FACTS GLOBAL ENERGY

Electric Vehicles and Oil Demand

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9th Turkey Energy Summit

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Londra Elektrikli Ulaşım Çalıştayı

- Londra Belediyesi'nin 2050 hedefi: şehirdeki bütün ulaşım "sıfır karbon" olacak

- Ana neden:
  - Hava kirliliği ile mücadele
  - Temiz şehir imajı

- Ara hedefler:
  - Nisan 2019'dan itiberen şehir merkezine emisyon kontrollü giriş
  - 2020'den itibaren "sıfır emisyonlu" semtler/yollar
  - Ekim 2021'den itibaren emisyon kontrollü geniş şehir içi
  - 2025'ten itibaren belediye filosu sıfır emisyonlu kullanım imkanı (!) sunacak
  - 2033'ten itibaren bütün taksi filosu sıfır emisyonlu kullanım imkanı (!) sunacak
  - 2037'den itibaren bütün otobüs filosu sıfır emisyonlu olacak

- Engeller
  - Şarj altyapısı
  - Bürokrasi
  - Maliyet (altyapı, araç vs)

Londra Elektrikli Ulaşım Çalıştayı

Türkiye için e-mobilite çerçevesi – Londra'dan çıkarımlar

- Otobüs
  - İETT:
    - *2.537 otobüs – 4,3 milyon sefer – 109 milyon km*
    - *593 metrobüs – 2,5 milyon sefer – 73 milyon km*
    - *182 milyon km, 6TL/litre'den yılda 437 milyon TL yakıt gideri*

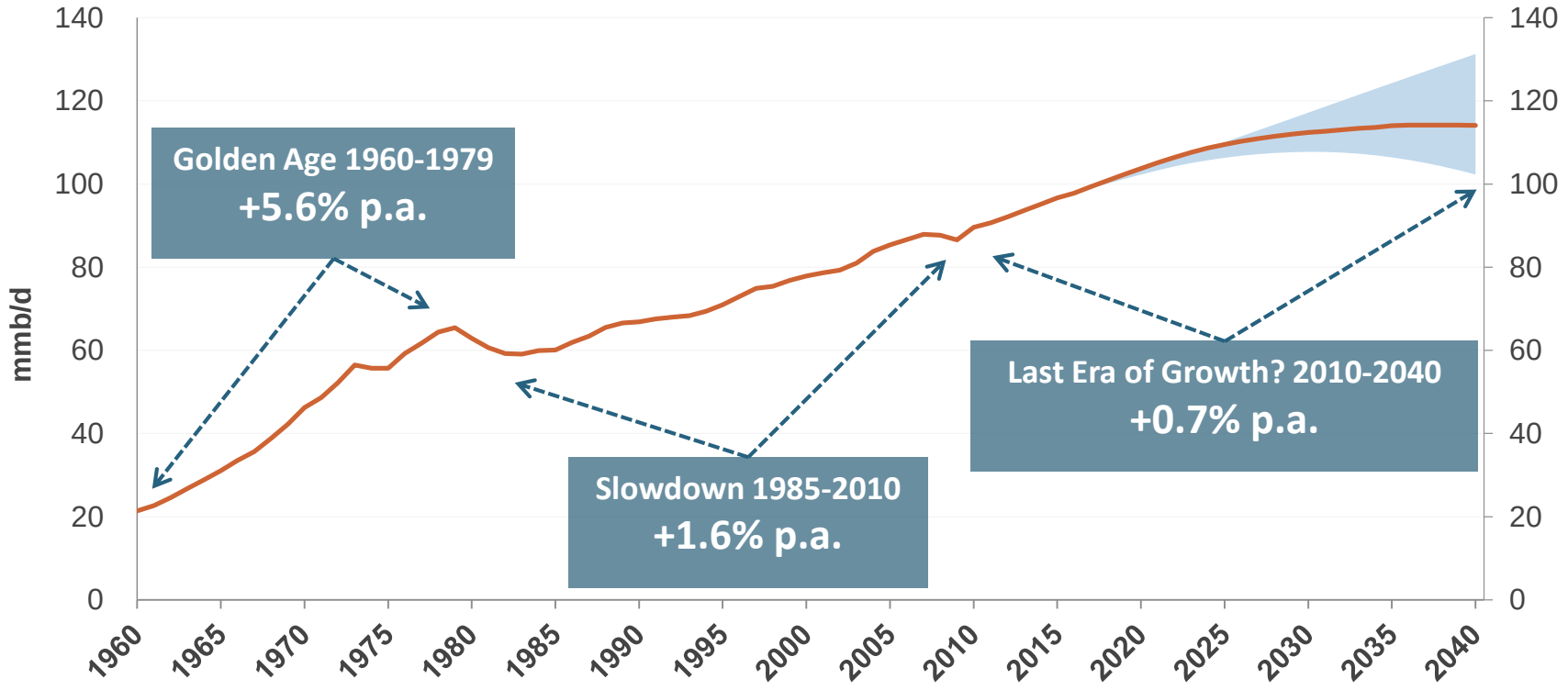
- Kamu filoları
  - 110 bin araçlık kamu filosu, %48'i binek otomobil ve panel van

- Ticari araçlar
  - Taksiler: şehir içi kullanım, günde X saat park
  - Kargo firmaları
  - Hizmet sektorü

E-mobilite için milli üretim ve sanayi hamlesi – ticari odak

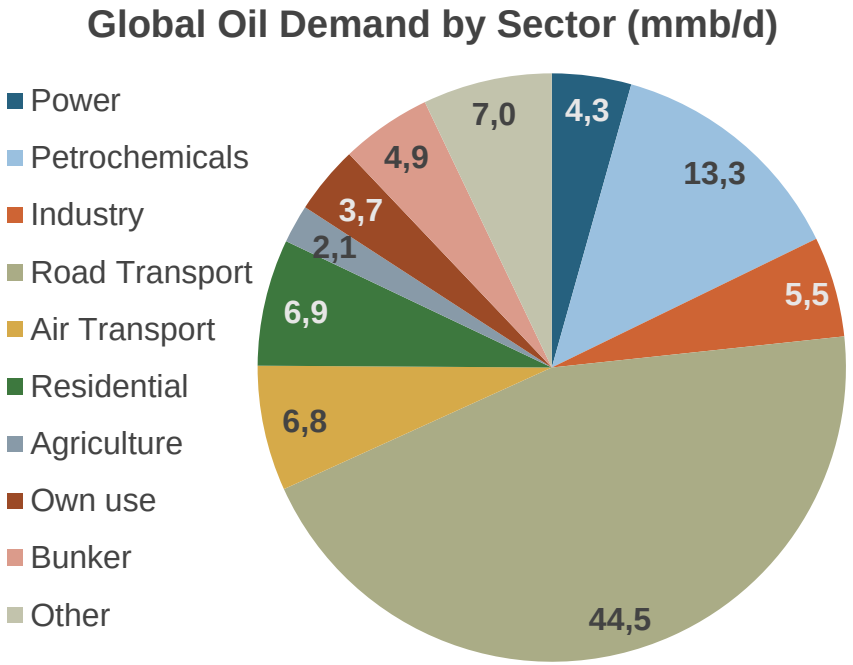
- Ana sorular:
  - Ne kadar istihdam?
  - İhraç potansiyeli (Karsan USPS)
  - Teknolojik liderlik
  - PR – çevreci imaj

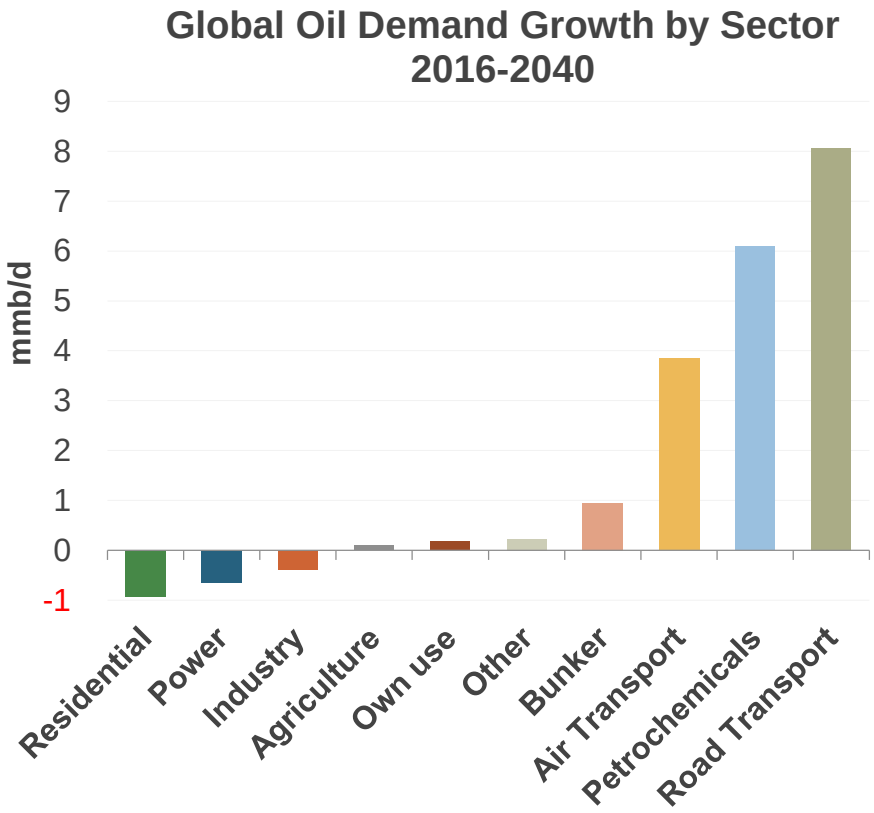
World Oil Demand Outlook



- Base case: 115 mmb/d by 2040, compared with 98 mmb/d in 2016.
- High case: 131 mmb/d by 2040, supported by low oil prices and strong consumer demand.
- Low case: peak at 108 mmb/d around 2030, strict implementation of environmental policies and strong efficiency gains.

Transport Sector is the Biggest Driver of Oil Demand

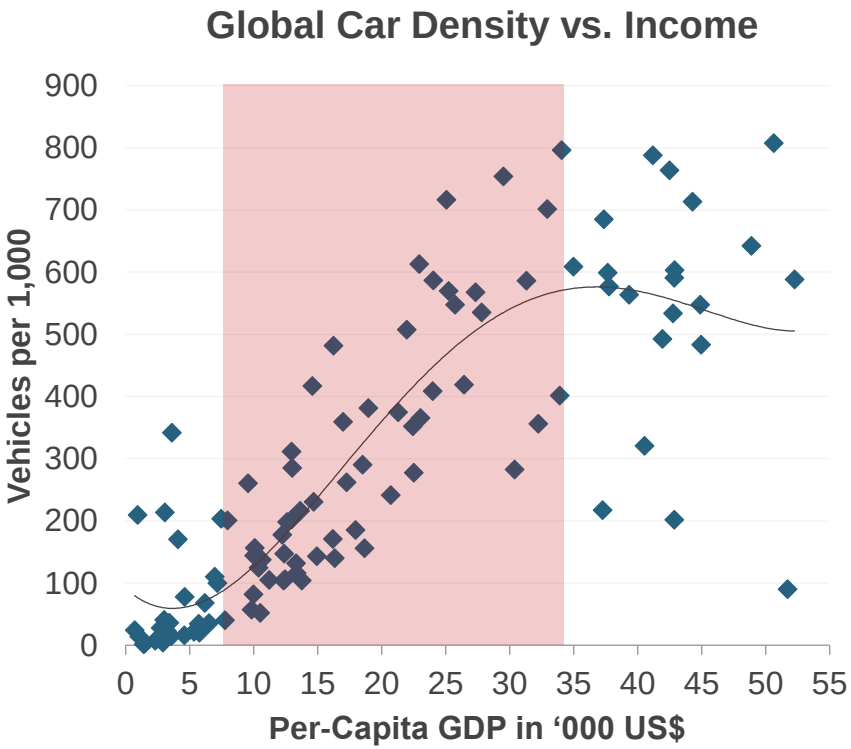


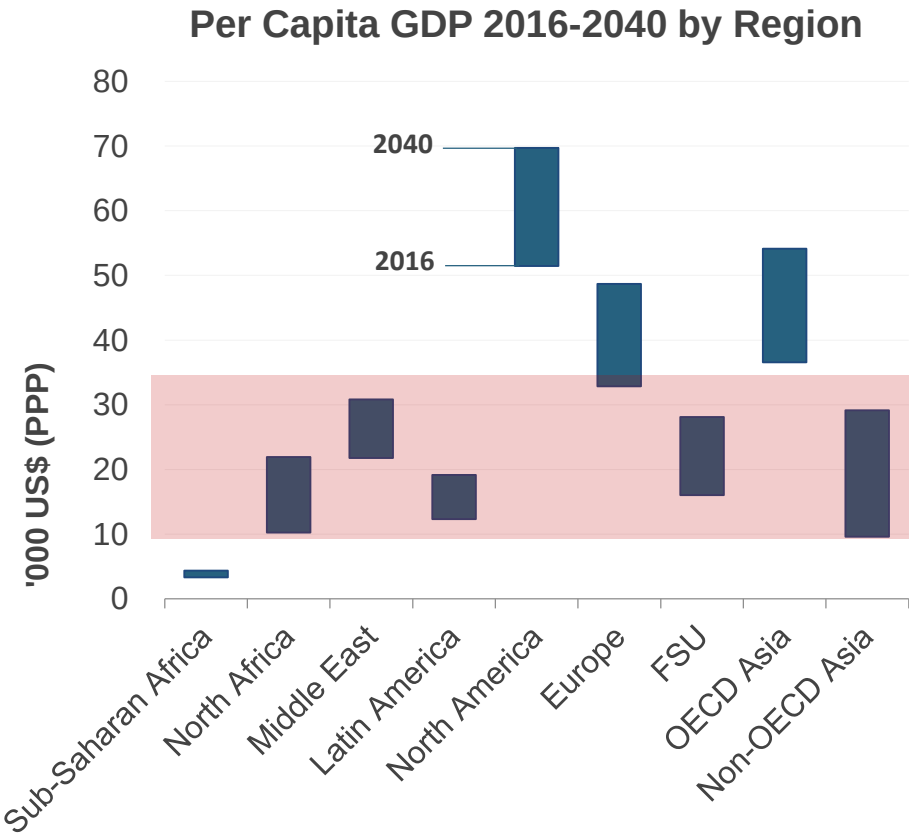


- Transport sector will account for 75% of incremental oil demand between 2016-2040 (Road +8 mmb/d, Air +4 mmb/d).
- Petrochemical feedstock use (incl. ethane) will grow by at least 6 mmb/d.
- Bunker sector will add 1 mmb/d.
- Residential, power generation and industry sectors will decline by about 2 mmb/d combined.

Income & Car Density Relationship

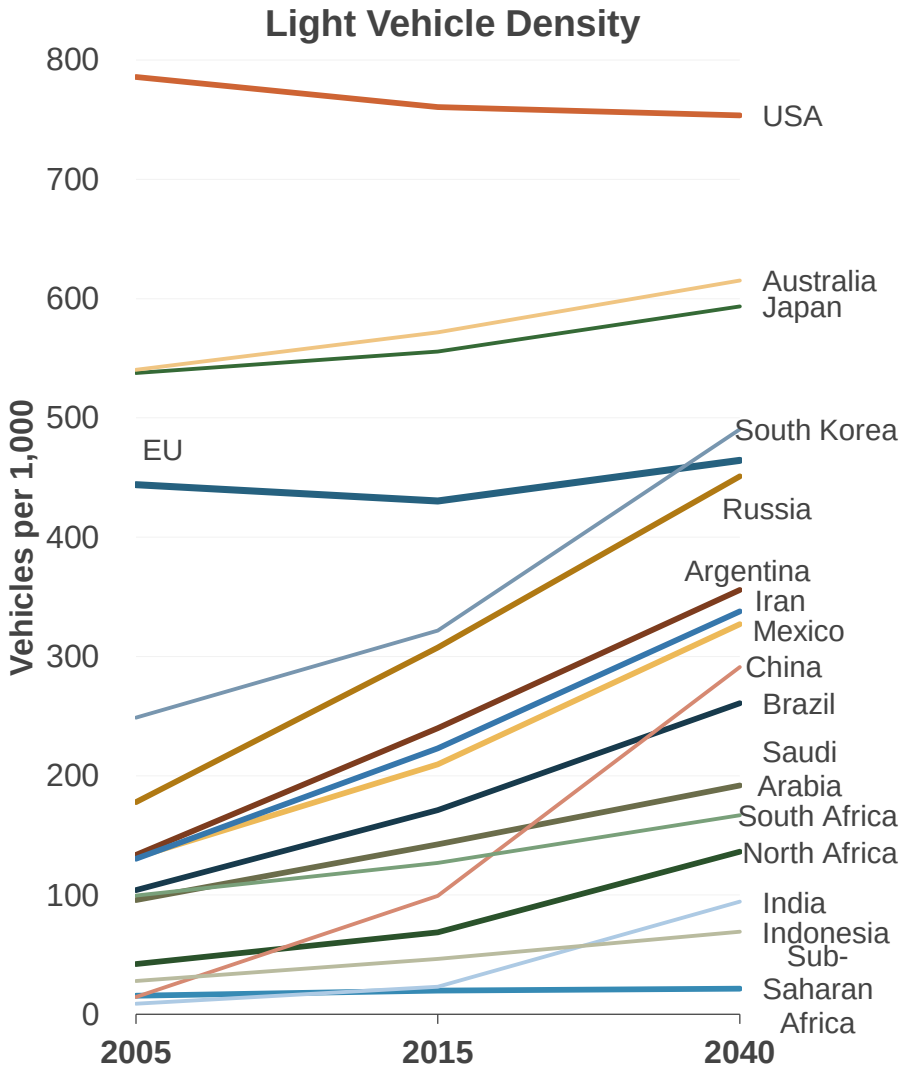
Motorization range: $8-10,000 to $35,000

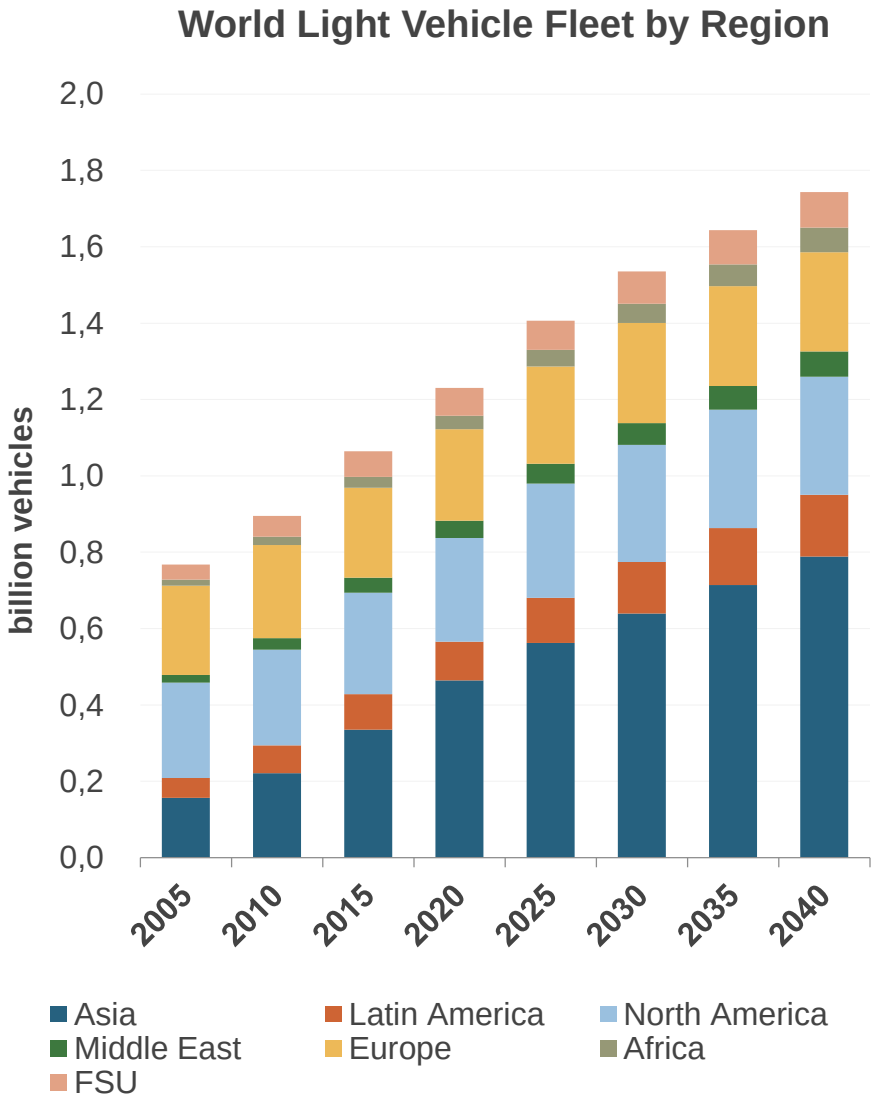




Catching Up: Vehicle Density

World light vehicle density to grow from 146 in 2016 to 184 in 2030 and then 194 per 1,000 in 2040.





Pillars of Electrification

POLICY

Government incentives and subsidies are the key to mass electrification of road transport.

How much subsidies can a government afford?

INFRASTRUCTURE

BATTERY PRICE & TECHNOLOGY

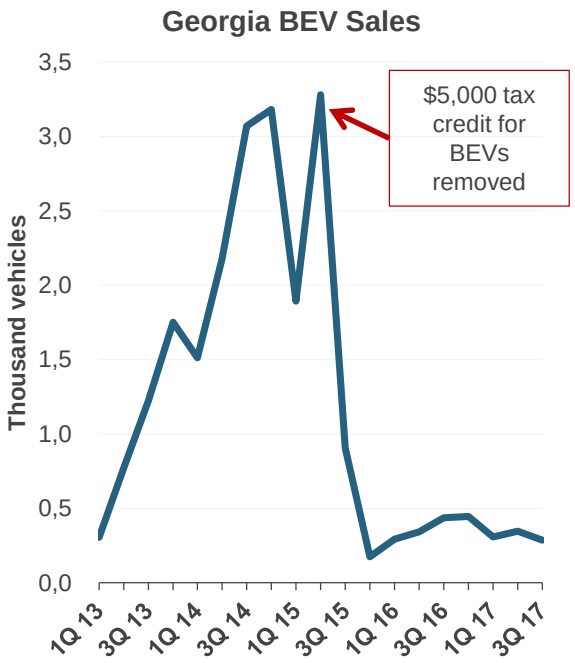
PRODUCTION CAPACITY

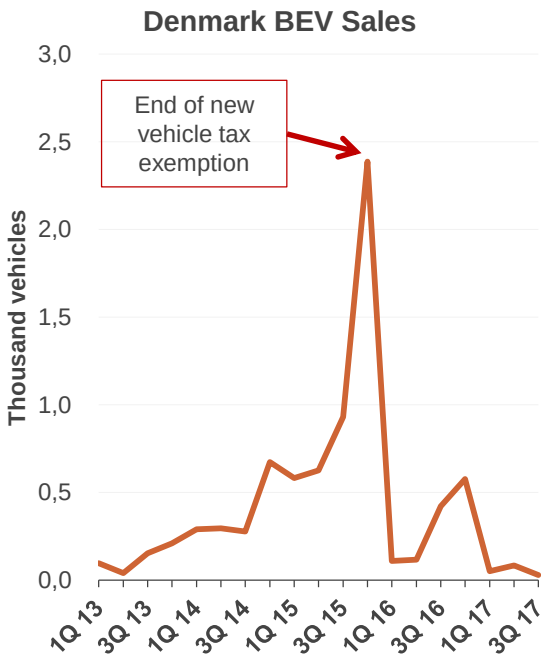
OTHER FACTORS

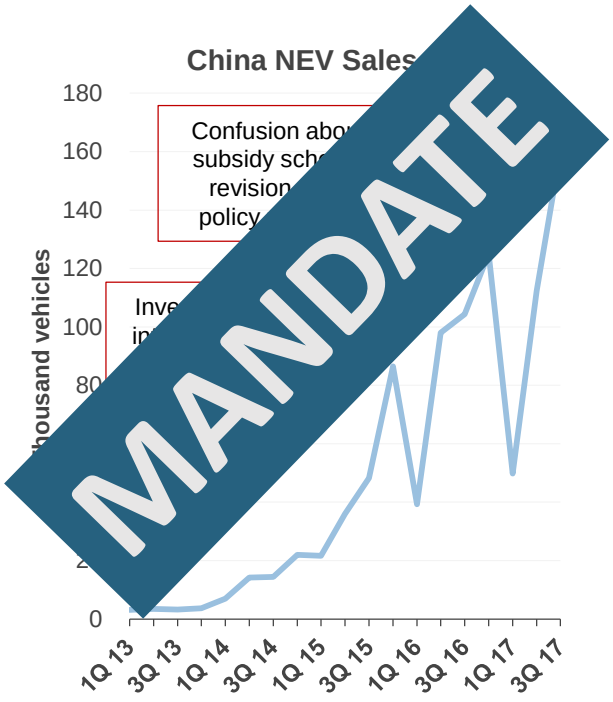
SUVisation resulting in higher curb weights poses a problem. Lower oil prices delay penetration of EVs.

EV Subsidies - Removal is a Big Deterrent for EV Buyers

Unless reinstated, subsidy removals have significant adverse effects on electric vehicle sales.







- Adverse effect of subsidy removal on EV sales is greater in the case of cheaper cars where the subsidy ratio is higher; the effect on expensive models is likely to be limited.

Electric Cars are not coming quickly (2)

Charging infrastructure in the cities, where majority of the people do not have off-street parking, will remain inadequate

EV Charging Infrastructure & Investment Requirement

In order to improve access for vehicles that are 100% reliant on electric power, the new policy reserves the City's EV charging stations for battery-only electric vehicles. All other vehicles (including plug-in hybrid electric vehicles) and any vehicle without an active charging session or not connected to a station may be subject to citation and/or towing at the owner's expense.

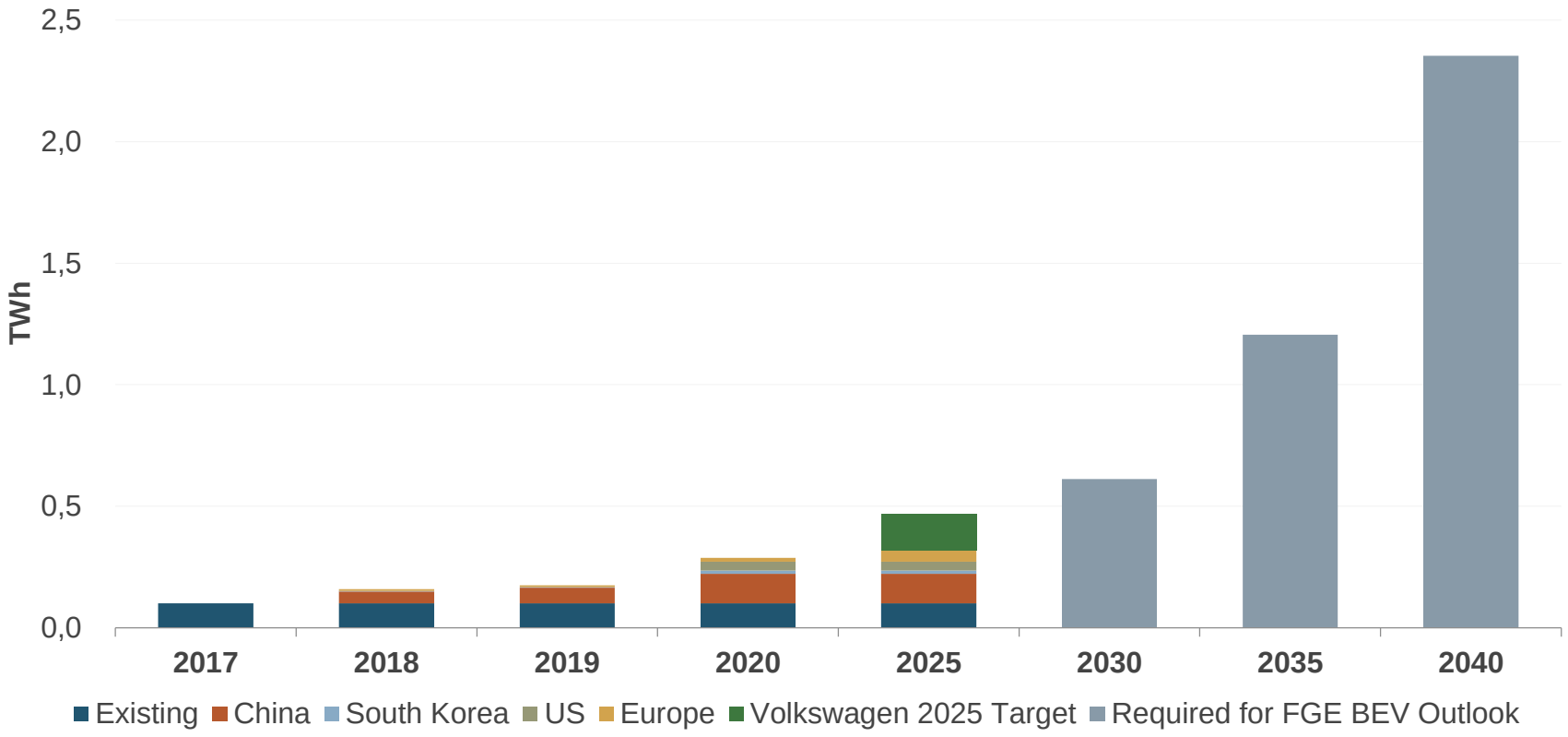
Until the 30th of June 2018, Shell is offering an introductory offer - just 25p per kWh vs. the normal price of 49p per kWh.

Tesla Hikes EV Supercharger Rates Across US By As Much As 100 Percent

Do NOT buy an electric car unless you can charge it at home!

Battery Production Capacity

Mass electrification will require substantial investment in battery production.



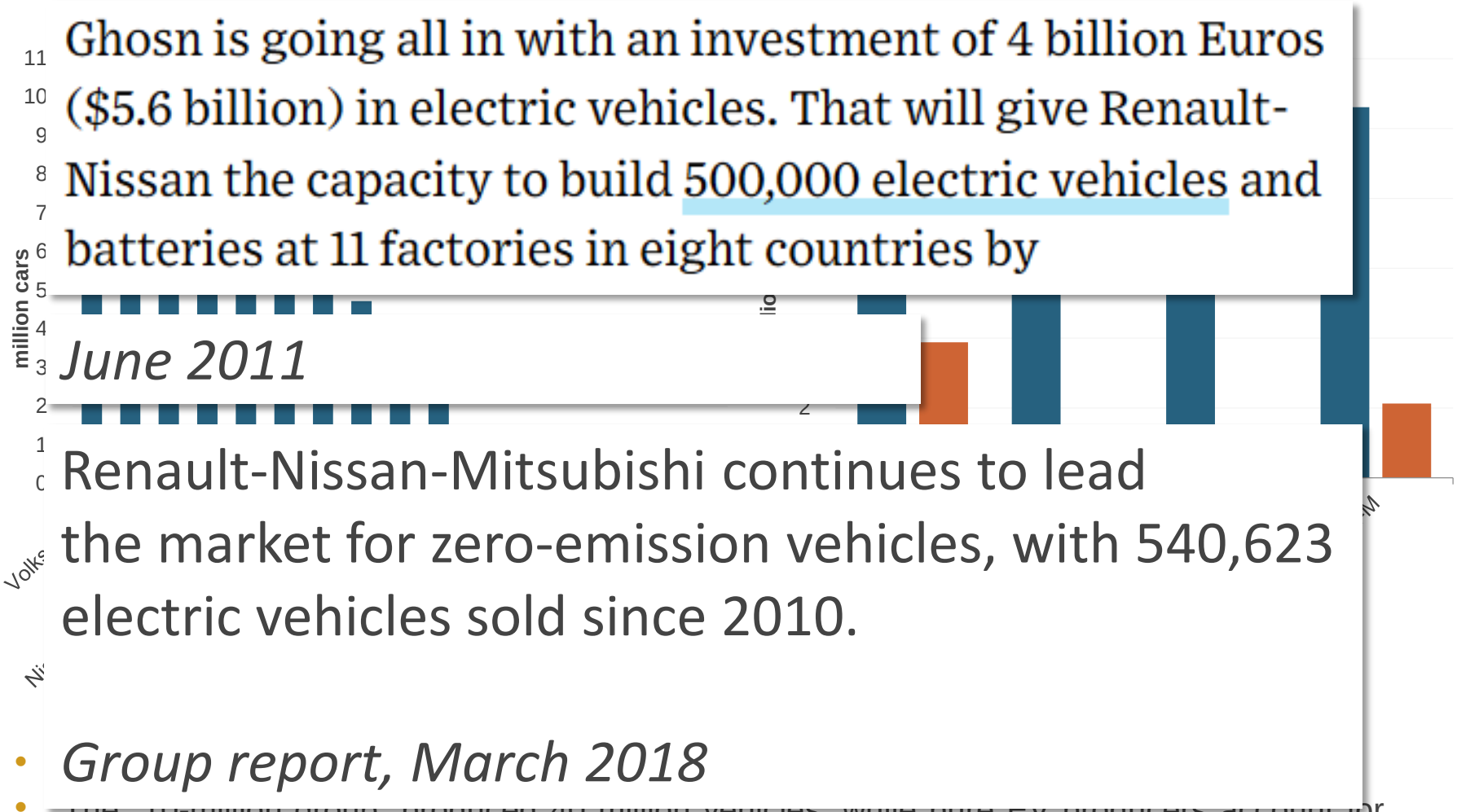
- For just the BEVs in our base case, some 2.3 TWh of battery production is required by 2040 – 67 x Tesla Gigafactory.
- Based on the average cost of US$190 million/GWh, this equals US$437 billion of potential investment.

Battery Production Capacity

If you expand electrification to other areas of transport, much more battery power needed…

Vehicle Production Capacity

Mass electrification of road transport is difficult without large-scale involvement of the big car producers.



Ghosn is going all in with an investment of 4 billion Euros ($5.6 billion) in electric vehicles. That will give Renault-Nissan the capacity to build 500,000 electric vehicles and batteries at 11 factories in eight countries by

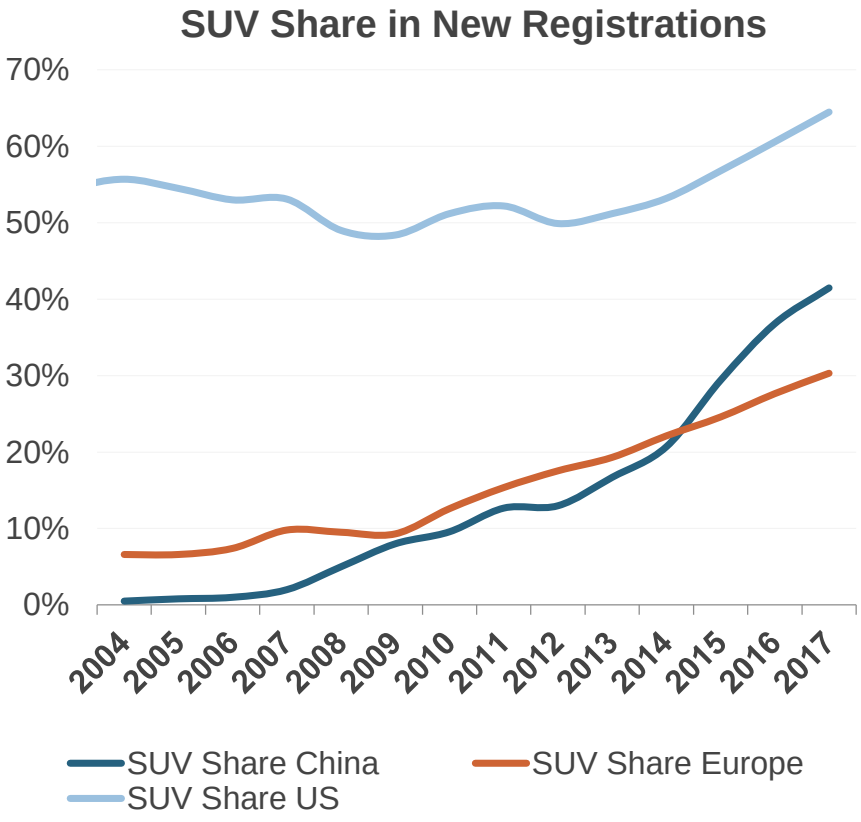
June 2011

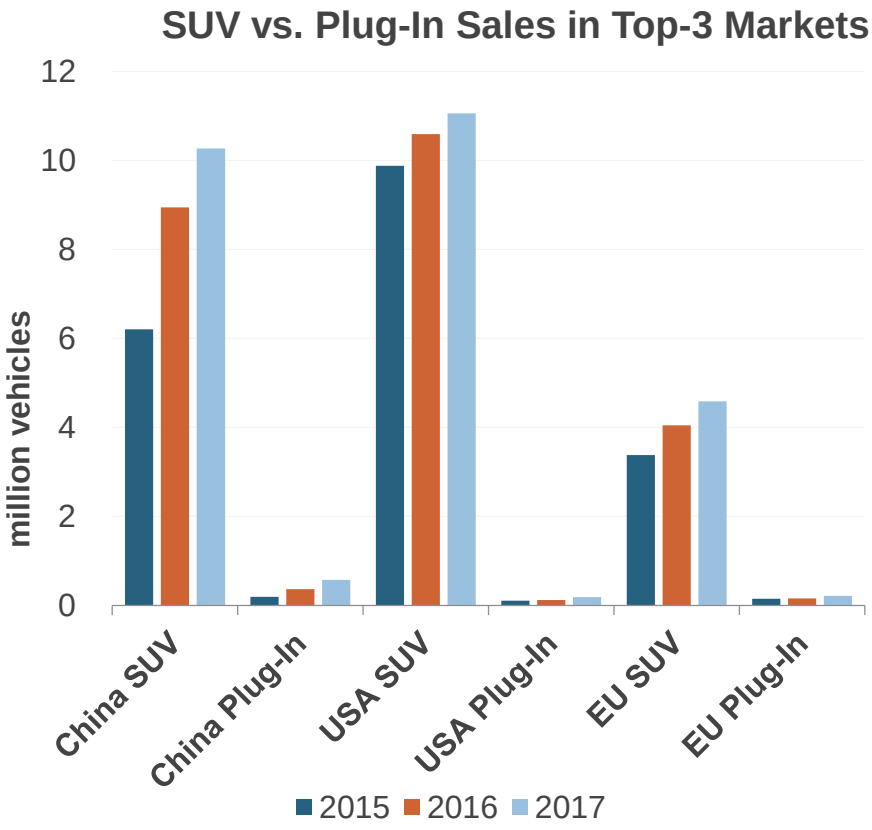
Renault-Nissan-Mitsubishi continues to lead the market for zero-emission vehicles, with 540,623 electric vehicles sold since 2010.

- *Group report, March 2018*
- The "10-million group" produced 40 million vehicles, while pure EV producers account for less than 1% of global vehicle production.

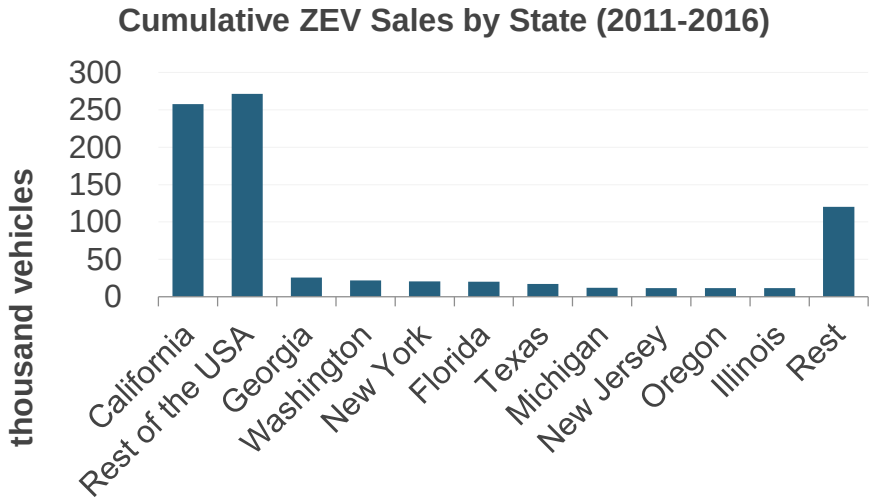
“SUVisation”

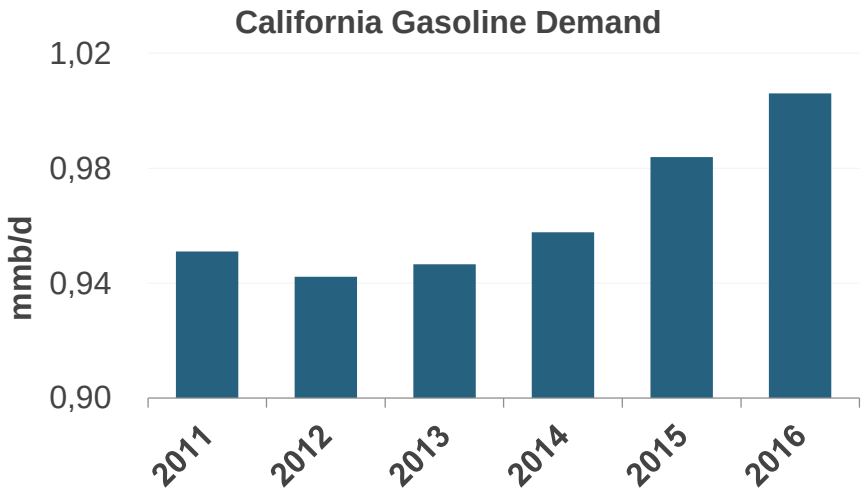
SUVs adding weight and fuel demand

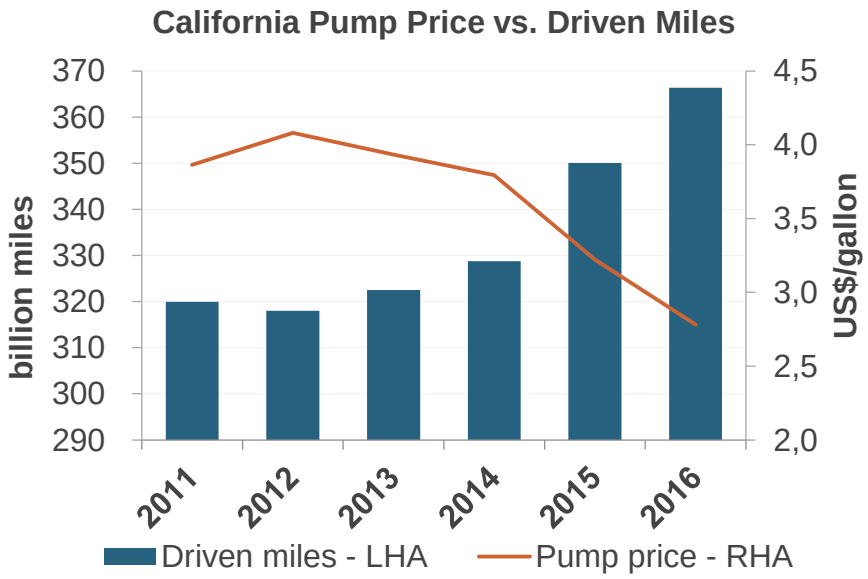


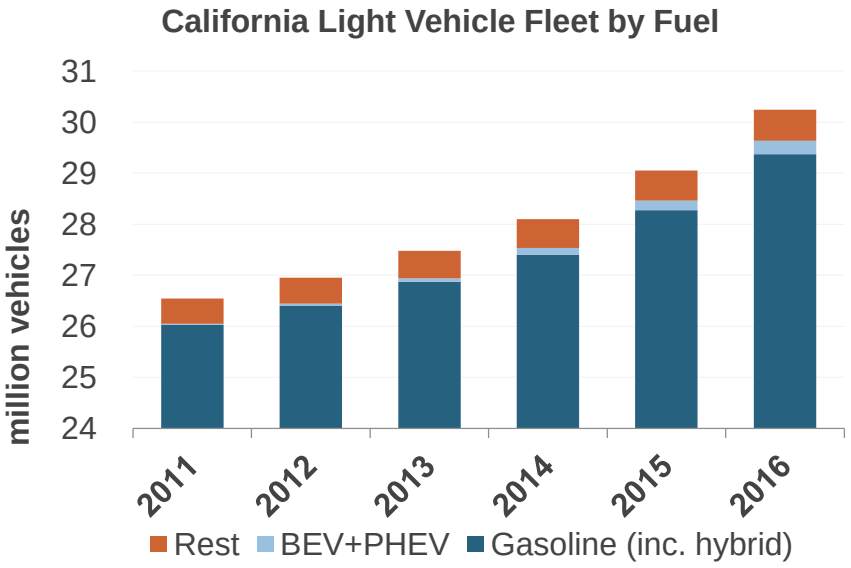


Gasoline Demand Growth with Electrification – California

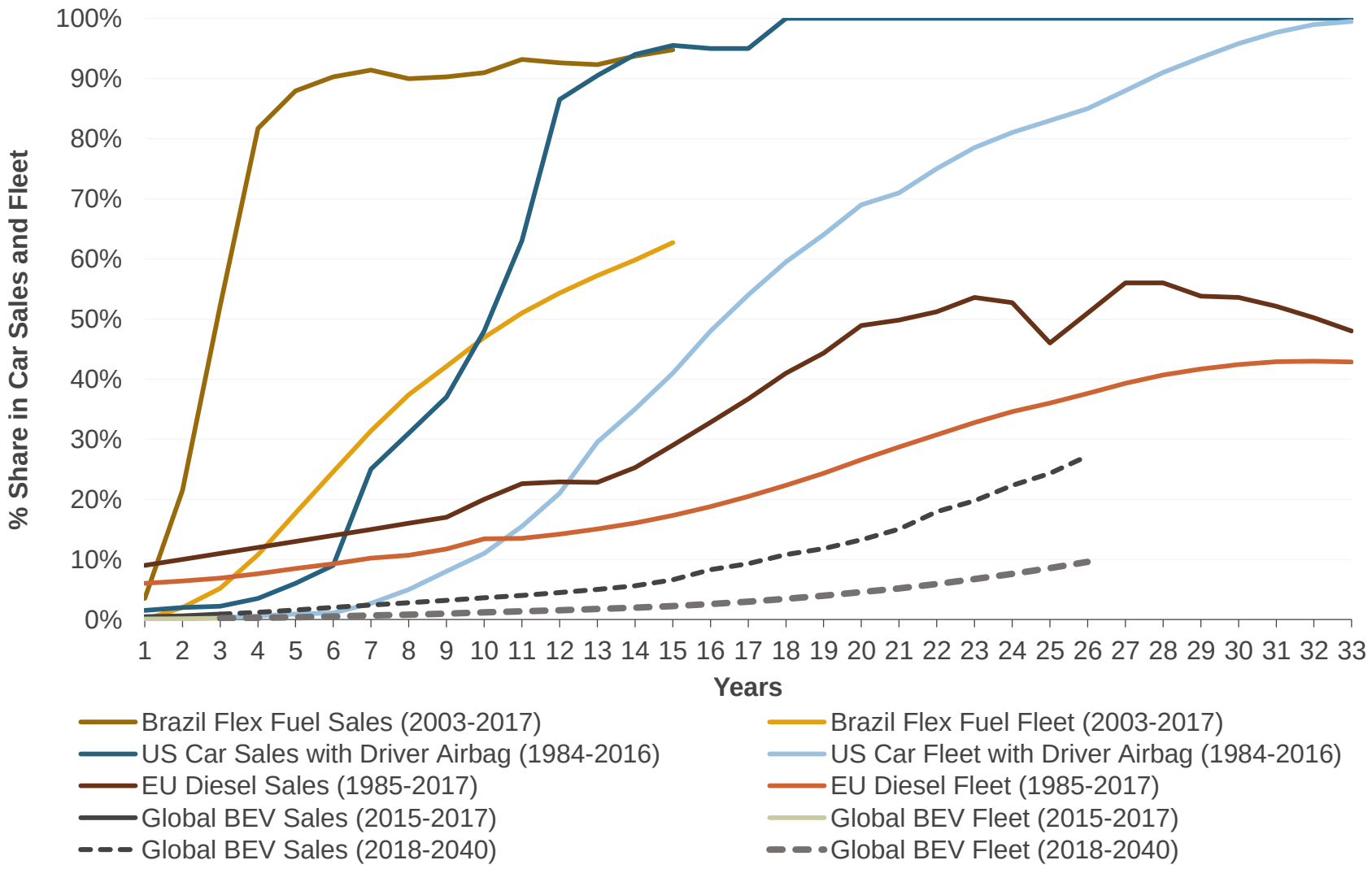




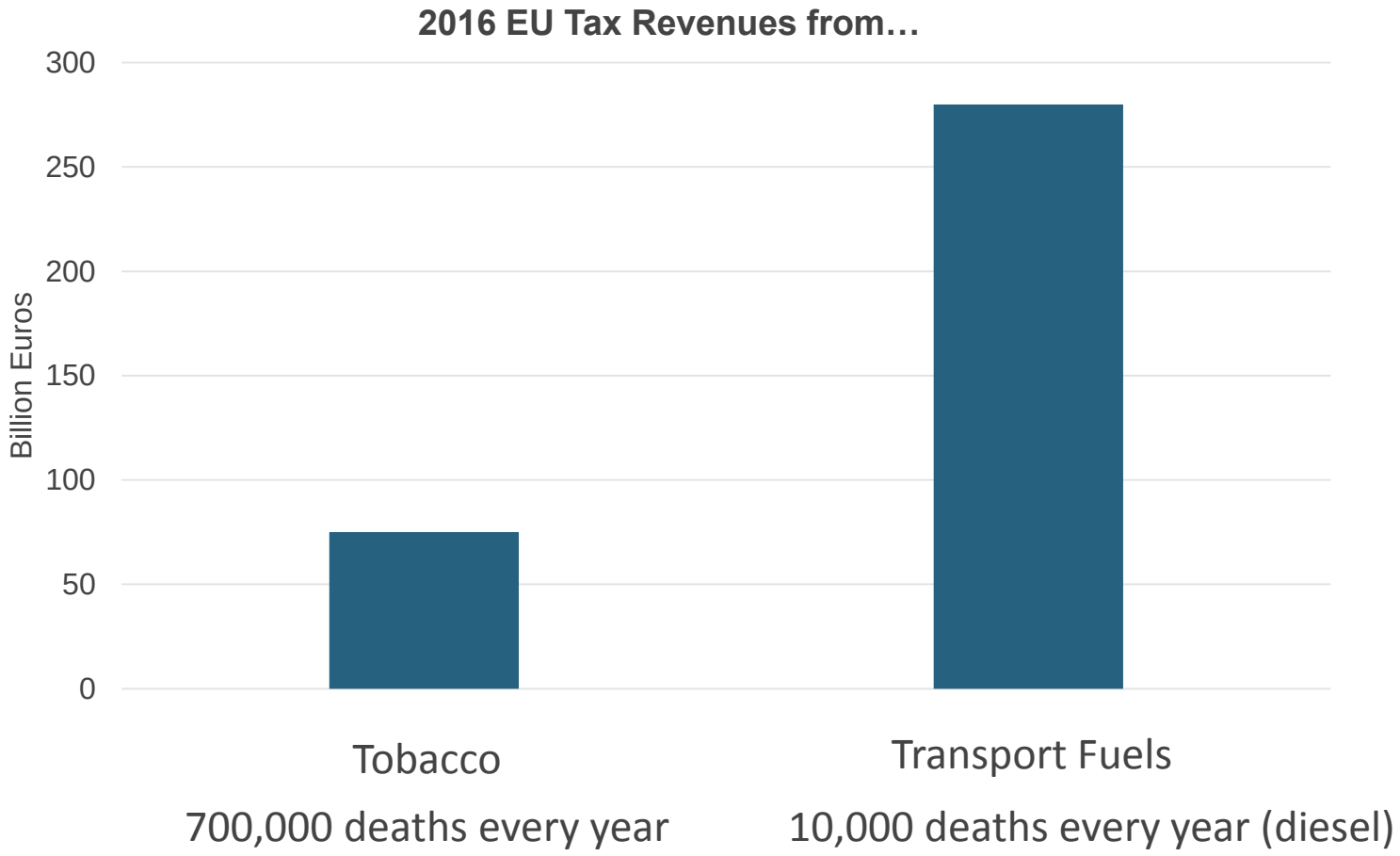




Speed of Transformation in Car Industry – Historical Examples

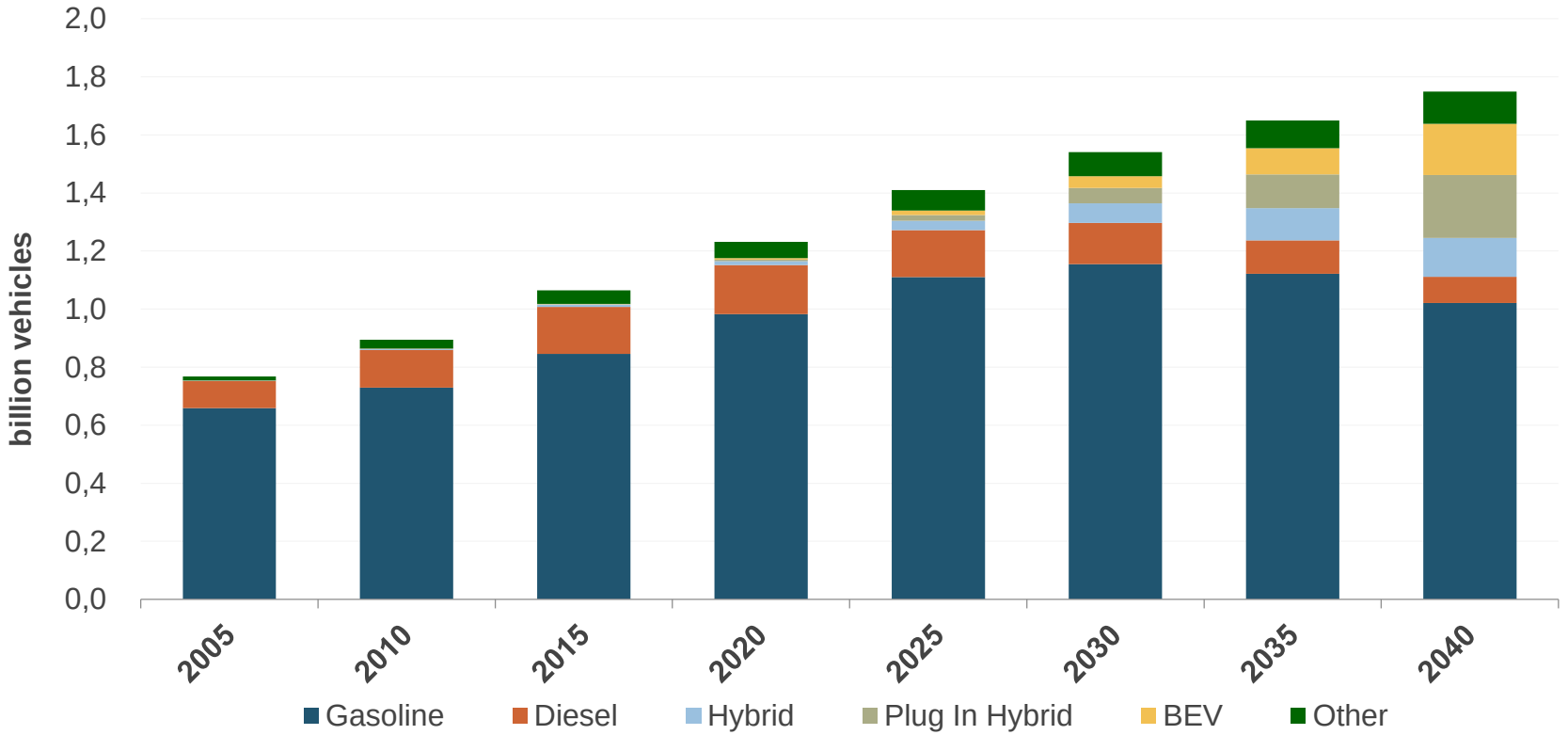


To ban or not to ban!



- Ever heard of a government imposing a total ban on tobacco? Why not?
- What is the potential reduction in government revenues from a ban on ICE?
- What are the consequences for government revenues?

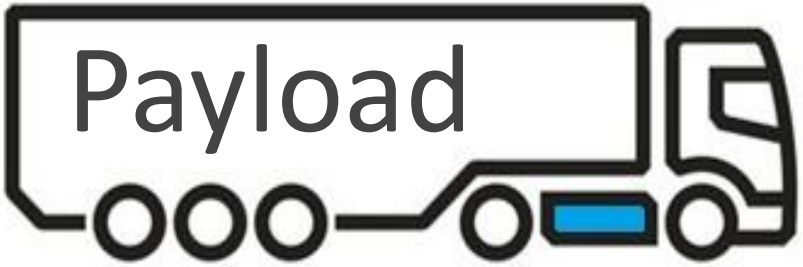
World Light Vehicle Fleet by Fuel



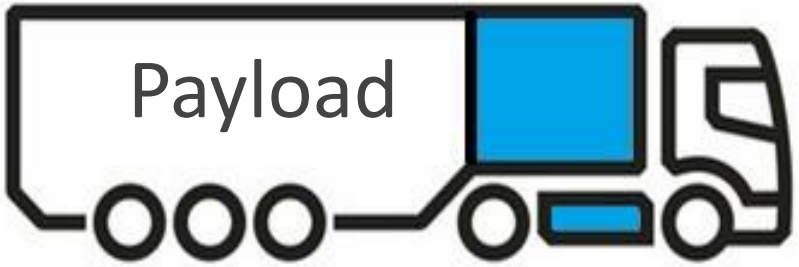
- Today, 80% of world's light duty vehicle fleet is gasoline driven – by 2030, gasoline will still account for 75% of the global fleet, while diesel's share will drop from 15% to 8%.
- Share of hybrid (8% in 2040), plug-in hybrid (13% in 2040) and battery electric (11% in 2040) vehicles will gain significantly after 2030, amounting together to 31% by 2040.
- Alternative vehicles (LPG and CNG, flex-fuel) will account for only a small fraction.

Heavy Goods Vehicles Will Remain Diesel-Driven

Approximate values (FGE calculations). Blue area represents fuel/battery, white area represents the payload. Values based on Volvo FH 13 6x2 Tractor.



800 liter diesel / >1,000 miles range / 19 tonne payload



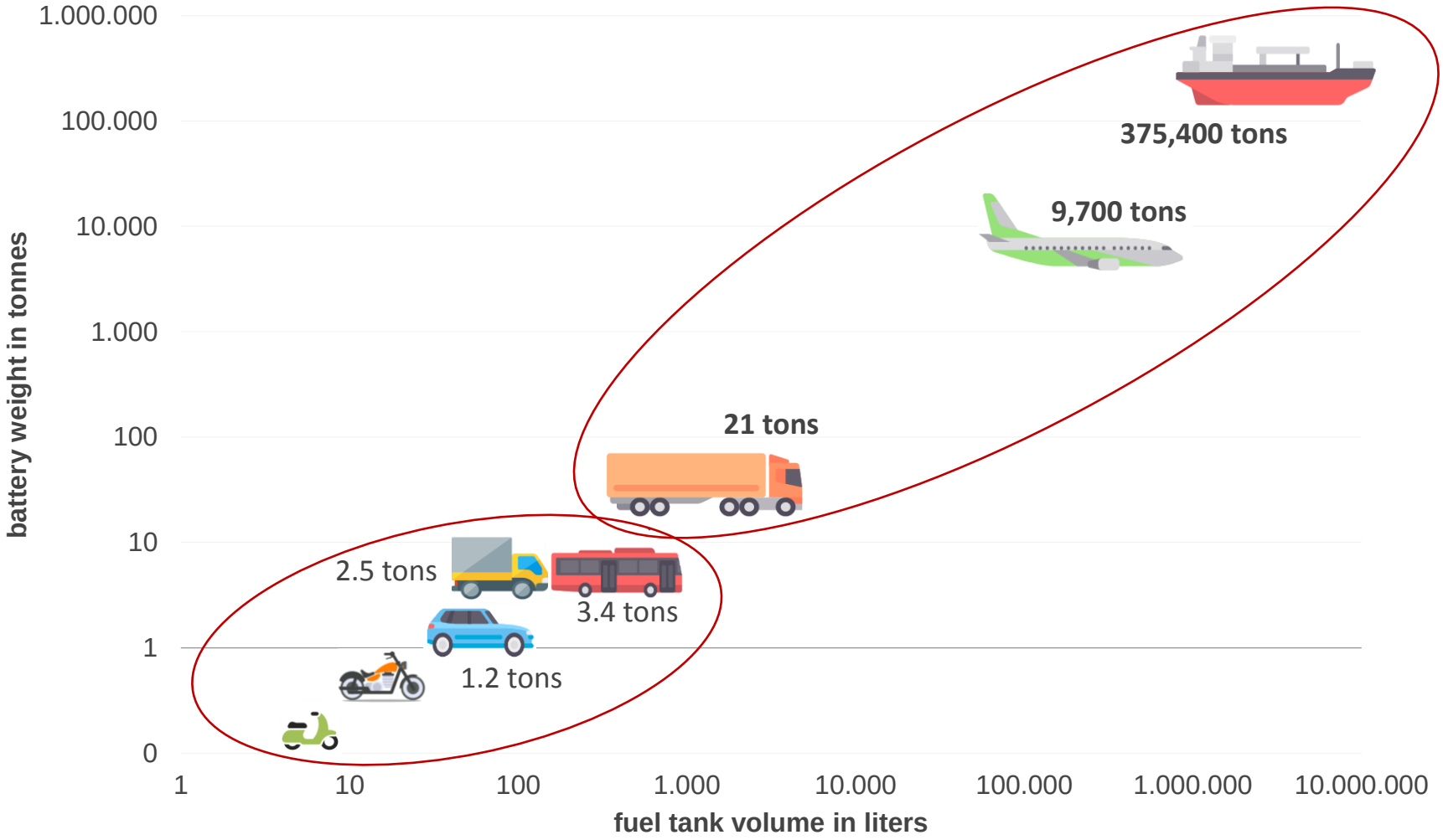
1,000 kWh battery / 300 miles range / 13 tonne payload

2,050 kWh battery / 600 miles range / 7 tonne payload

3,100 kWh battery / 900 miles range / 0.5 tonne payload

- Due to its high energy density, diesel allows big payloads in the trucking sector.
- Switching to battery may be economically not viable for long-haul heavy duty transport.
- At about US$210/kWh currently, a 1,000 kWh battery pack alone would cost US$210,000; compared with US$120-140,000 for a complete diesel-driven truck.

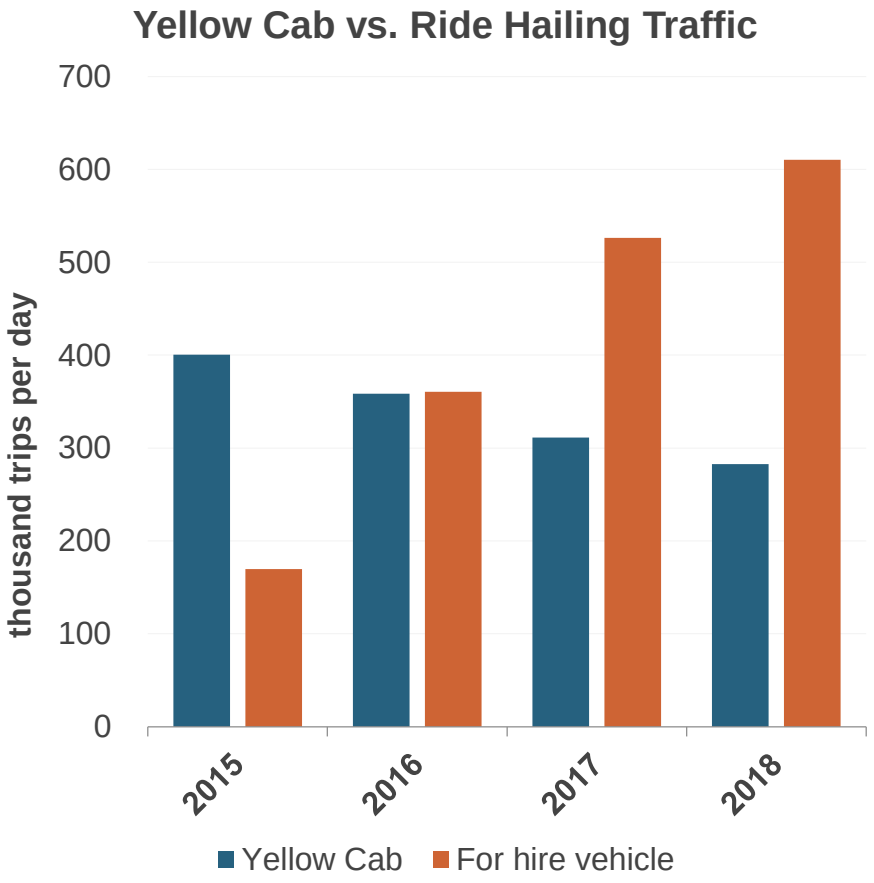
Limited Electrification Beyond Bus/Light Truck Segment

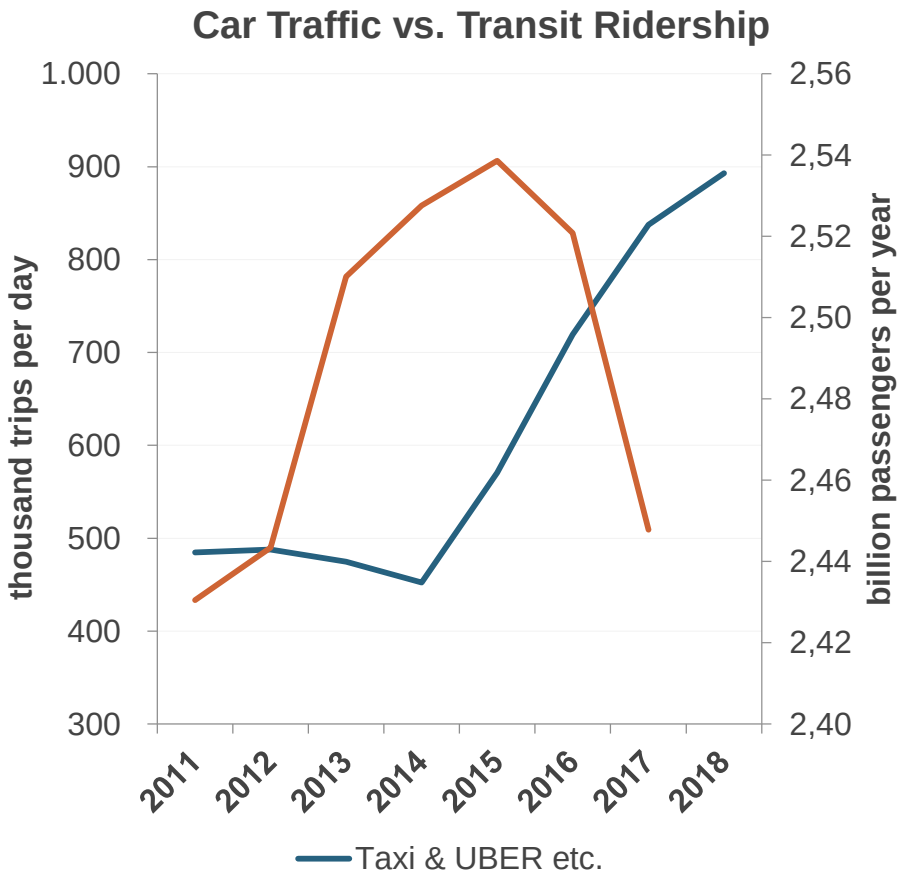


Ride Hailing – What Does it Mean for Oil Demand?

How Does Uber Change Mobility?

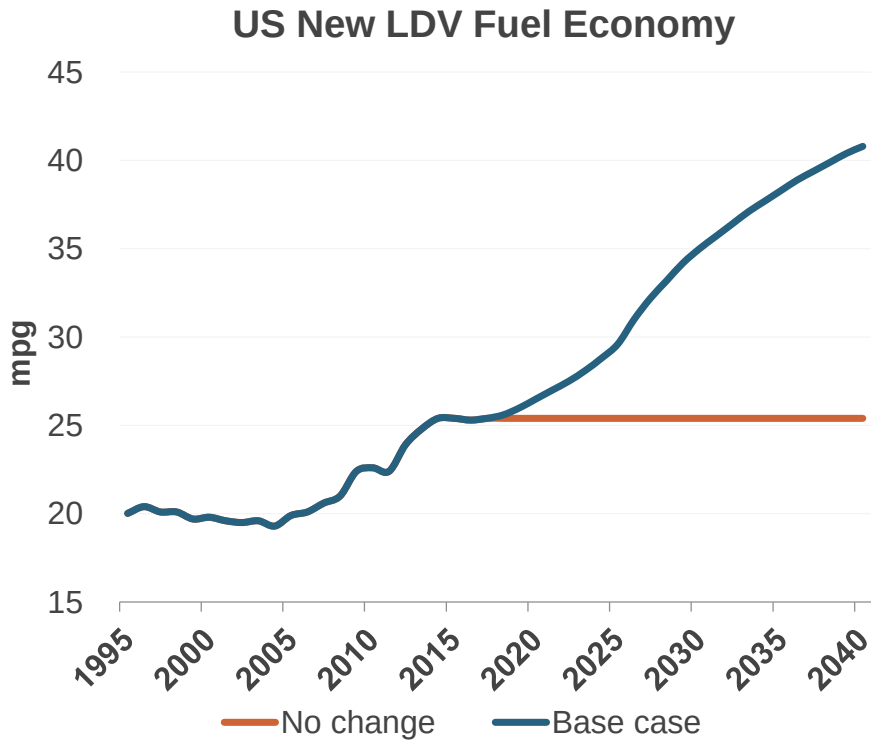
Data from New York

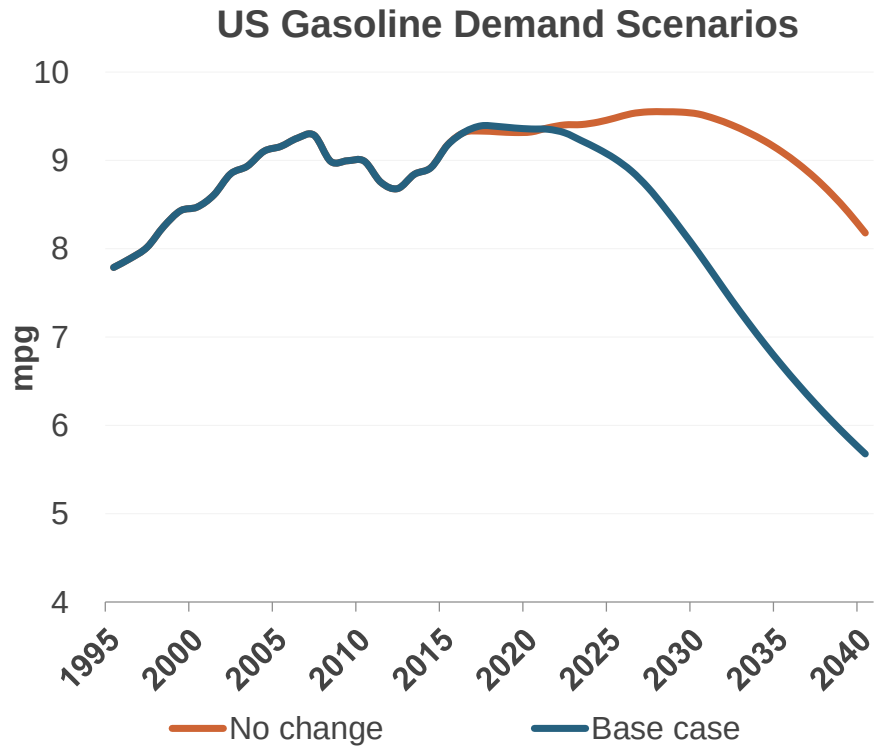




- Ride hailing takes people off the mass transit and puts them into cars
- If the car share in personal transport is sustained, passenger car fuel demand in the US and the EU will be 600 kb/d and 200 kb/d higher than in our base case, respectively.

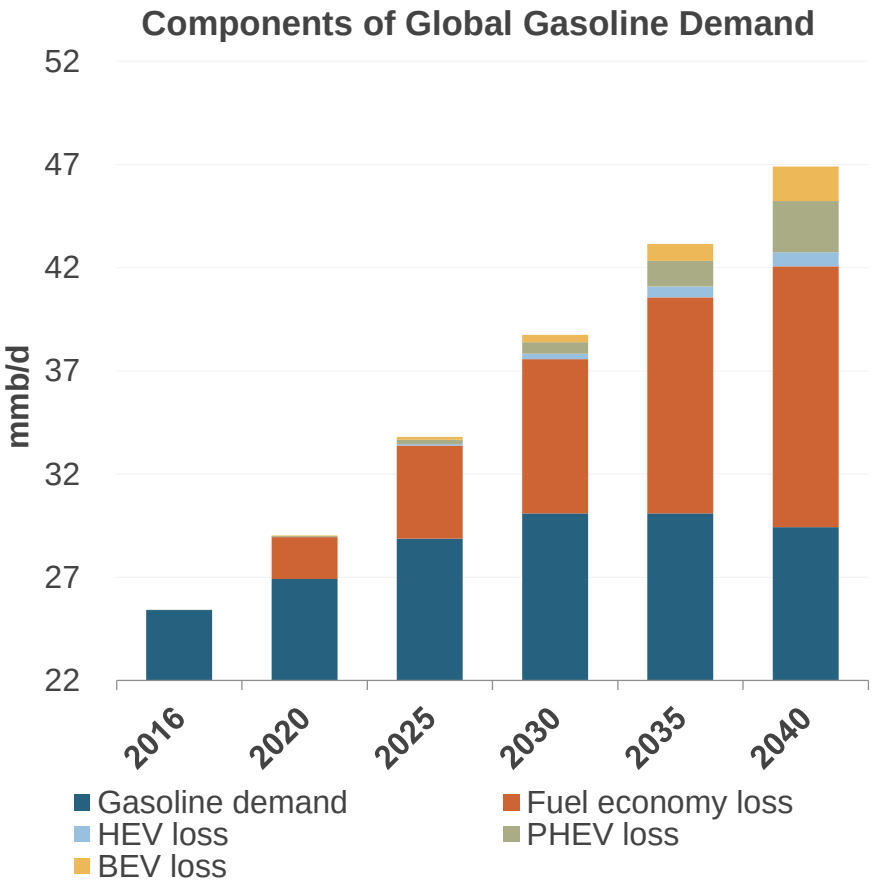
US - Fuel Economy Impact on Gasoline Demand

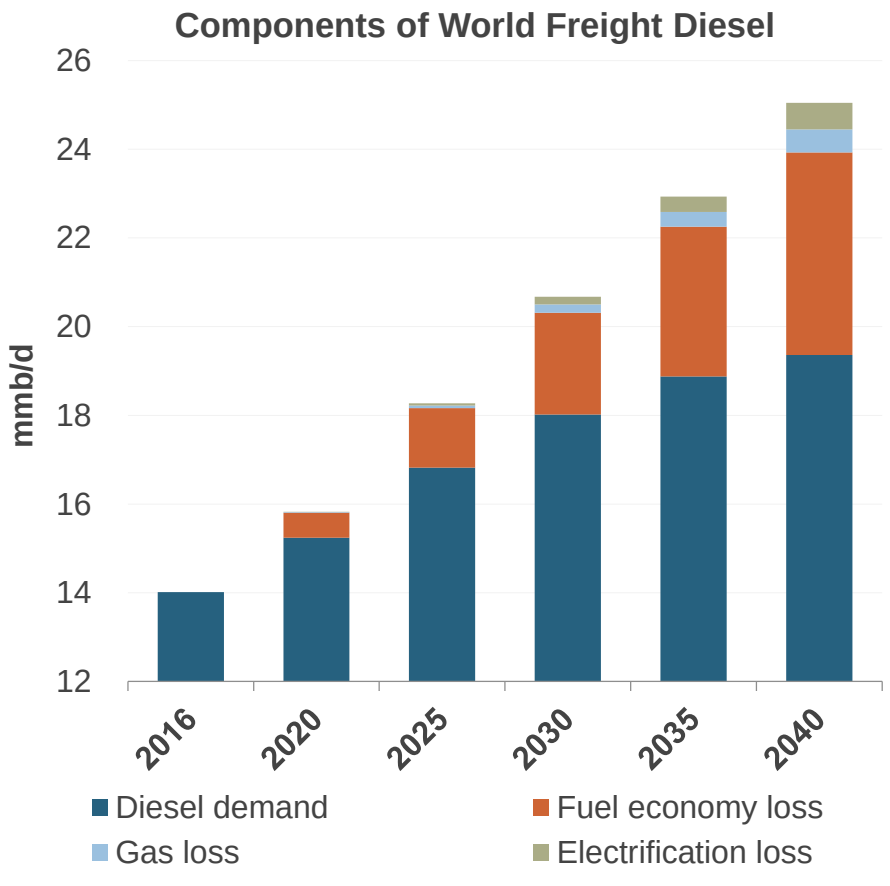




- US new vehicle fuel economy has been stagnating since 2014.
- While we project a gradual improvement in new vehicle fuel economy in line with the change in CAFE standards, a “high truck share, flat fuel economy” scenario can easily add 1.5 mmb/d of gasoline demand by 2030 compared with our base case, then another 1 mmb/d by 2040.

Fuel Economy is Biggest Threat to Oil Demand, Not Electrification





1pp lower fuel economy per year
+6 mmb/d gasoline demand by 2040

1pp lower fuel economy per year
+3.3 mmb/d diesel demand by 2040

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