheelers :

- Annual sales > 30 millions !
- Stock > 200 millions !

Source :
https://www.wedemain.fr/Comment-la-Chine-a-subitement-dit-adieu-au-scooter-a-essence_a1424.html

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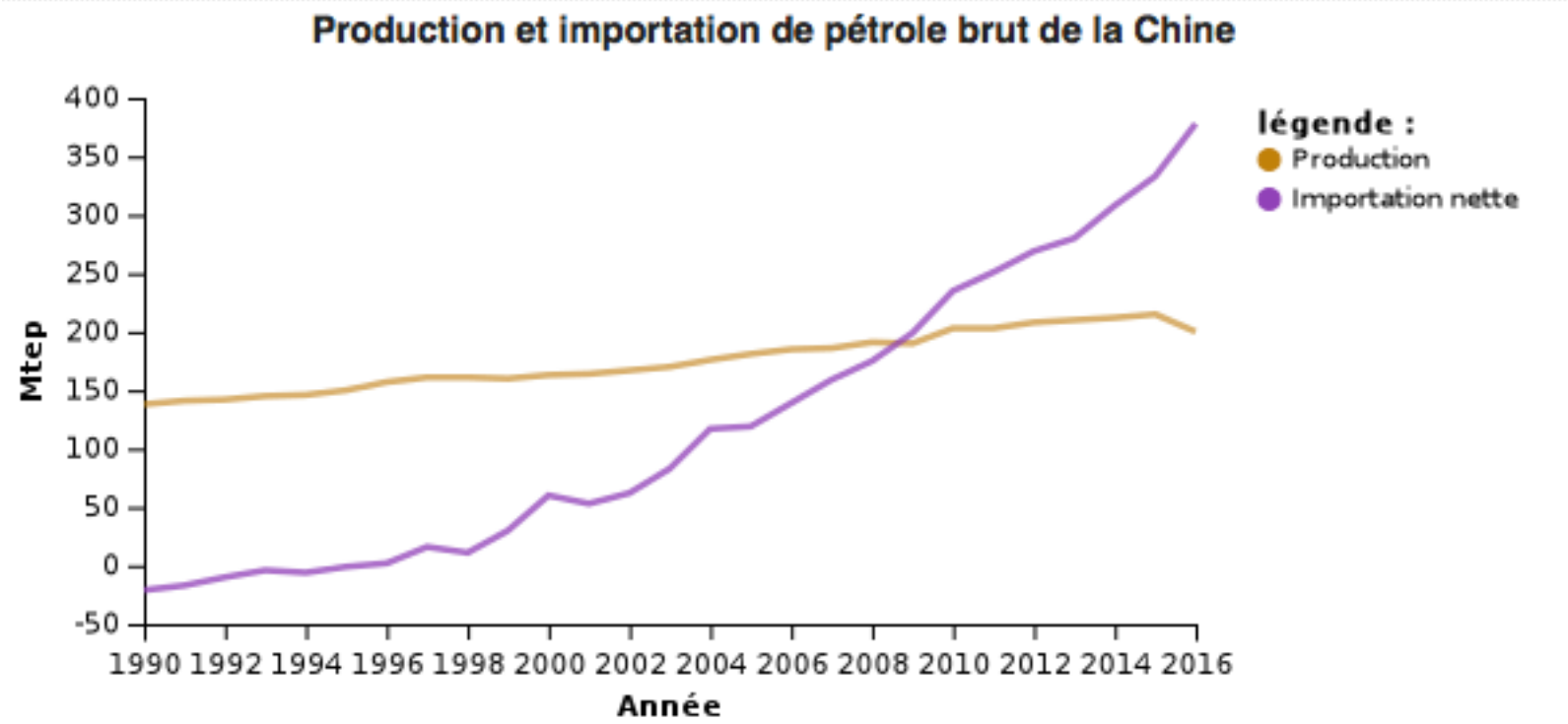
Energy aspects : petrol



Source :
https://fr.wikipedia.org/wiki/Énergie_en_Chine

Energy aspects : electricity

- China grid capacity :
  - Energy : 6000 TWh / year (France : 500 TWh)
  - Power : 1600 GW (France : 130 GW)

- BEV consumption :
  - Energy : 2 MWh / year (200 Wh / km over 10,000 km)
  - Charging power : 3 kW – 10 kW – 40 kW – 100 kW – ?

- China stock : 185 millions cars

- Towards 100 millions NEV?

• Annual consumption :	Energy 200 TWh	→ OK
• Recharge at 3kW :	power 300 GW	→ NOK !
• Recharge at 10 kW :	power 1000 GW	→ NOK !!
• Recharge at 40 kW :	power 4000 GW	→ NOK !!!

Source :
https://en.wikipedia.org/wiki/Electricity_sector_in_China
https://news.autojournal.fr/news/1526207/Chine-Industrie-Economie-SUV-voiture-électrique

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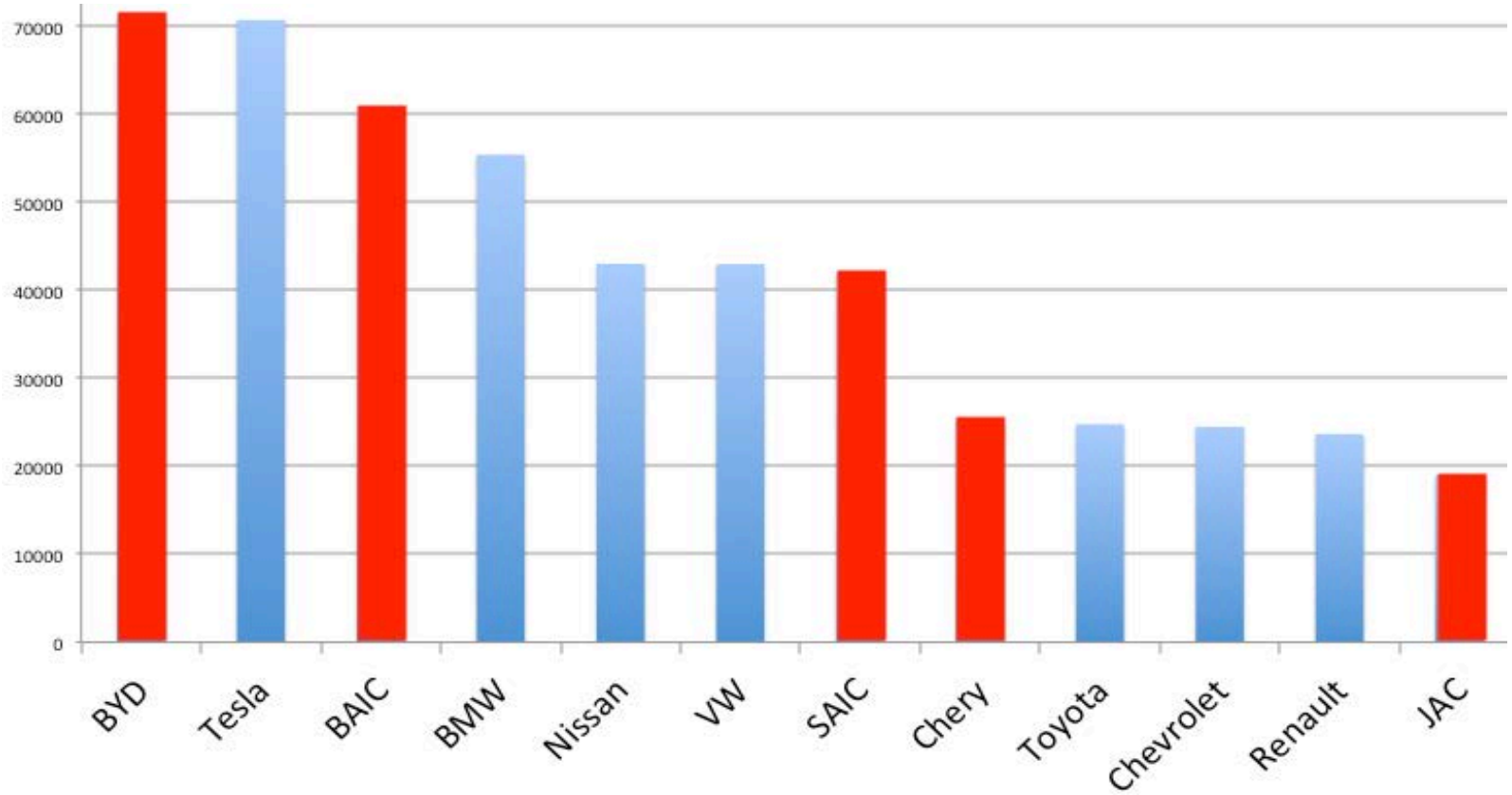
Aspects industriels : exportations

In the first half of 2018, 5 of the top 10 electric car manufacturers were Chinese :



In 2017, China exported 891 000 véhicules (PC + CV) of which about 100 000 NEV.

Markets : Iran, Mexique, Brasil, USA, Russia …

Sources :
http://autonews.gasgoo.com/china_news/70013287.html
https://en.wikipedia.org/wiki/Electric_vehicle_industry_in_China
https://webikeo.fr/public/media/100031632/181220-webconference-quelle-place-pour-la-voiture-electrique-dans-la-mobilite-de-demain.pdf

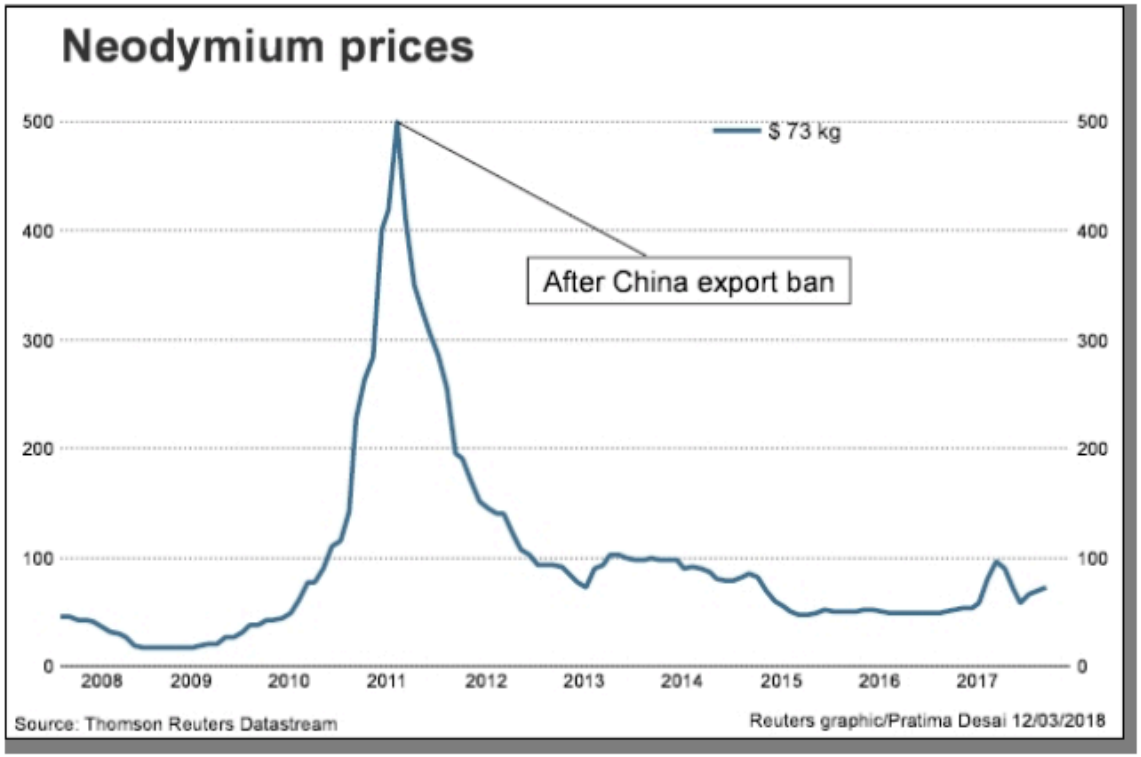
Aspects industriels : exportations

Sources :
https://www.

Industrial aspects : rare earth metals

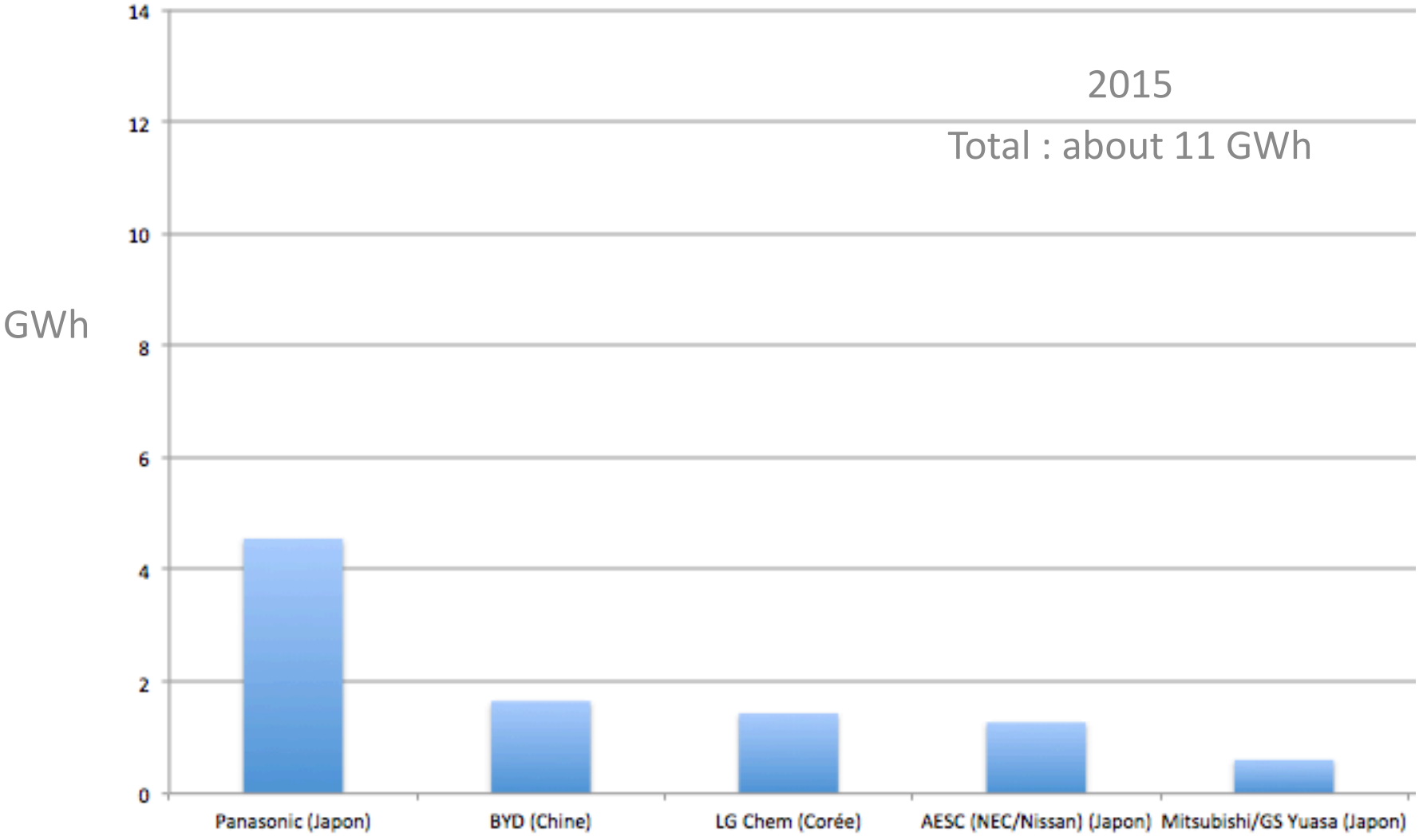
China has :

- 30% of the world reserves
- 80%-90% of the world production



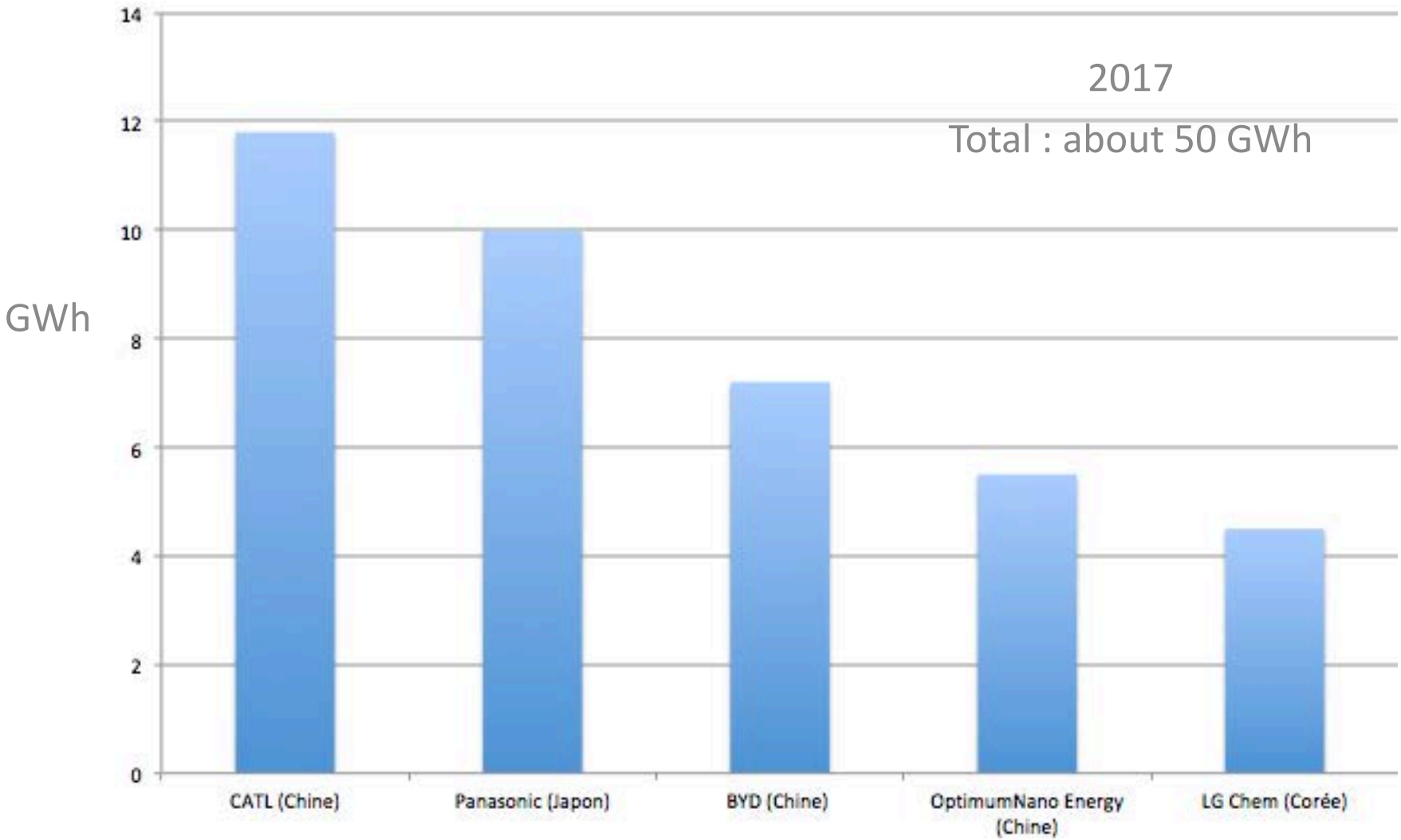
Source :
https://en.wikipedia.org/wiki/Rare_earth_industry_in_China
https://www.lepoint.fr/technologie/terres-rares-la-bombe-a-retardement-11-03-2018-2201477_58.php
http://www.atlantico.fr/decryptage/guerre-commerciale-chine-rappelle-toutes-fins-utiles-qu-elle-desormais-controle-marche-mondial-terres-rares-jean-marc-sylvestre-3548028.html
https://www.reuters.com/article/us-metals-autos-neodymium-analysis/teslas-electric-motor-shift-to-spur-demand-for-rare-earth-neodymium-idUSKCN1GO28I

Industrial aspects : batteries



Source :
https://cleantechnica.com/2016/03/26/top-ev-battery-producers-2015-vs-2014-top-10-list/

Industrial aspects : batteries



Source :
https://www.electrive.com/2018/06/06/catl-byd-rise-in-rank-to-join-worlds-top-3-battery-makers/
https://en.wikipedia.org/wiki/List_of_electric-vehicle-battery_manufacturers

Industrial aspects : batteries

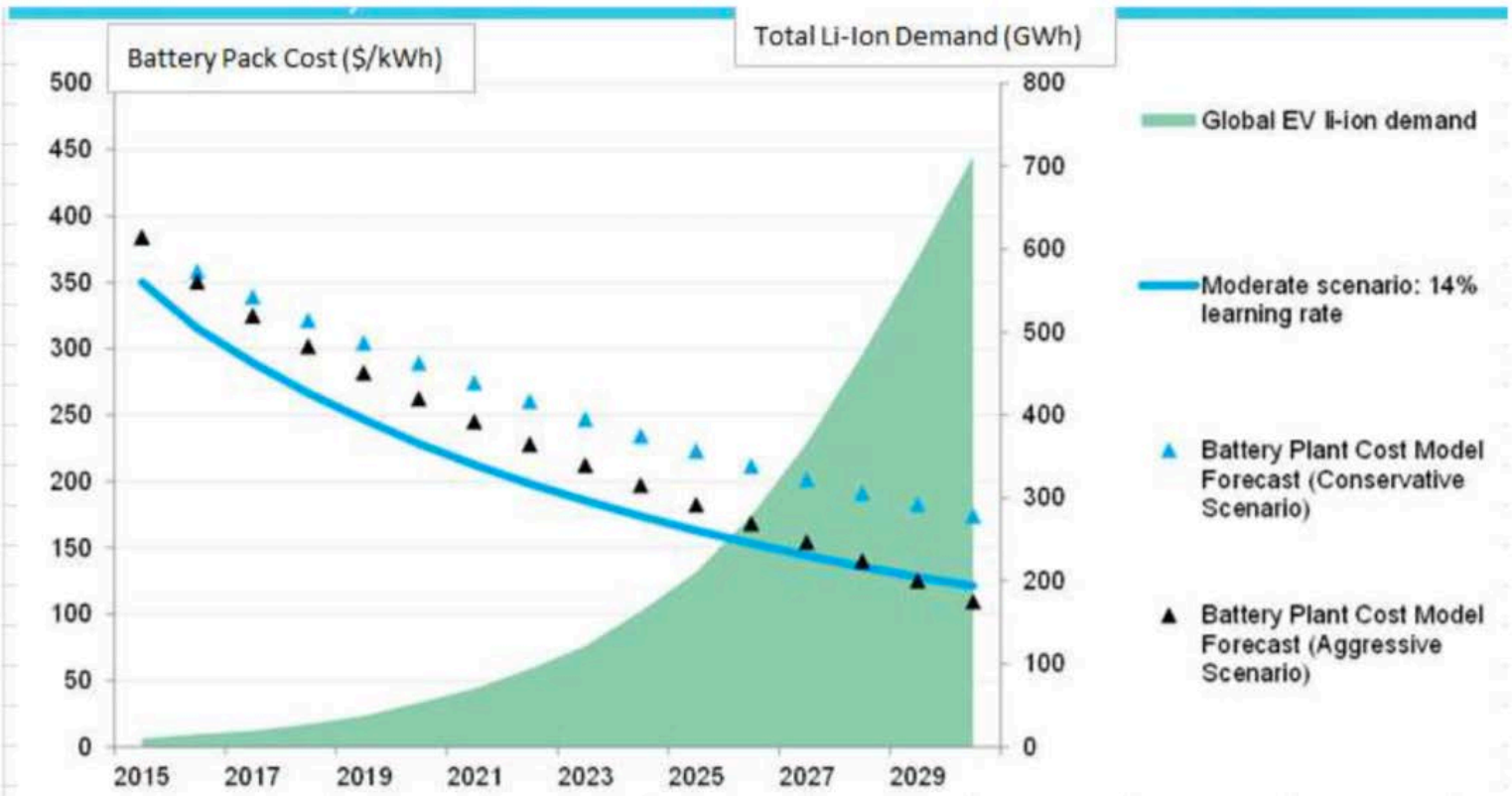
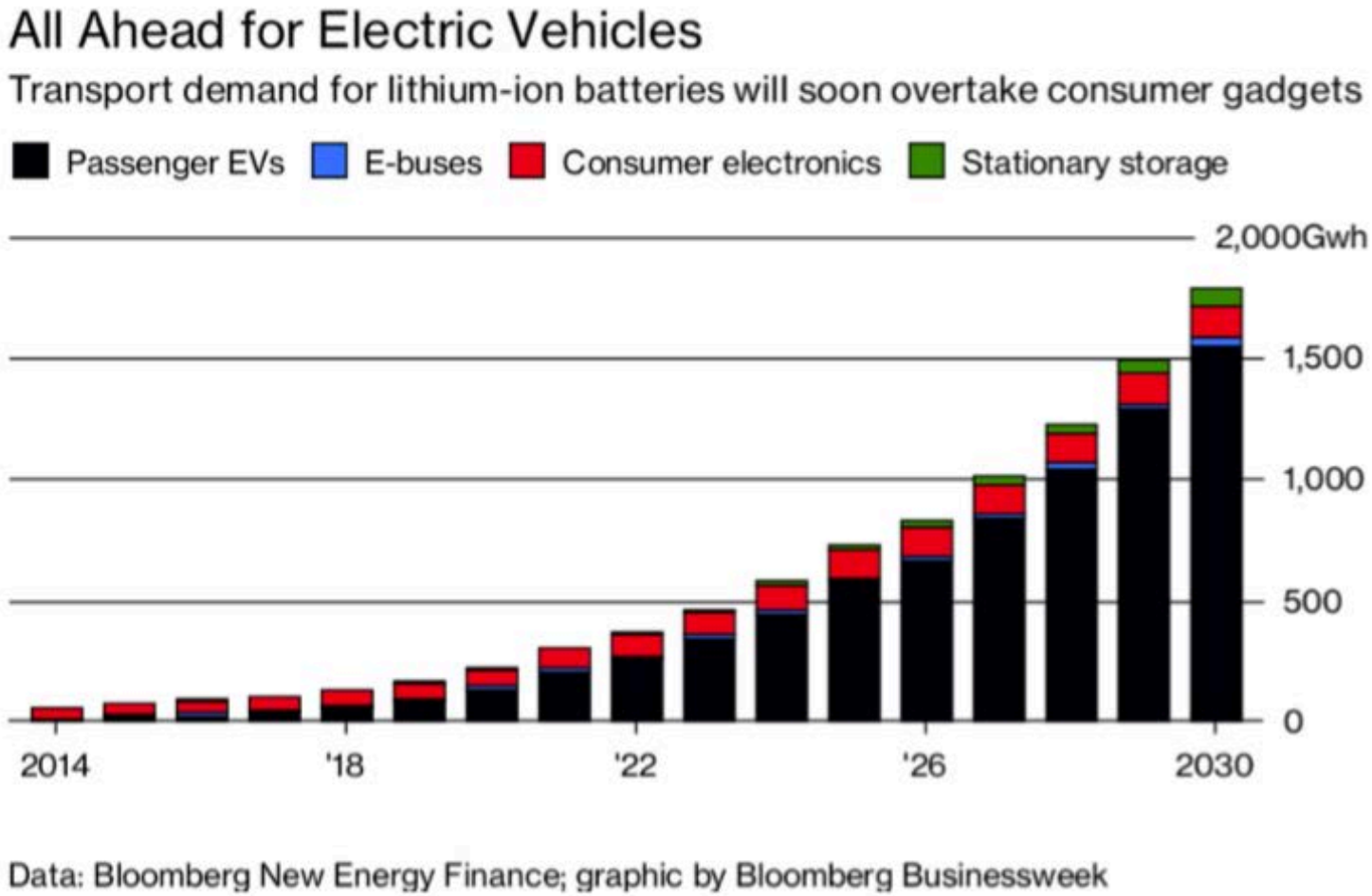


Figure 3 : Scénarios de l'évolution du prix des batteries (cellules + pack) entre 2015 et 2030 (source : BNEF)

Source :
https://www.ademe.fr/bilan-transversal-limpact-lelectrification-segment

Industrial aspects : batteries



Source :
http://aheadoftheherd.com/Newsletter/2018/The-EV-battery-arms-race-is-on.pdf

Industrial aspects : batteries

Raw materials :

02/2018 : There's a global Race to Control Batteries—and China Is winning

03/2018 : Chinese battery maker takes controlling stake in Quebec lithium project

05/2018 : China now effectively controls half the world's lithium production

06/2018 : Inside China's move to monopolise cobalt

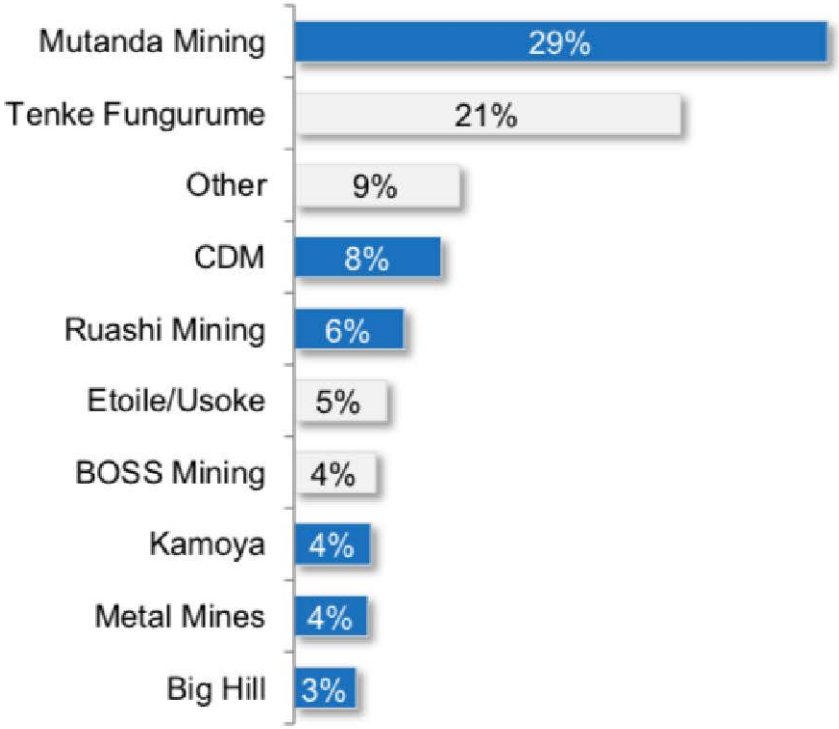
08/2018 : China Takes Control of Cobalt Mines

09/2018 : China battery firms set up $700 million nickel joint venture in Indonesia

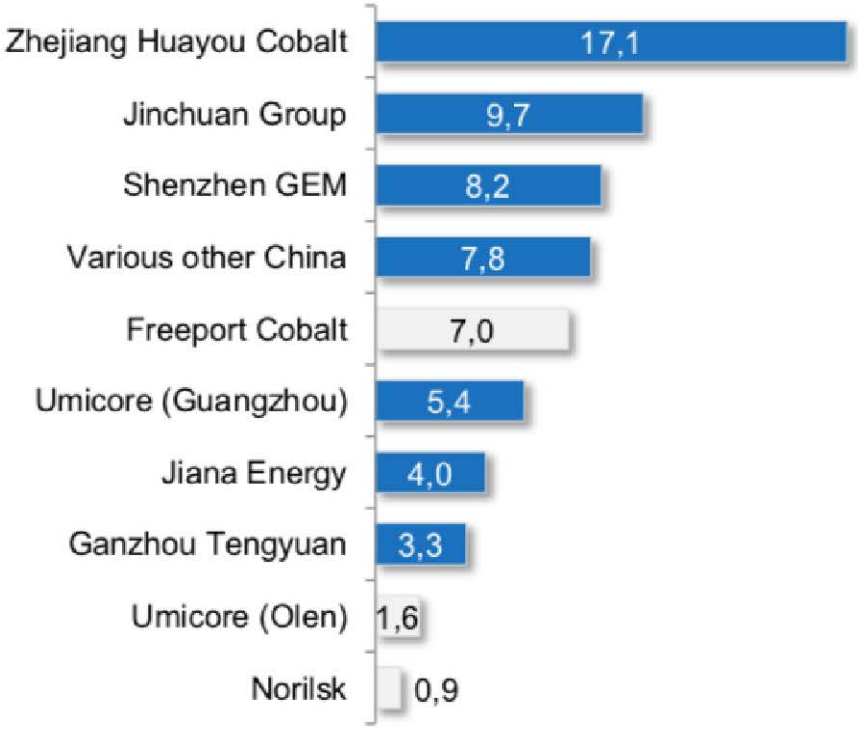
12/2018 : Nobel prize winner Denis Mukwege speech

Aspects industriels : batteries Li-ion

Mining



Refining



Source : Bloomberg, Darton Commodities Ltd, EO Browser/Sinergise Ltd., USGS Mineral Resources

In blue : China-controlled companies (2017)

Sources :
https://webikeo.fr/public/media/100031632/181220-webconference-quelle-place-pour-la-voiture-electrique-dans-la-mobilite-de-demain.pdf

Industrial aspects : batteries

Second life and recycling :

02/2018 : China unveils policy for NEV battery recycling

03/2018 : China's Giving Batteries a Second Life

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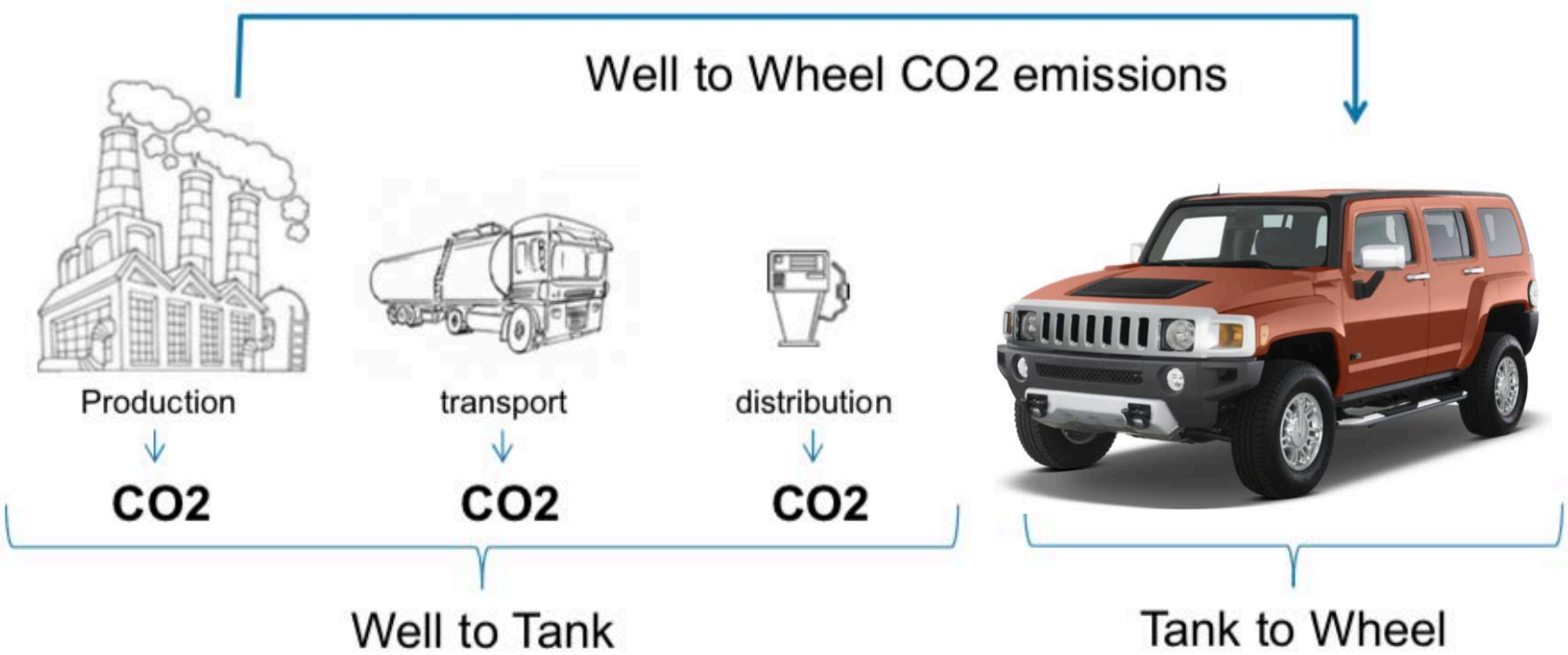
Ecological aspects : carbon intensity

Sources of CO_2 emissions :

- Well To Tank (WTT)
- Tank To Wheel (TTW)

well-to-Wheels (WTW)



Ecological aspects : carbon intensity

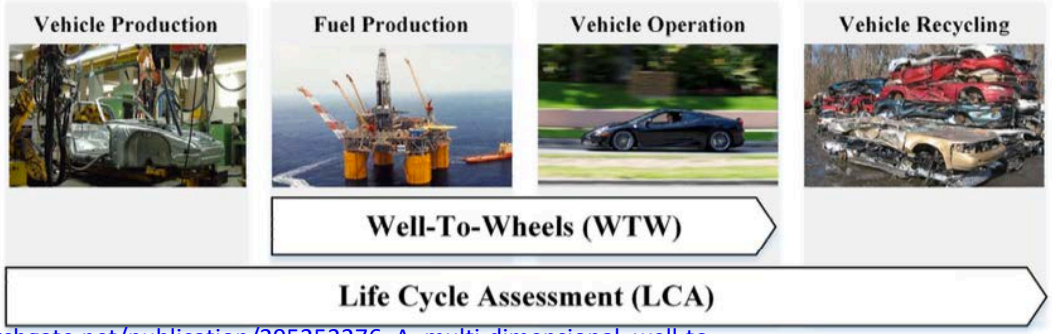
4 sources of CO_2 emissions :

- Well To Tank (WTT)
- Tank To Wheel (TTW)

well-to-Wheels (WTW)

- Production :
  - Of the vehicle
  - Of the battery
- Recycling :
  - Of the vehicle
  - Of the battery

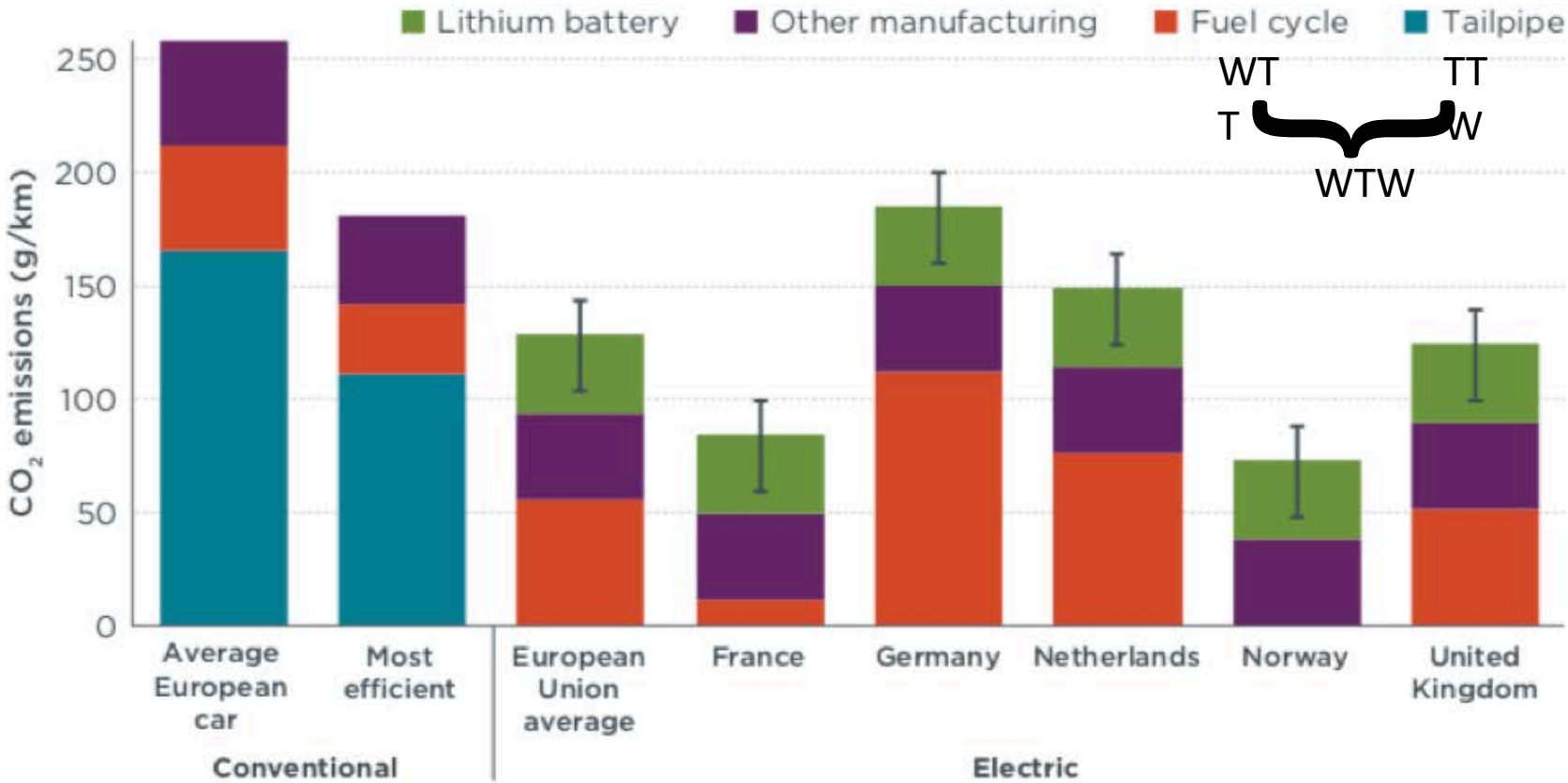
cradle -to- grave



Source : https://www.researchgate.net/publication/295252276_A_multi-dimensional_well-to-wheels_analysis_of_passenger_vehicles_in_different_regions_Primary_energy_consumption_CO2_emissions_and_economic_cost

Ecological aspects : carbon intensity

Result for Europe over 150,000 km:



Hypothesis :

- Vehicle production : 6,000 kg CO2 or 40 g CO2 / km over 150,000 km
- Battery production : 175 kg CO2 / kWh or 35 g CO2 / km over 150,000 km for a 30-kWh battery
- Electric vehicle consumption : 200 Wh / km

Source :
https://www.theicct.org/sites/default/files/publications/EV-life-cycle-GHG_ICCT-Briefing_09022018_vF.pdf

Ecological aspects : carbon intensity

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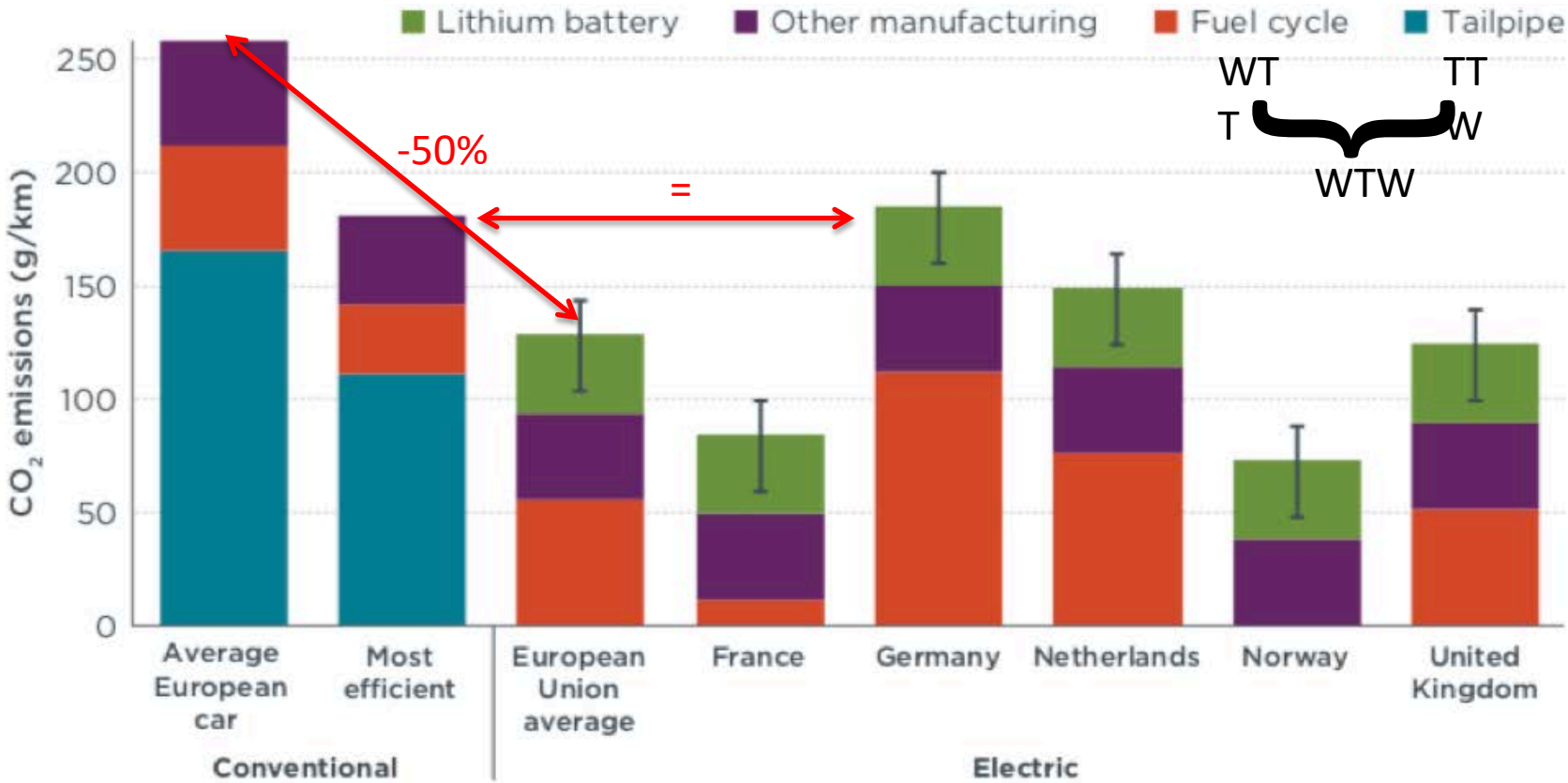

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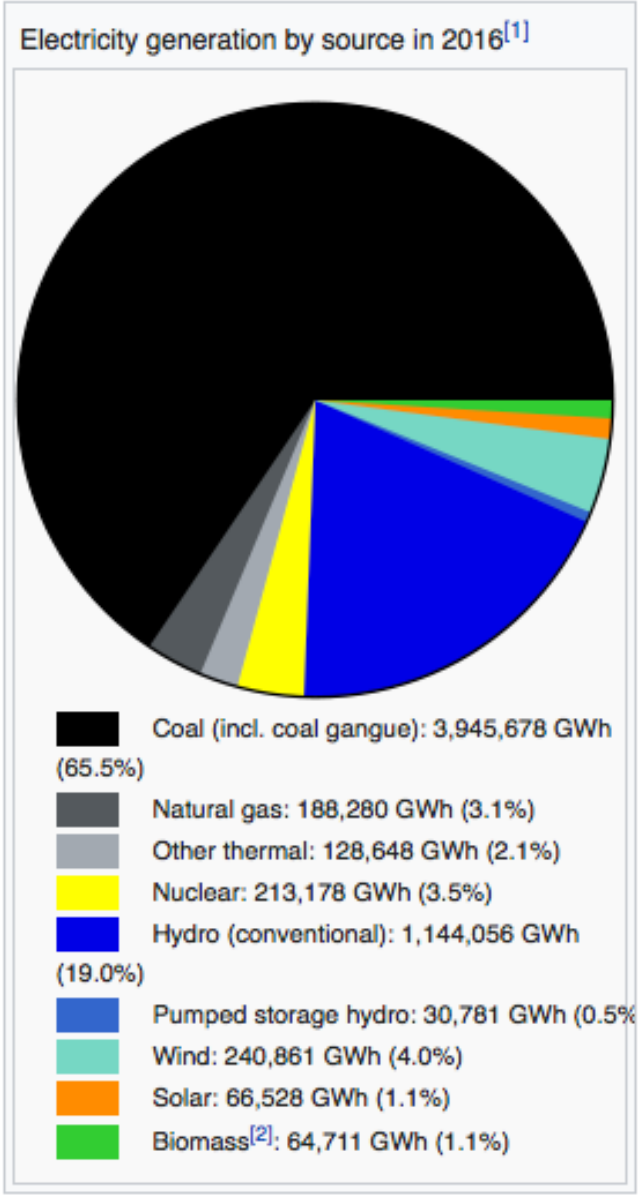
Ecological aspects : carbon intensity

Carbon intensity of the electric kWh (CO_2 / kWh) :

- France (2012) : < 100 g CO_2 / kWh
- USA (2017) : 439 g CO_2 / kWh
- Germany (2012) : 623 g CO_2 / kWh
- China (2013) : 712 g CO_2 / kWh

Emissions WTT for a BEV (200 Wh / km) :

- France : < 20 g CO_2/ km
- USA : 88 g CO_2 / kWh
- Allemagne : 125 g CO_2/ kWh
- Chine : 142 g CO_2/kWh



Sources :
http://iopscience.iop.org/article/10.1088/1748-9326/aabe9d
https://en.wikipedia.org/wiki/Electricity_sector_in_China
https://www.ademe.fr/sites/default/files/assets/documents/90511_acv-comparative-ve-vt-rapport.pdf
http://notrickszone.com/2017/07/27/new-study-electric-vehicle-use-does-not-appreciably-reduce-co2-emissions/

Ecological aspects : carbon intensity

BYD e6 over 150 000 km :

- Tank to wheel (TTW) : 0 g CO2 / km
- Well to tank (WTT) : 142 g CO2 / km
- Production :
  - vehicle: 40 g CO2 / km
  - 61-kWh battery : 71 g CO2 / km
- Recycling : 0 ?

Total 253 g CO2 / km

Source :
https://www.statista.com/statistics/278566/urban-and-rural-population-of-china/

Ecological aspects : carbon intensity

China makes enormous effort to reduce the carbon intensity of its electricity generation :

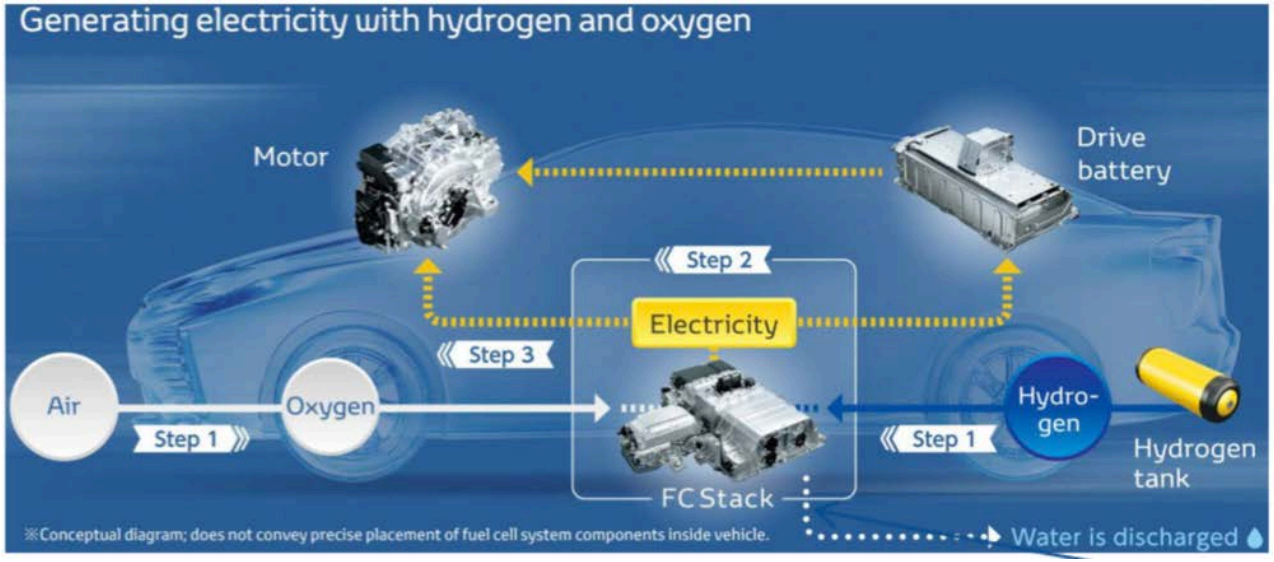
- In 2018 : the equivalent of 10 nuclear power plants was built with solar panels !

Source :
https://www.xataka.com/energia/gran-muralla-china-sol-planta-solar-grande-mundo-cubre-1-200-km2-esta-ubicada-desierto-tengger

Content

- Government policies
- Market
- Brands and models
- Other vehicules
- Energy aspects
- Industrial aspects
- Ecological aspects
- What to expect next ?

Next : hydrogen !



Benefits :

- Autonomy
- Recharge time
- No emission TTW except water vapor
- Reduced CO_2 emissions WTT if hydrogen is made from hydrocarbures
- No CO_2 emission WTT with green hydrogen (made from renewable energy)

Drawbacks :

- Price of the vehicle
- Price of the green hydrogen
- Very few charging stations

Shanghai Anting

Source :
http://www.lbma.org.uk/assets/events/Conference%202017/S5_JW.pdf

Next : hydrogen !

Three H_2 buses at the 2008 olympics and tens H_2 minibuses at Shanghai expo in 2010

- 300 H_2 buses in operation at Foshan starting in 2018
- October 2018 : Hyundai and Tsinghua university establish a $ 100 million fund
- An ambitious plan :

	2017	2020	2025	2030
H2 refueling station	6	100	1,000	3,000
FCVs (passenger cars & commercial vehicles)	100	5,000	50,000	1 million
Platinum demand from FCVs		0.2 ton	1.6 tons	30 tons

Source :
http://www.lbma.org.uk/assets/events/Conference%202017/S5_JW.pdf
http://ballard.com/about-ballard/newsroom/news-releases/2016/09/29/first-ballard-powered-buses-hitting-the-road-in-china-s-largest-fuel-cell-bus-deployment
https://org3-www.hyundai.com/worldwide/en/news/news-room/news/hyundai-motor-to-establish-'hydrogen-energy-fund'-with-top-chinese-r%26d-institute-btirdi-0000016058

Next : hydrogen !

Wangang again !

Chairman of the China Association for Science and Technology Wangang: Accelerate the Industrialization of Hydrogen Energy and Fuel Cell Vehicles

Source :
https://fuelcellsworks.com/news/chairman-of-the-china-association-for-science-and-technology-wangang-accelerate-the-industrializati
https://www.bloomberg.com/news/articles/2019-06-12/china-s-father-of-electric-cars-thinks-hydrogen-is-the-future

Conclusion

This proactive electrification led by MIIT serves the following objectives :

- Reduce dependency on petroleum

  → ☹

- Create a competitive industry

  → ☺

- Reduce urban pollution

  → ☹☺

中华人民共和国工业和信息化部

Ministry of Industry and Information Technology of the People's Republic of China

谢谢

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法国华人汽车工程师协会

Association des Ingénieurs Chinois de l'Automobile en France