Decarbonizing Road Transport to Zero-Emission Pathways for Electric Vehicle

Yossapong Laoonual, PhD

Mobility & Vehicle Technology Research Center (MOVE)

King Mongkut 's University of Technology Thonburi

Session 3: Environmental related Transportation on Decarbonization Issues

The 14th ATRANS Annual Conference

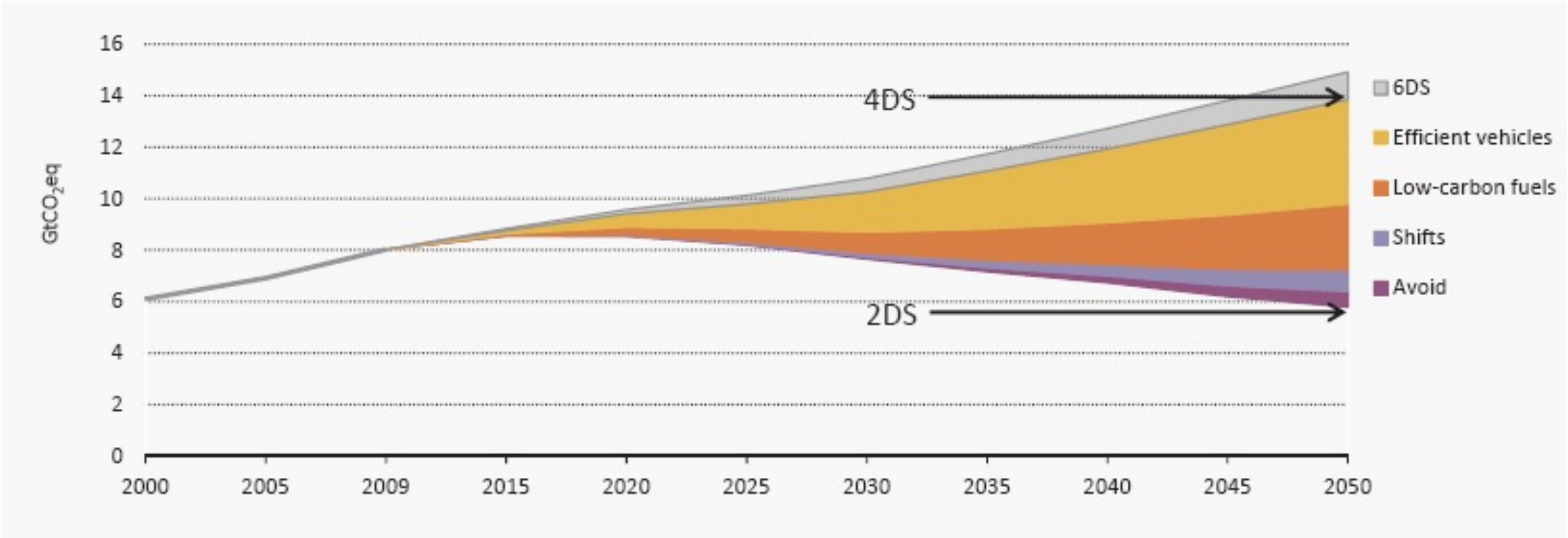
18 December 2021

Key Drivers for Next Generation Mobility

Air Pollution and Climate Change

Key Drivers for Next Generation Mobility

2 degree scenario by International Energy Agency (IEA)



Source: IEA (2012) Energy Technology Perspective

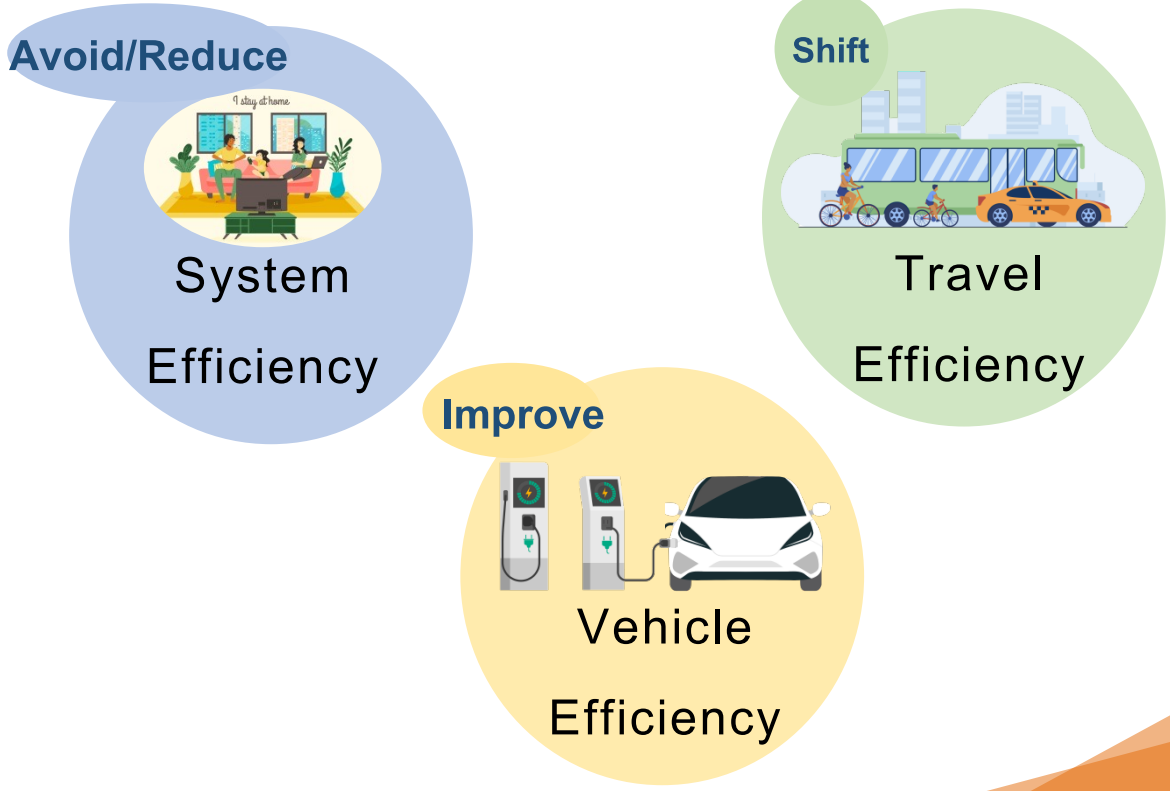
Note: 2DS/4DS or 2°C/4°C Scenario describes an energy system consistent with an emission trajectory that recent climate science research indicates would give and 80% chance of limiting average global temperature increase to 2^0C/4°C.

Key Drivers for Next Generation Mobility

Sustainable Mobility

3P toward Sustainability

Avoid-Shift-Improve



Next Generation Mobility Technology

CASE

Connected Vehicle

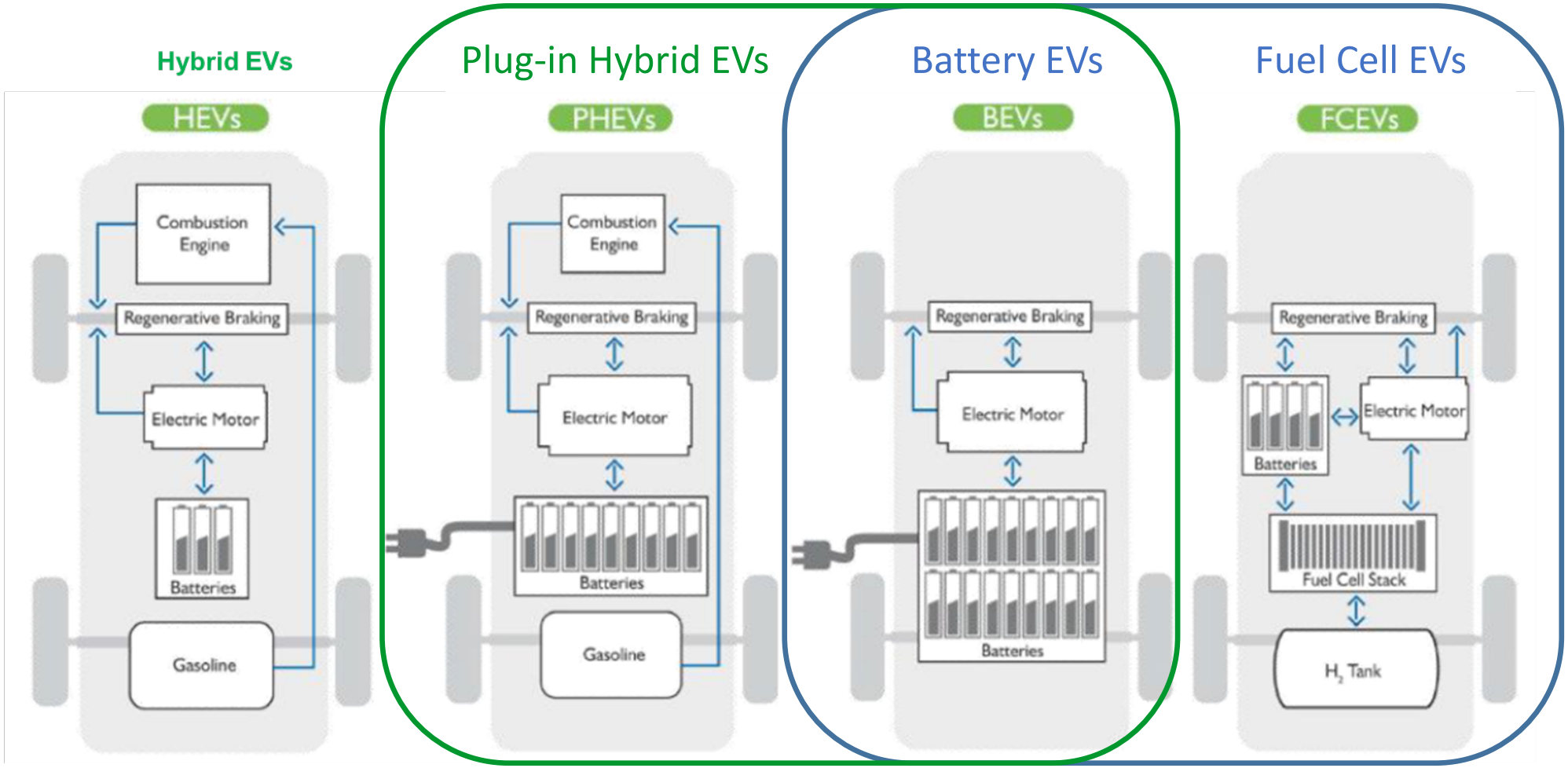
Autonomous Vehicle

Shared Mobility

Electric Vehicle

Electric Vehicle Technology

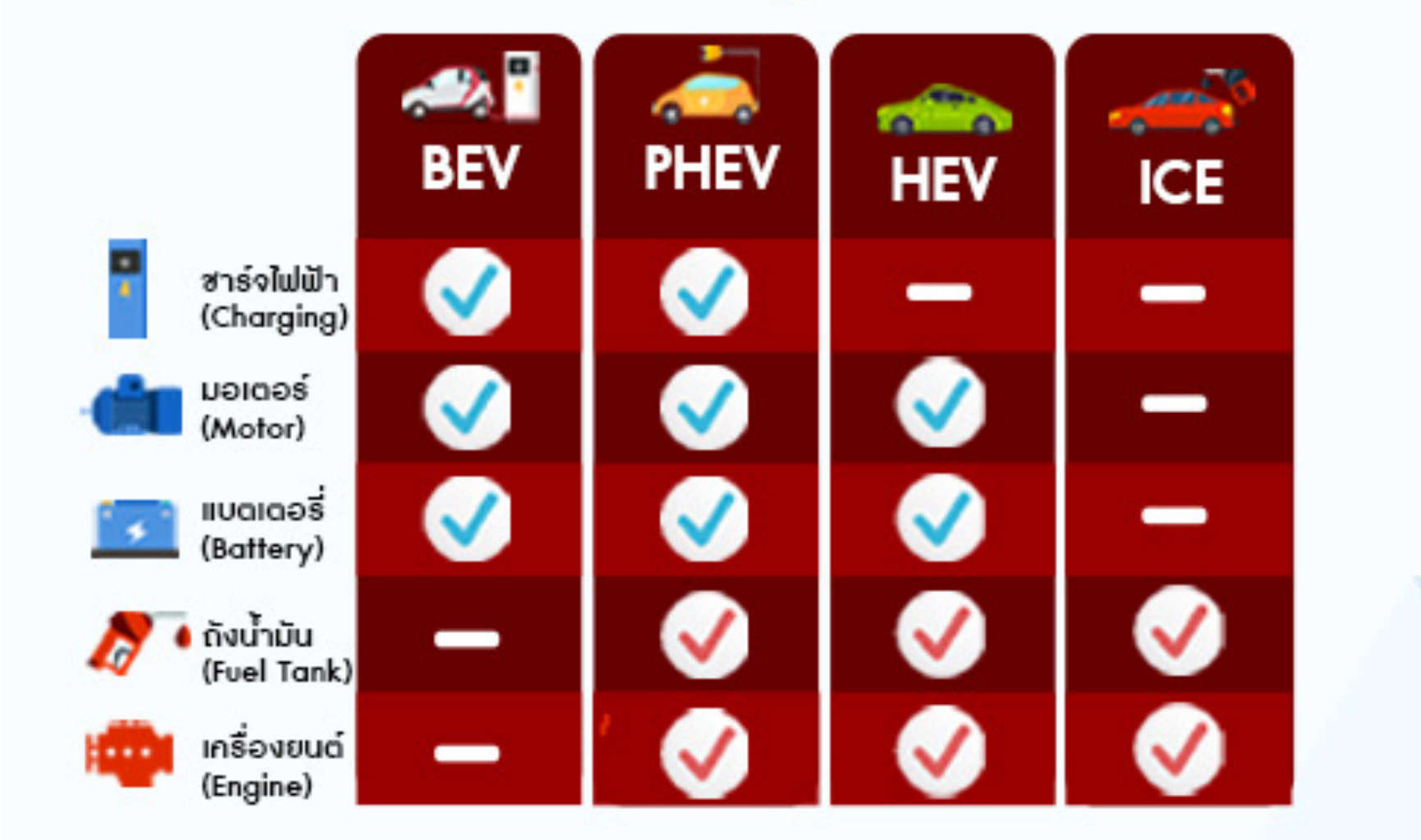
Type of Electric Vehicles



Source: Shukla, A, DolceraWiki (2009). A Market Study on Hybrid Vehicles and the Concept of V2G.

Electric Vehicle Technology

Type of Electric Vehicles



Electric Vehicle Technology

Battery Electric Vehicle

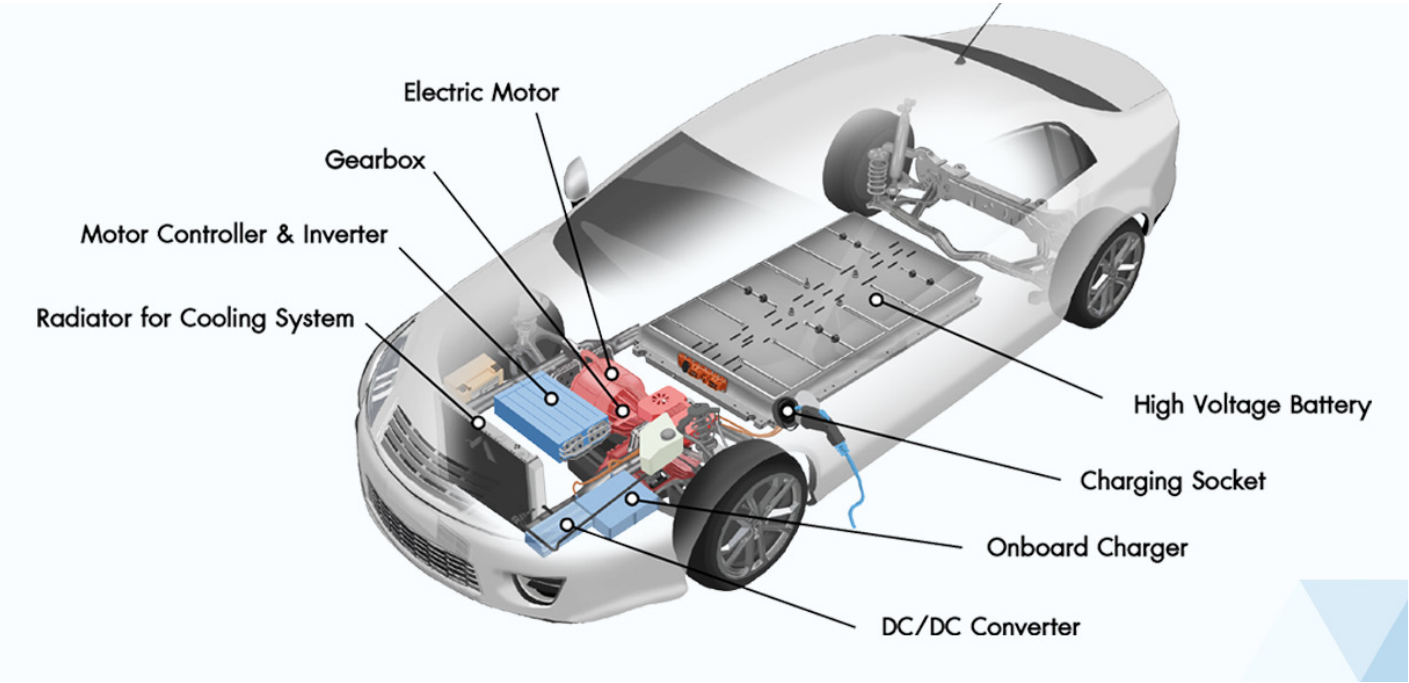
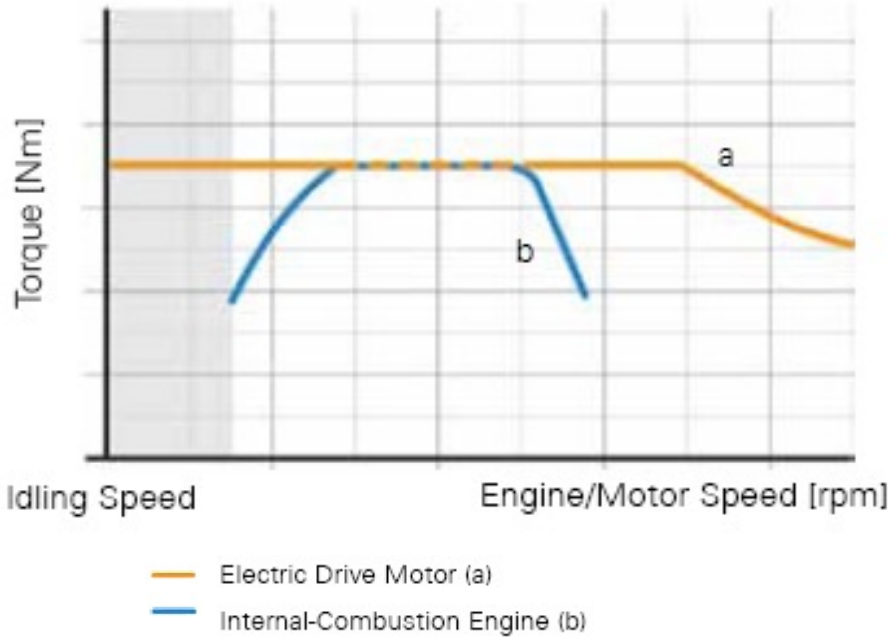


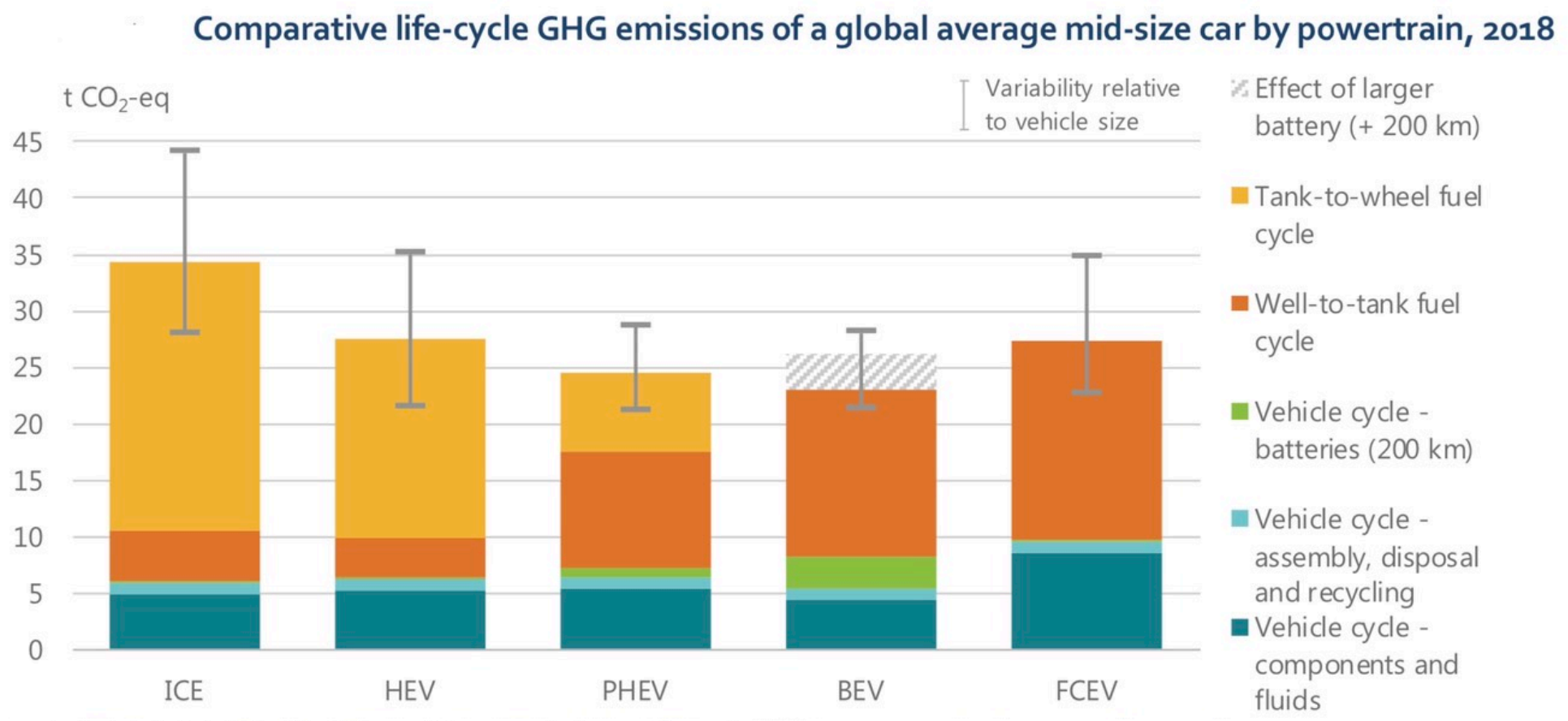
Photo Source: afdc.energy.gov



Source: NATEF-Basics of Electric Vehicles

http://www.natef.org/

Electric Vehicle Technology

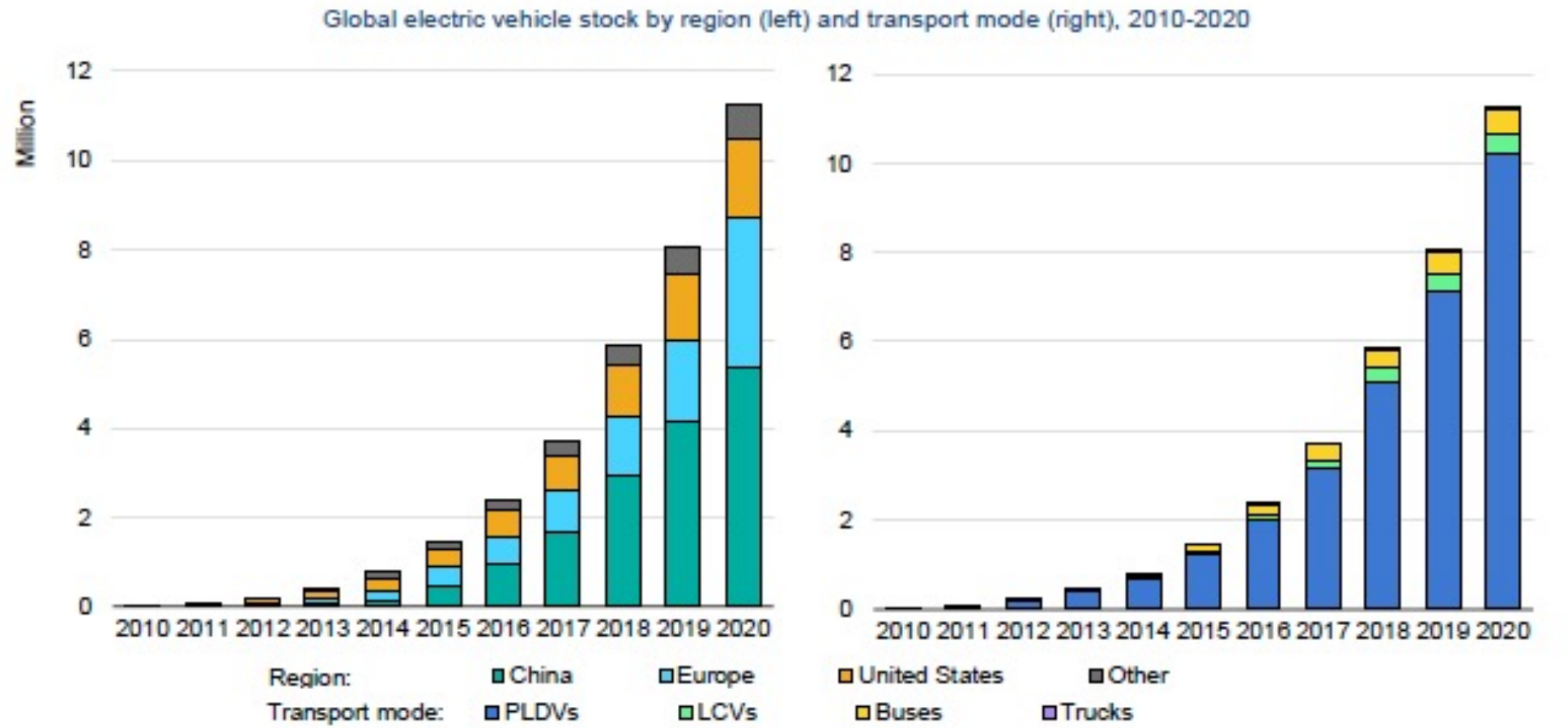


Notes: All ICE powertrains (i.e. including in the HEV and the PHEV categories) are assumed to be powered by gasoline.
Vehicle assumptions: vehicle power 110 kW, battery size 38 kWh (BEV with a range of 200 km) or 10.5 kWh (PHEV with a range of 55 km); battery chemistry NMC111; annual mileage 15 000 km; vehicle lifetime ten years. (Assumptions applicable to all powertrains unless otherwise stated).
Fuel economy assumptions (WLTP values): ICE - 6.8 litres of gasoline equivalent per 100 kilometres (Lge/100 km); HEV - 5.1 Lge/100 km; BEV - (200 km range) 19.0 kWh/100 km (2.1 Lge/100 m), BEV (400 km range) 19.4 kWh/100 km (2.1 Lge/100 km); FCEV 3.7 Lge/100 km. PHEV is a combination of ICE and BEV fuel economies, with 40% total mileage driven on gasoline and 60% on electricity (this utility factor is in line with WLTP provisions). The fuel economy of BEVs and PHEVs (for the electric powertrain) include a 5% penalty for charging losses.
Power supply CO_2 intensity in the fuel cycle is 518 g CO_2.eq/kWh. This is representative of the 2018 global average and includes transmission an distribution system losses.

The hydrogen production pathway considered here is steam methane reforming from natural gas (well-to-wheel emissions intensity of 3.2 kg CO_2-eq/Lge), which is representative of the majority of current hydrogen production.
The ranges suggested by the sensitivity bars represent the case of small cars (lower bound) and of large cars (upper bound) – for BEVs, the lower bound of the sensitivity bar represents a small car with a 200 km range, and the upper bound represents a large car with a 400 km range. All parameters relative to small and large cars are detailed in the notes to Figure 4.4.
Sources: IEA analysis based on ANL (2018); IEA (2019a),(2019b).

Source: IEA, Global EV Outlook 2019

Global Electric Vehicle Stock

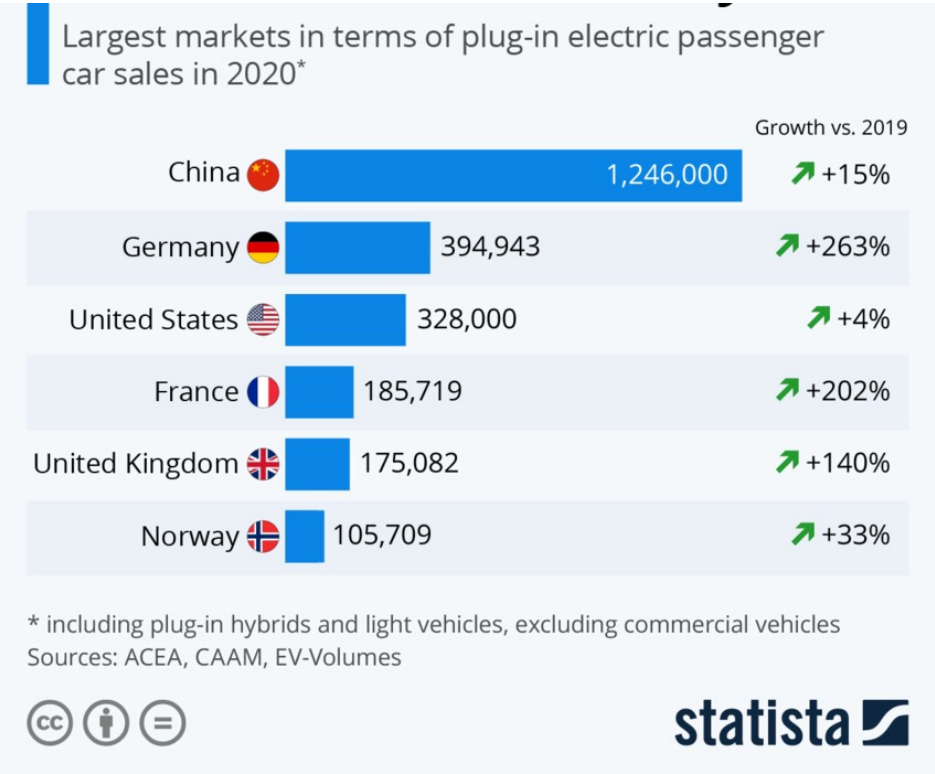


Source: International Energy Agency (IEA), Global EV Outlook 2021.

Electric Vehicle Technology

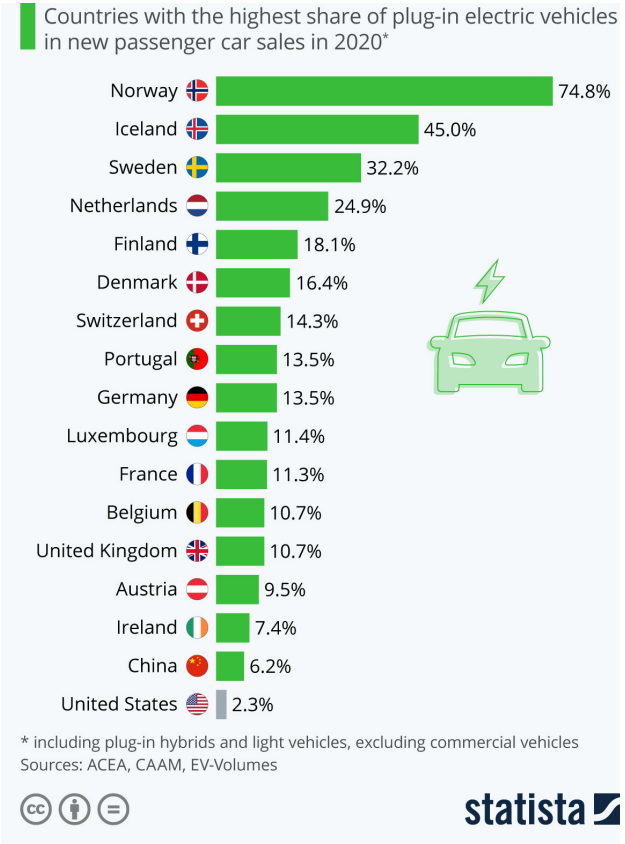
Global Electric Vehicle Markets

2020 plug-in electric passenger sales by country



Source: https://www.weforum.org/agenda/2021/02/electric-vehicle-market-global/

2020 share of plug-in electric passenger sales by country

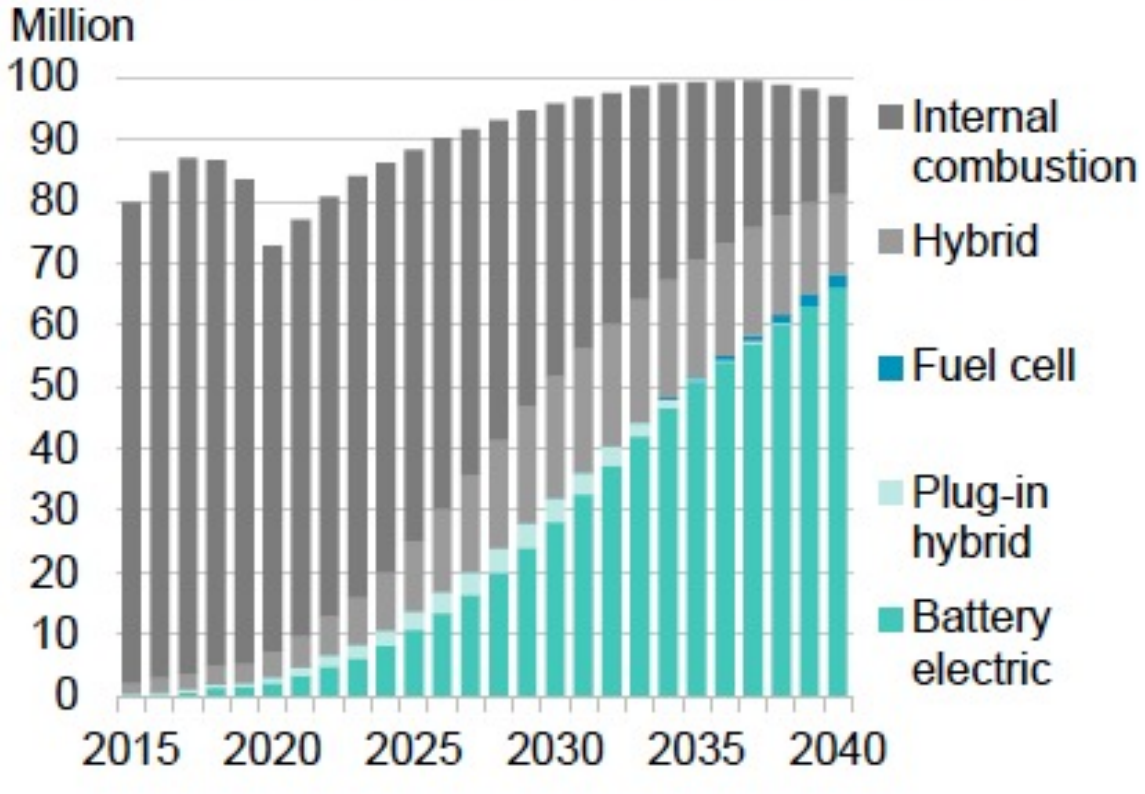


https://www.statista.com/chart/17344/electric-vehicle-share/

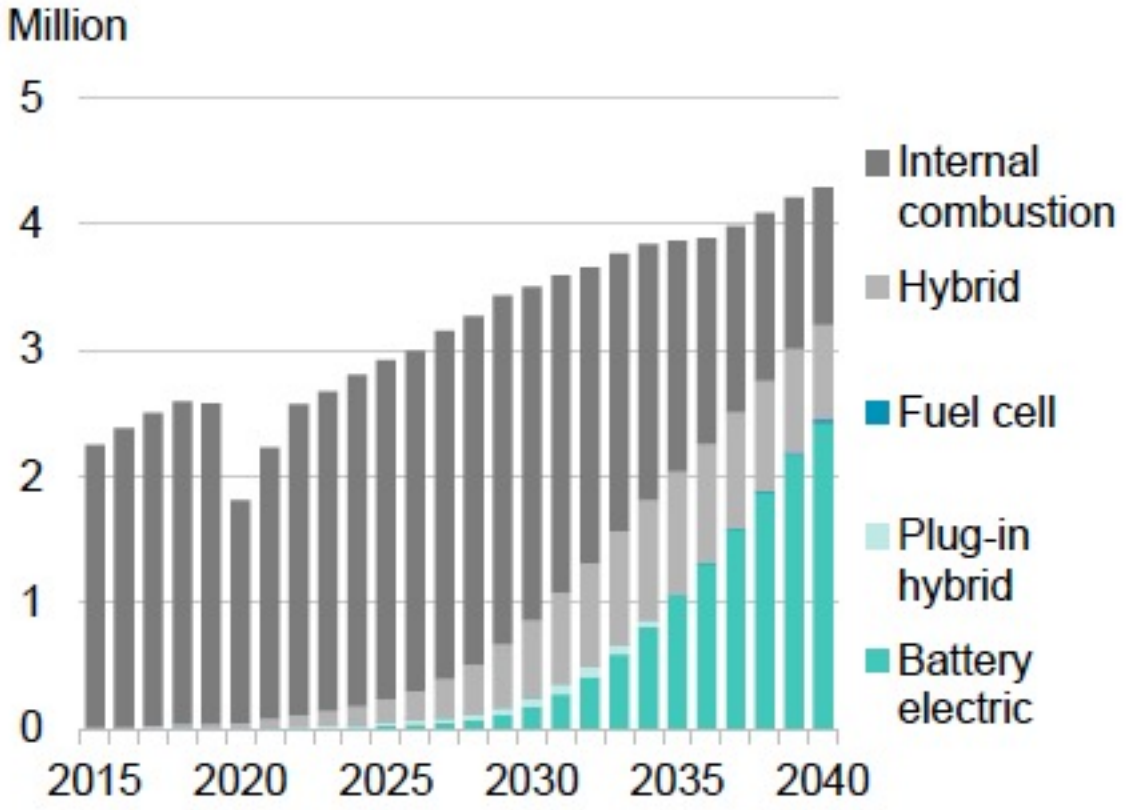
Electric Vehicle Technology

Global Electric Vehicle Markets

Global passenger vehicle sales outlook by drivetrain – Economic Transition Scenario



Southeast Asia passenger vehicle sales by drivetrain

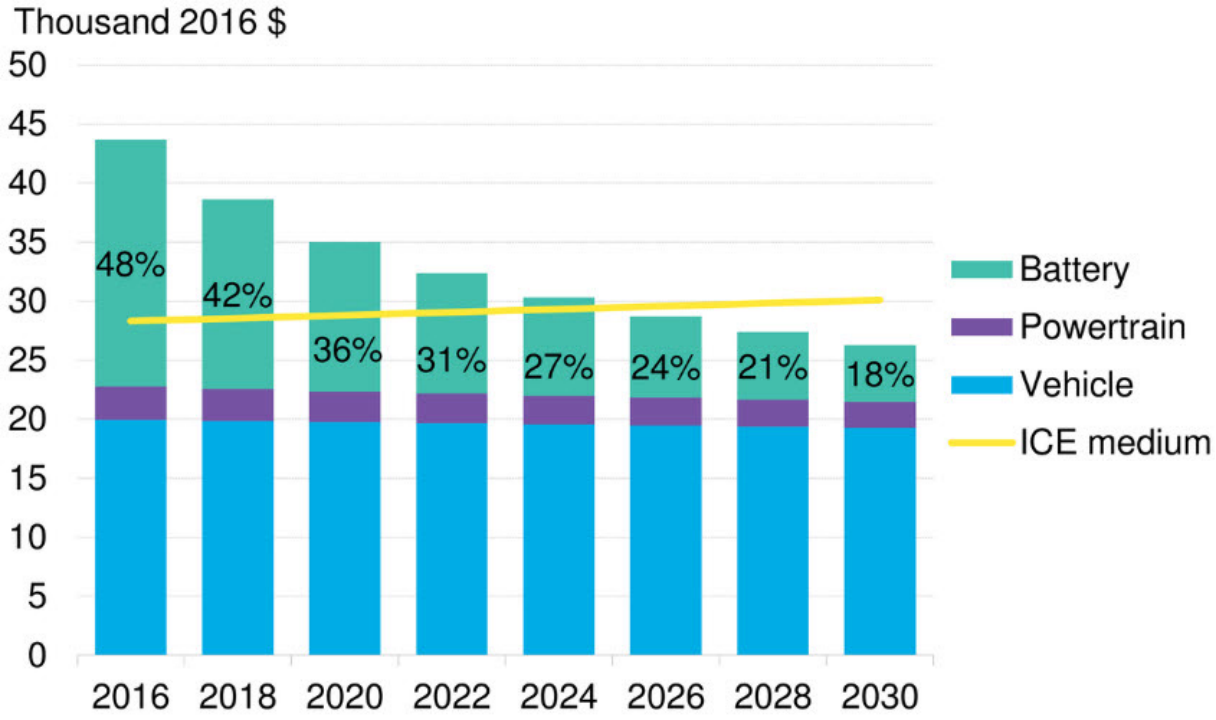


Source:

BloombergNEF, iEVTech 2021,14 October, Bangkok

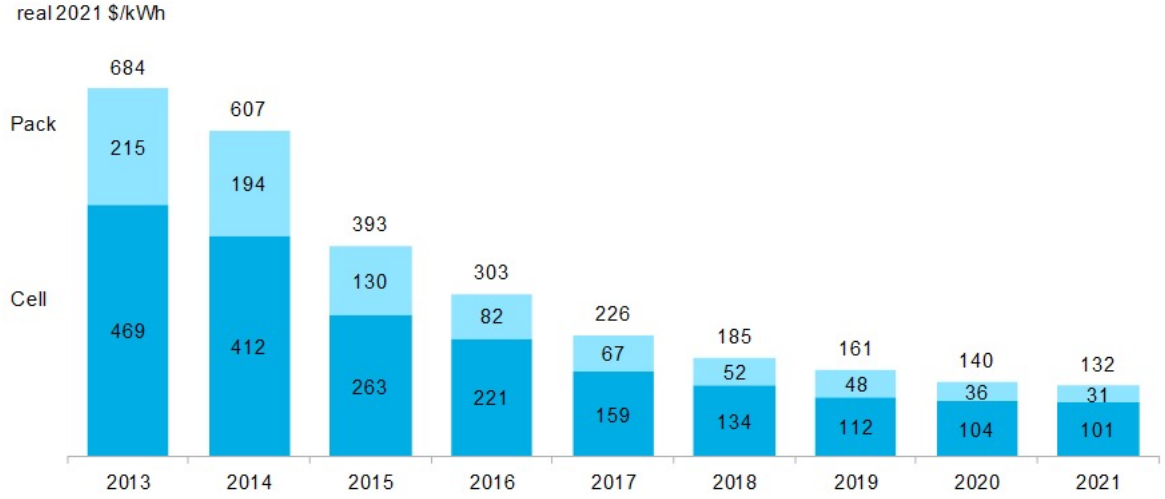
Electric Vehicle Technology

EV & Battery Price Outlook



https://about.bnef.com/blog/electric-cars-reach-price-parity-2025/

Figure 1: Volume-weighted average pack and cell price split

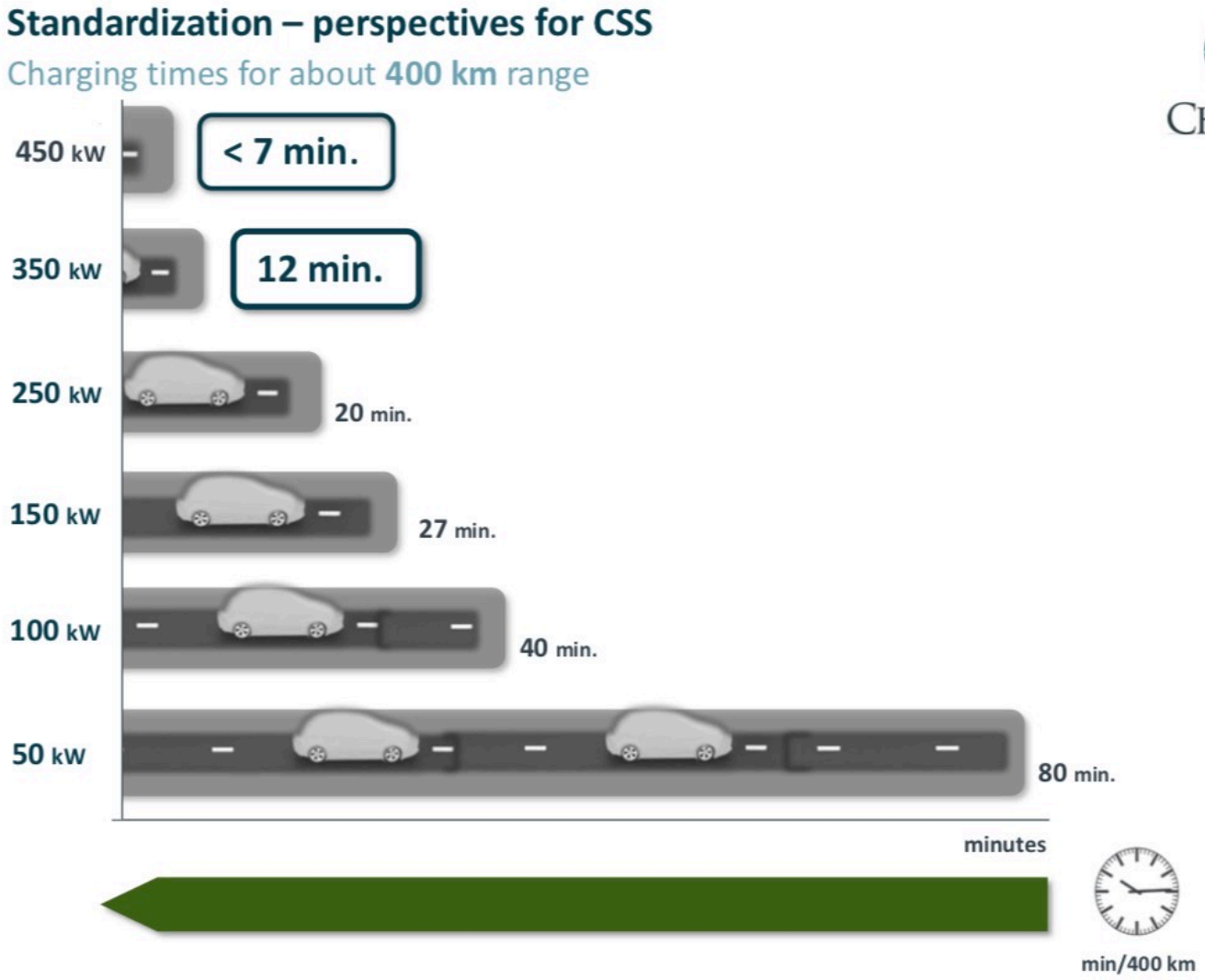


Source: BloombergNEF.

Source:

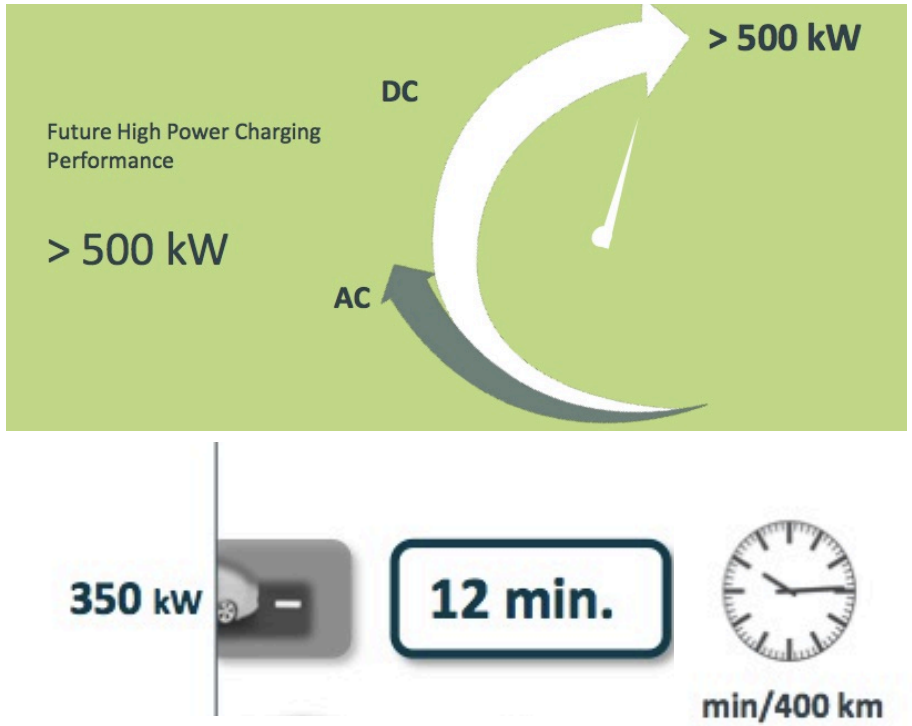
https://about.bnef.com/blog/battery-pack-prices-fall-to-an-average-of-132-kwh-but-rising-commodity-prices-start-to-bite/

Electric Vehicle Technology



CHARIN

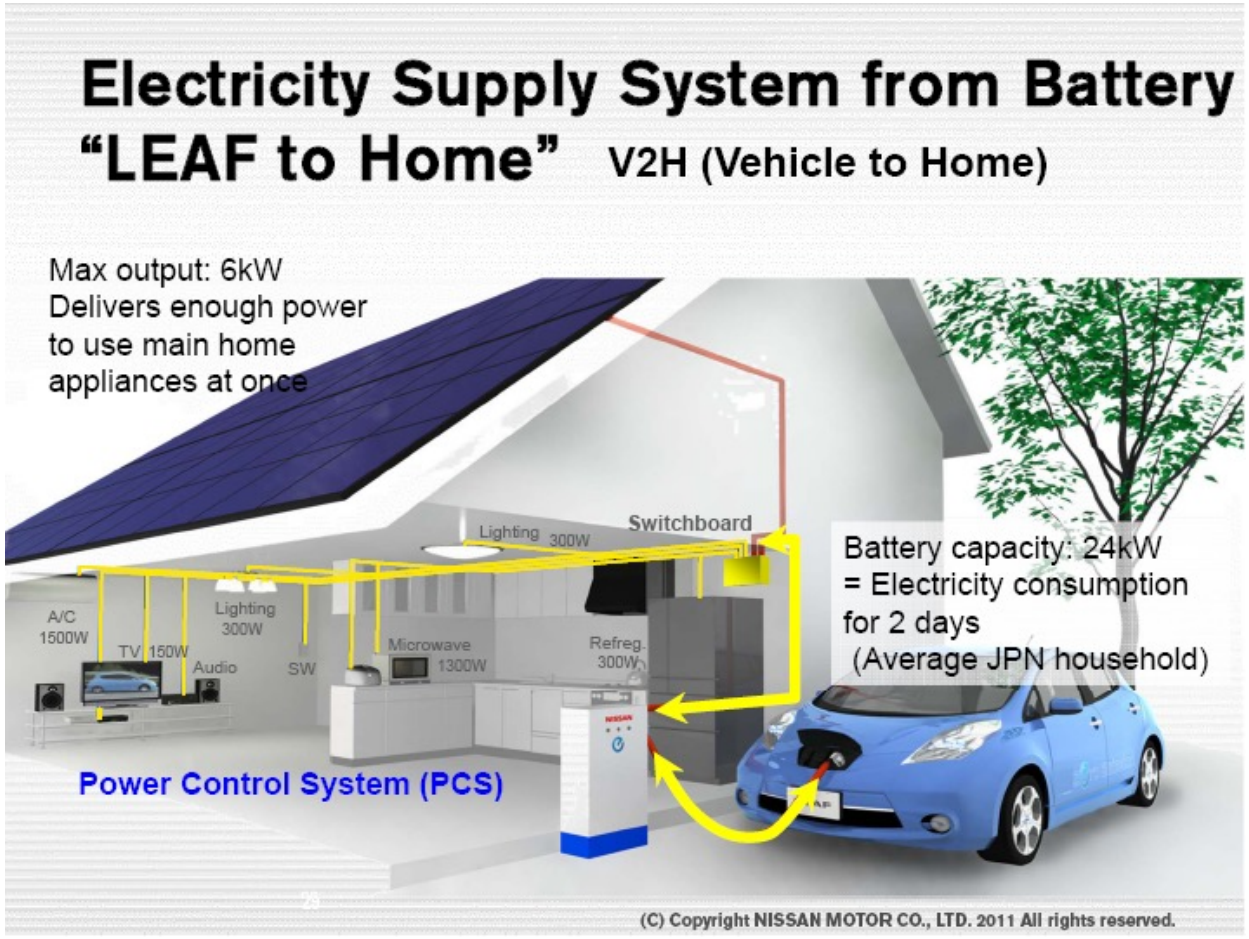
High Power Charging

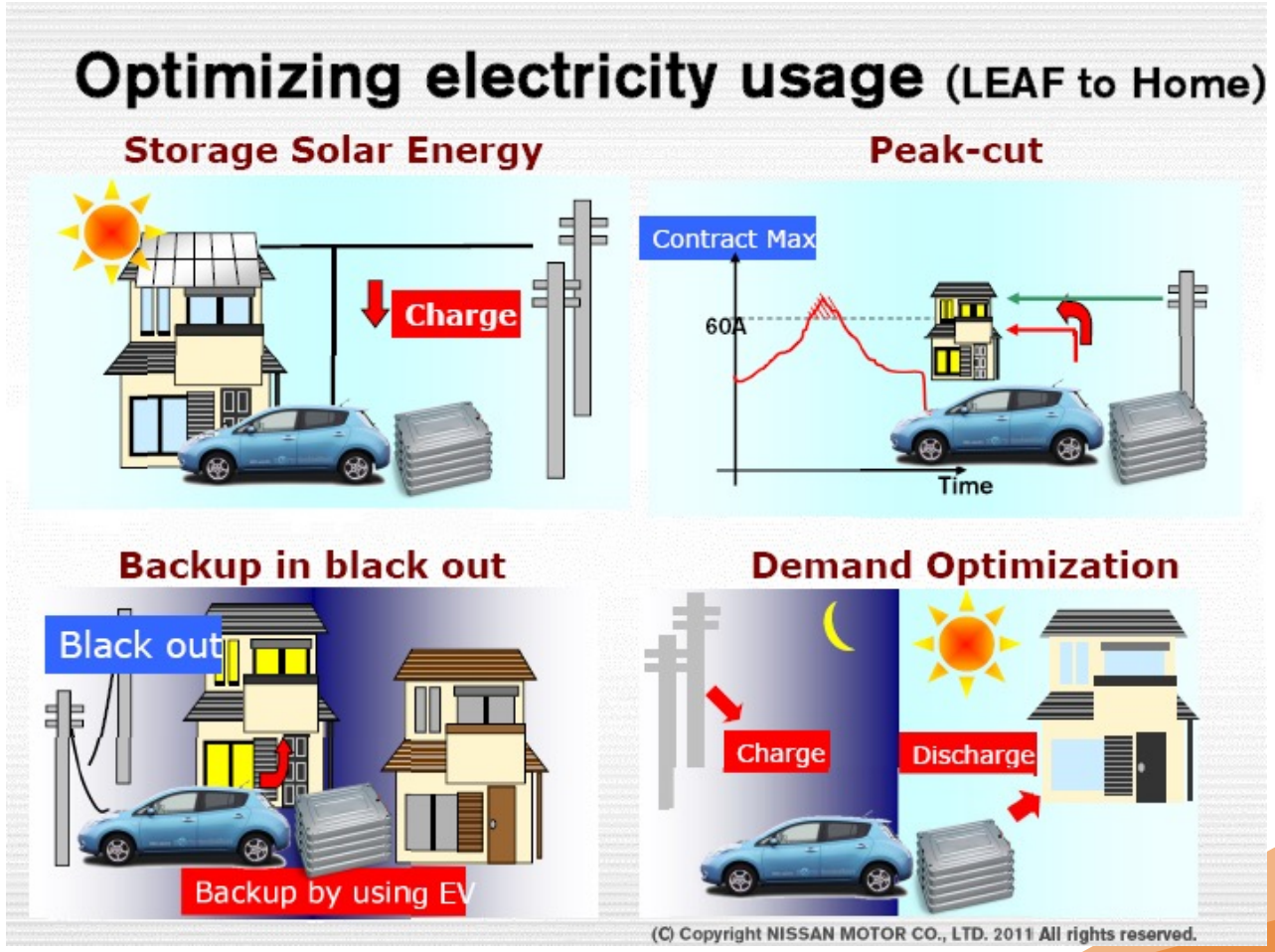


Source: iEVTech 2019, BITEC, Bangkok

Connected EV Vehicle

Vehicle to Home (V2H) & Vehicle to Grid (V2G)

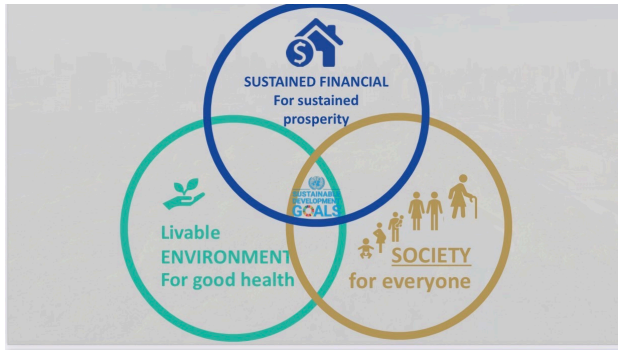




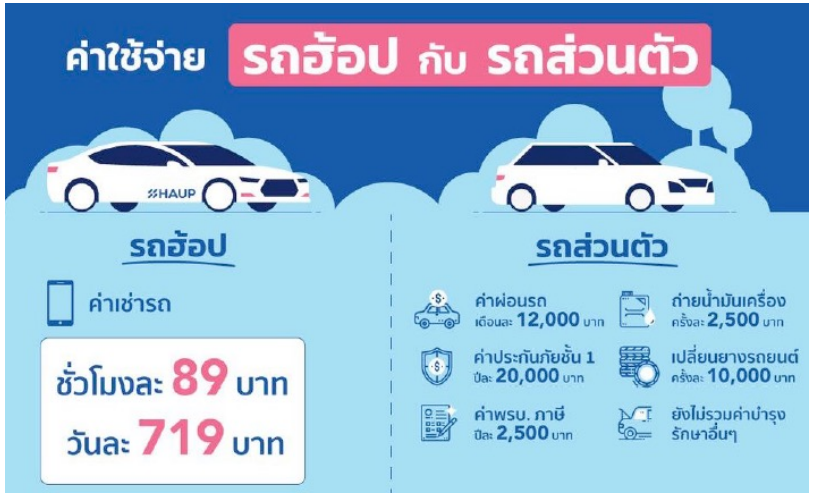
Source: Nissan Motor Co.Ltd

HAUP The first EV sharing in Thailand

Haupcar is the first service provider of “carshare” mobility platform including “electric vehicle” in Thailand to enable individuals to travel seamlessly without the hassle that comes with car-ownership.



Economic	- Reduce debt: No need to buy cars - Efficiency: High utilization rate
Environment	- Reduce waste: 1 car for 7 people - Clean energy: No Co2 emission from EV cars
Equity	- Affordable price: Start at 99 THB/hr - Available anywhere: Station nationwide



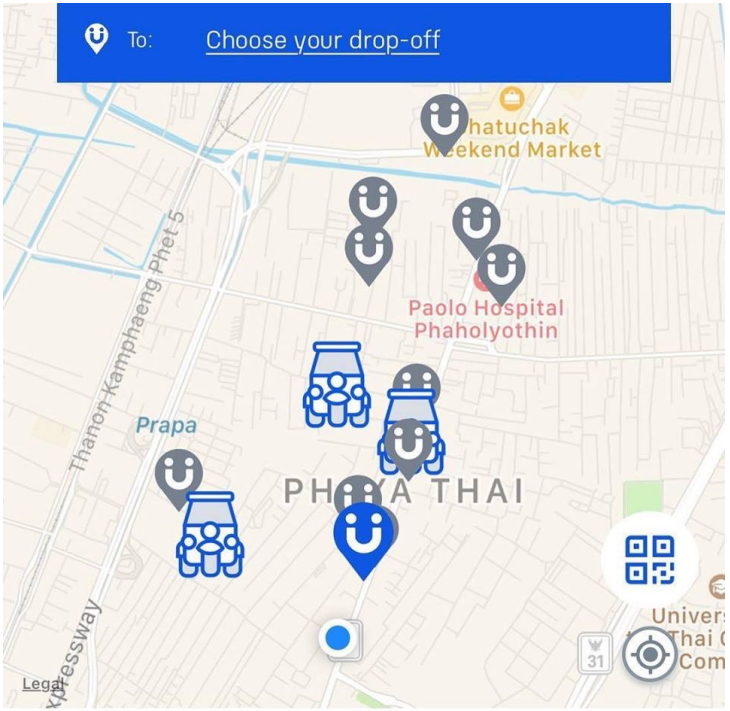
Access to variety of cars 24/7

Reduce parking congestion

Slow down car-ownership

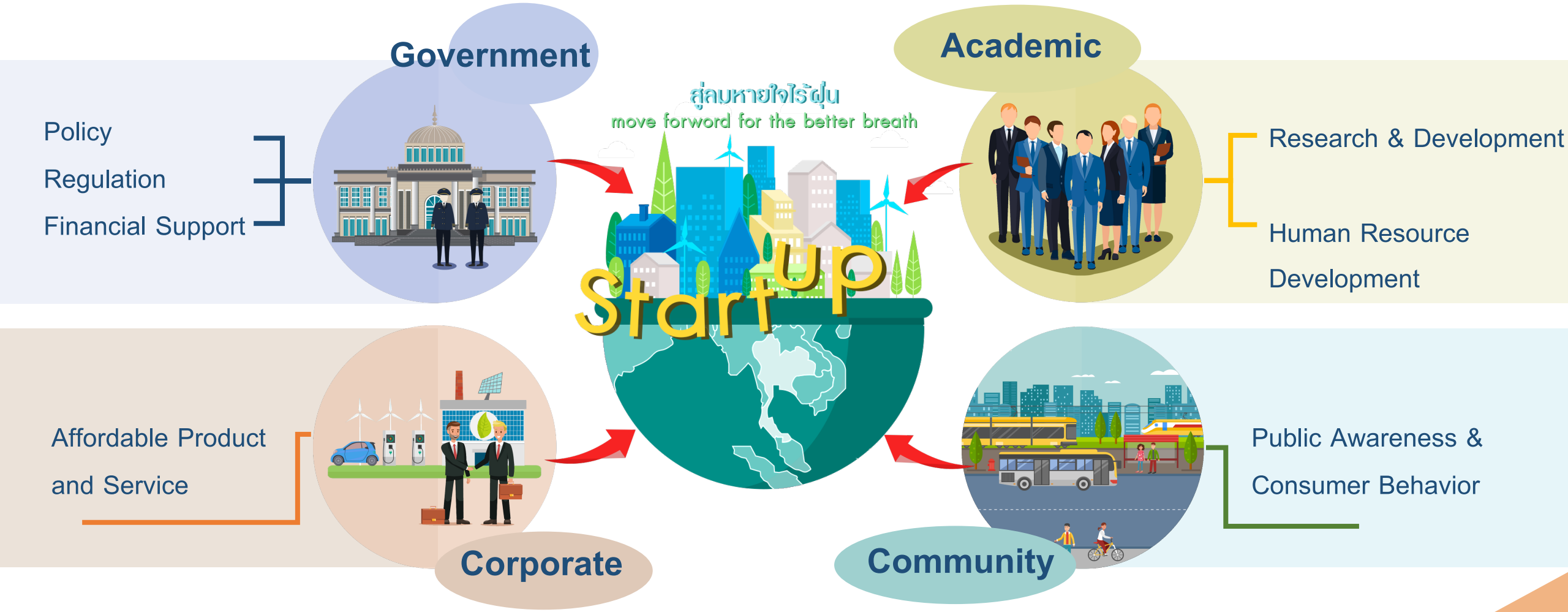
e-Tuk Tuk on Demand

MÜVMI is the first ride hailing of “electric tuk tuk” in Bangkok and Thailand. The first service area is located at Chulalongkon University which now expand to several area in Bangkok.



Source: http://www.facebook.com/muvmi

Collaborative Solutions



Thank you

Yossapong Laoonual, Ph.D.

E-mail: yossapong.lao@kmutt.ac.th

19