



Outlook⁷

The Challenging Road Ahead for Thai xEV

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Asia Powertrain Forecast

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Electrified Vehicle Types in Thailand

Bigger Battery



- BEV

Nissan Leaf BEV



- PHEV

Mercedes-Benz C350e PHEV



- HEV

Toyota C-HR FHEV



Engine

- ICE

Isuzu D-max



- Pure electric motors
- ICE + electric motors
- ICE (Internal Combustion Engine)

Outline

- **Factors Supporting xEV Growth**
- **Challenges to xEV Growth**
- **Conclusions**



Factors Supporting xEV Growth

Global Warming



Is hail a sign of Global **Warming** ?

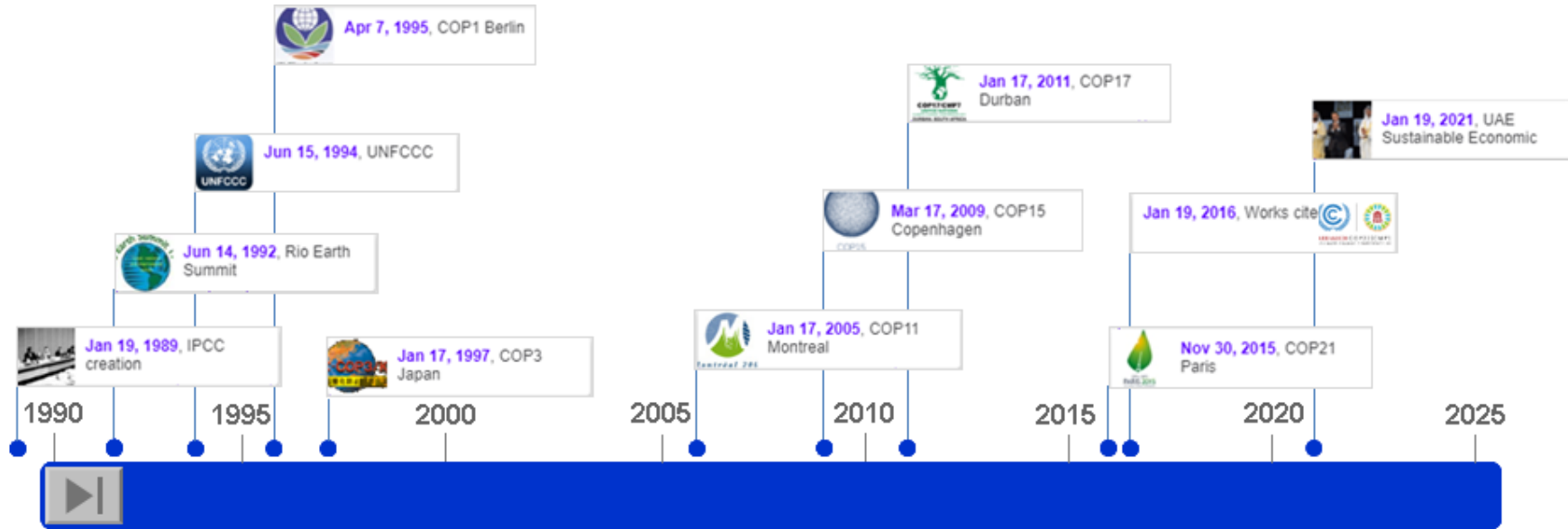


PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21•CMP11



Conference of Parties (COP) Timeline

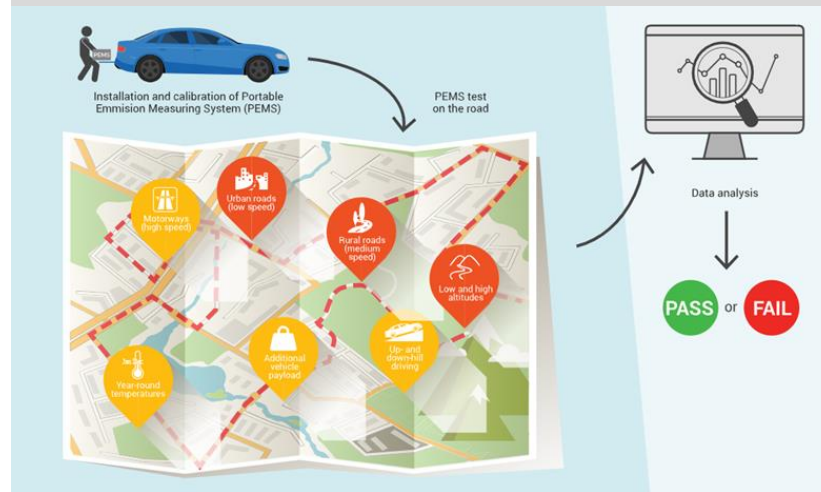
Government officials from around the world assess progress in dealing with climate change and establish legally binding obligations to reduce their greenhouse gas emissions



EU Commission: New mandatory car emissions tests

- New cars in the EU will have to pass stricter emissions tests
- RDE tests for all Euro5 / Euro6 vehicles, resulting in higher costs

THE REAL DRIVING EMISSIONS (RDE) TEST ?



Key point	Detail
Measurements	All ICE
Lean-NOx	Diesel have to be fitted with SCR
RDE Step 2	Jan 2020 onwards, applied to all vehicles exported to EU
Higher Euro Standards	RDE test will be deployed with the Euro 6 standard

OEM Investment in xEV

- Push from OEMs required to make xEV become a reality

European OEMs



100K units/2025

DAIMLER

100K units/2020



1mn units/2025

American OEMs



1mn units/2020



13 new model/2020



30k units/2017

Japanese OEMs



10 model/2020



1mn units/2022

8 model/2022

Others



上汽集团
SAIC MOTOR



北京汽车
BAIC MOTOR

4.52mn units/2020



HONDA

US market



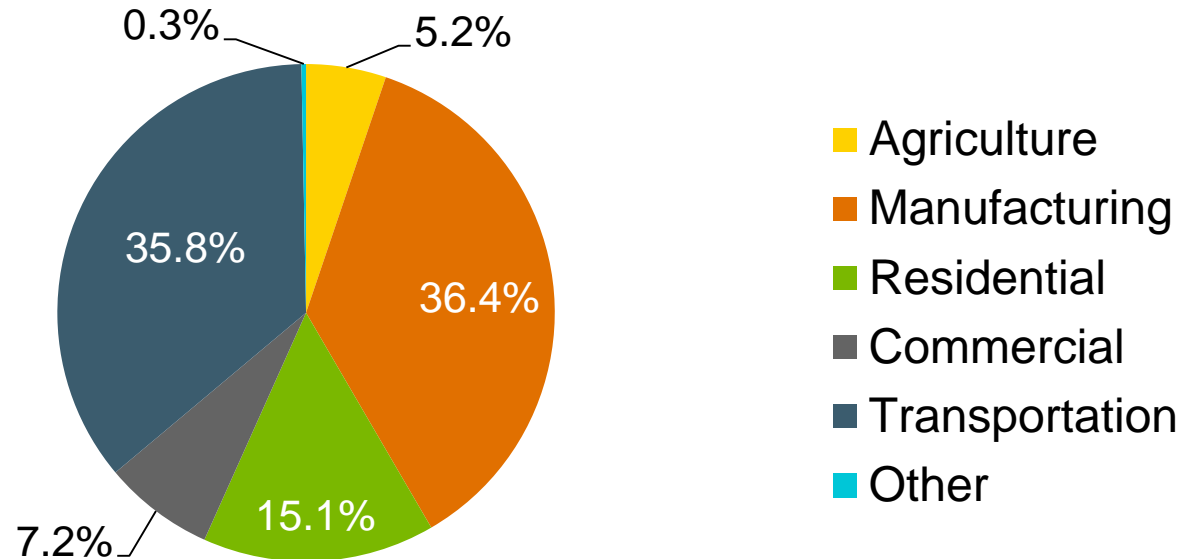
Mahindra

India market

Thailand's Pollutant Emissions - 2012

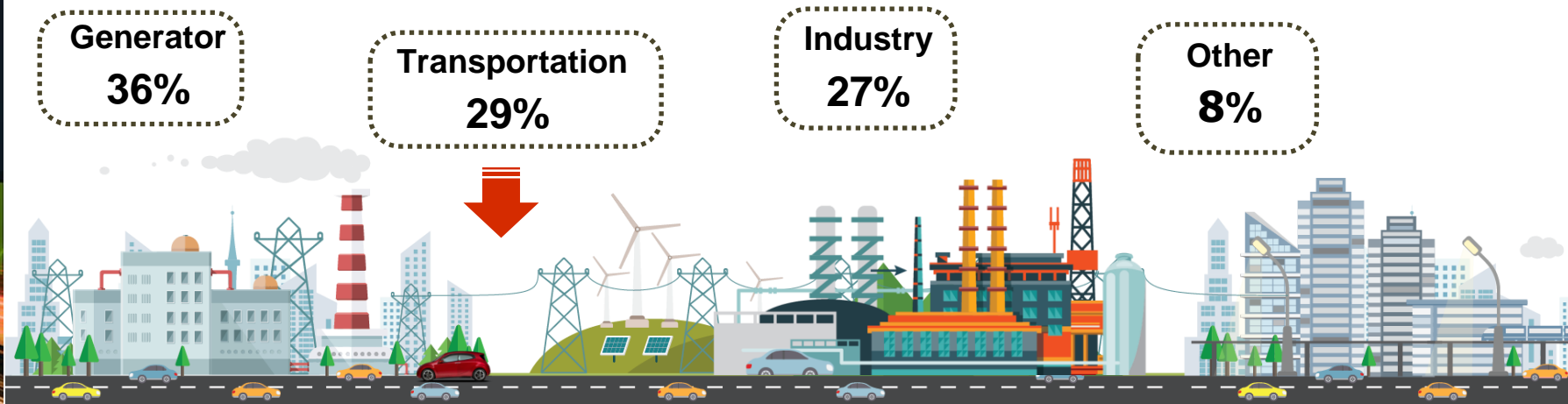
- Transportation was a major contributor to CO2 emissions
- Almost all NOx and black smoke was created by diesel engine

2012 CO2 Emissions



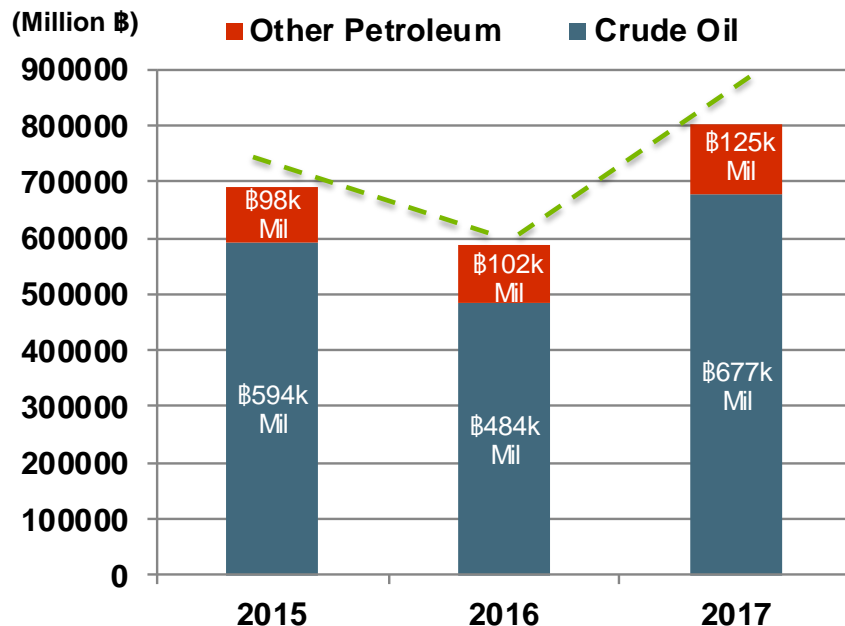
Thailand's Pollutant Emissions - 2018

- Data of CO2 emissions released by industry categories during Jan-Mar'18
- 2012 vs. 2018 found CO2 reduced by 6.8%

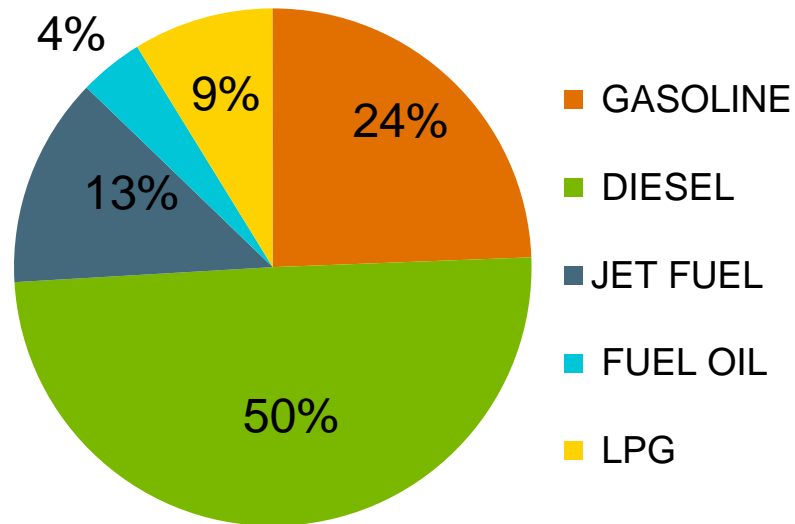


The impact of a high fuel consumption

- Thailand imports about 80% of total domestic oil demand (1 mn barrels/day)
- More than 60% use in transportation sector

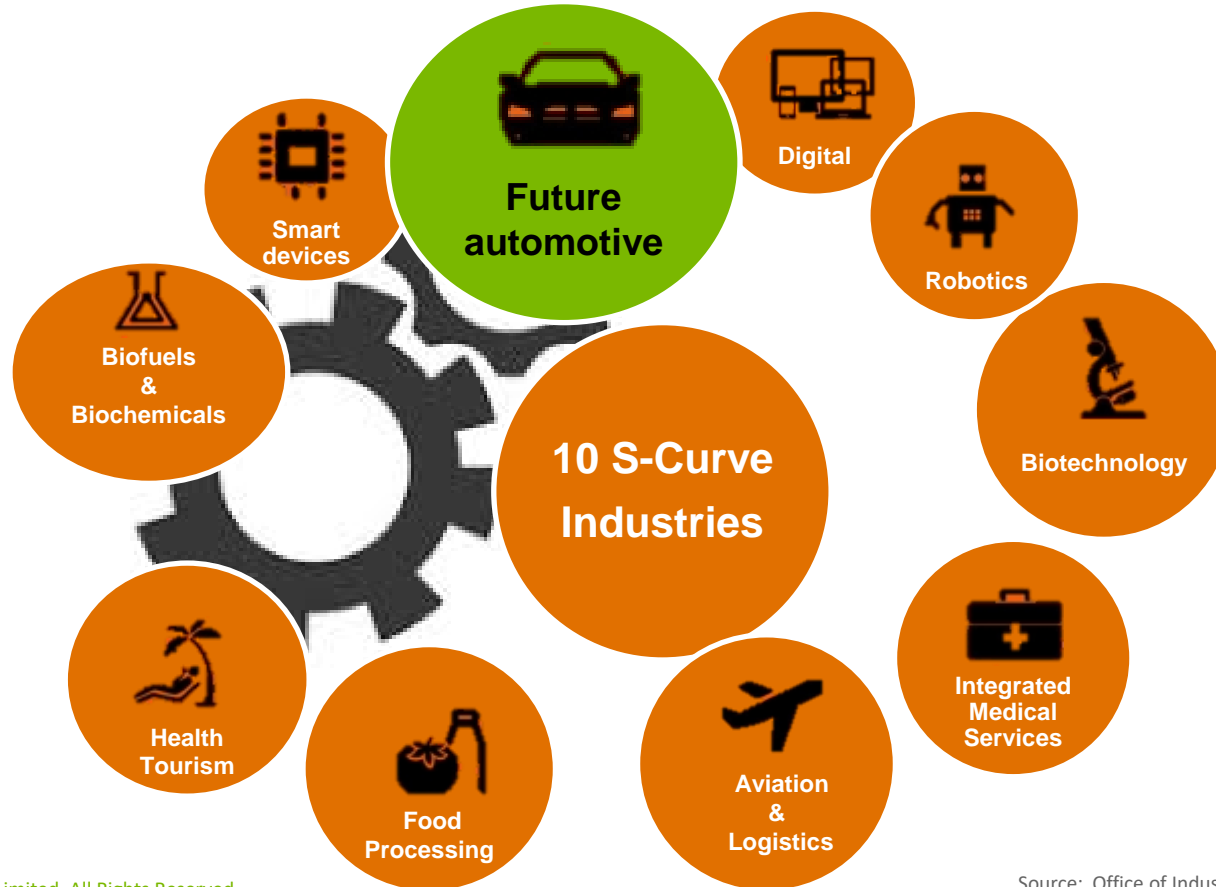


2017 Fuel Consumption by Type

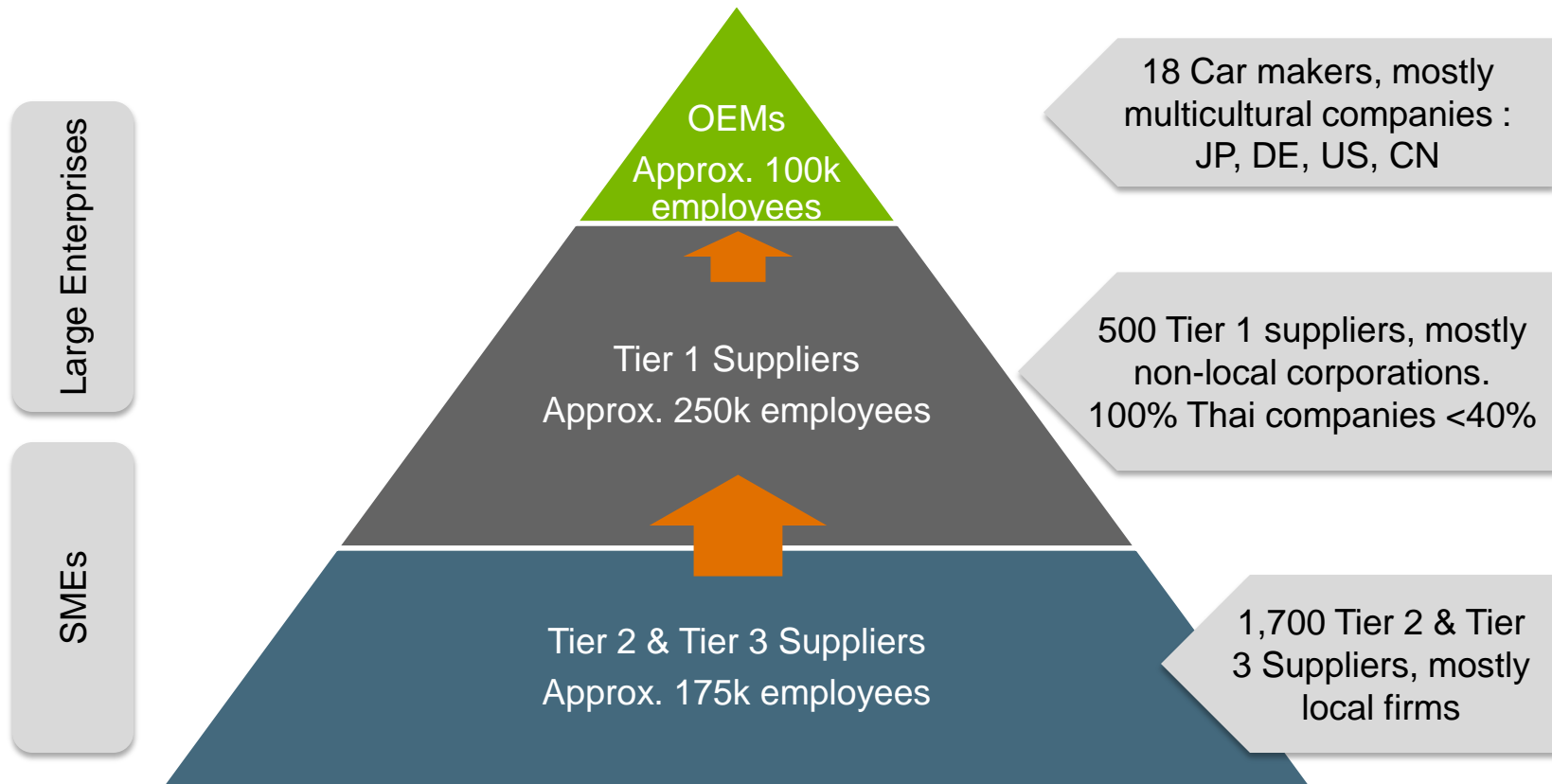


- Diesel is the most dominant fuel type in Thailand

The government's s-curve program



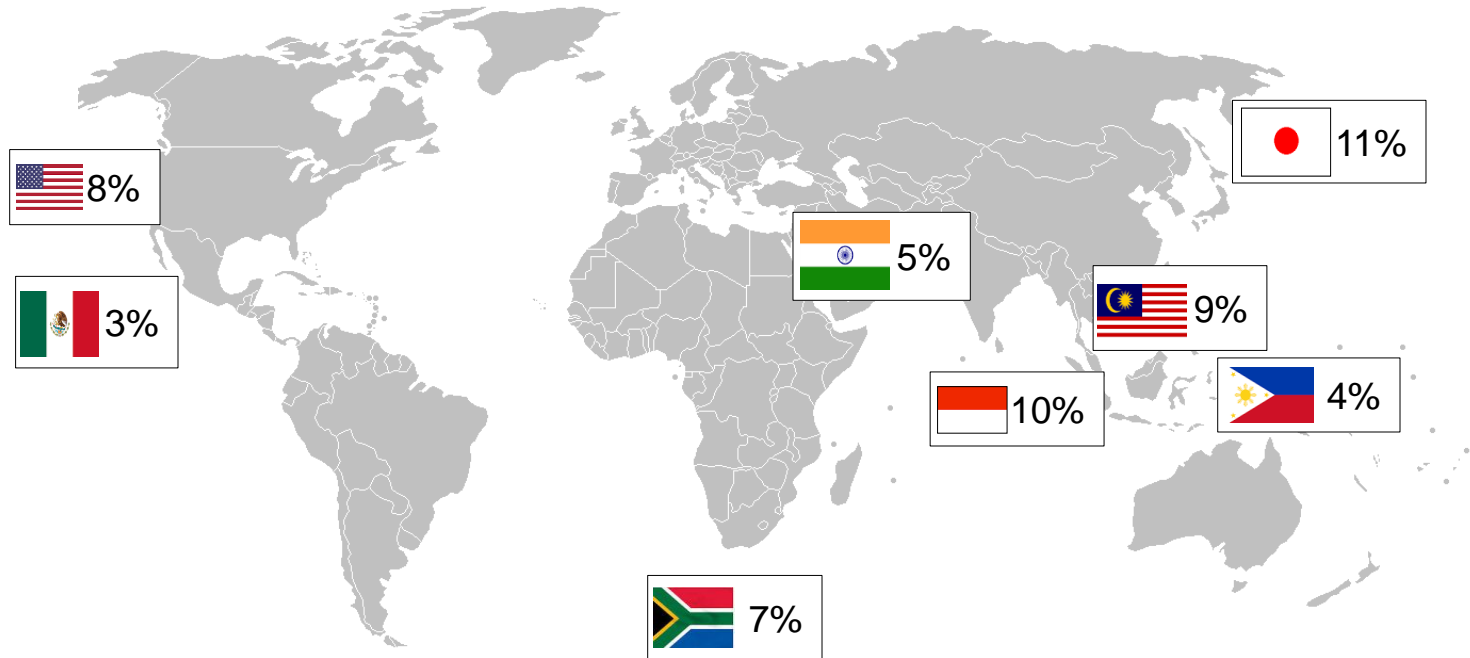
Robust Competitive Advantages



Source: KBANK's Economy & Industry Analysis , and FTI

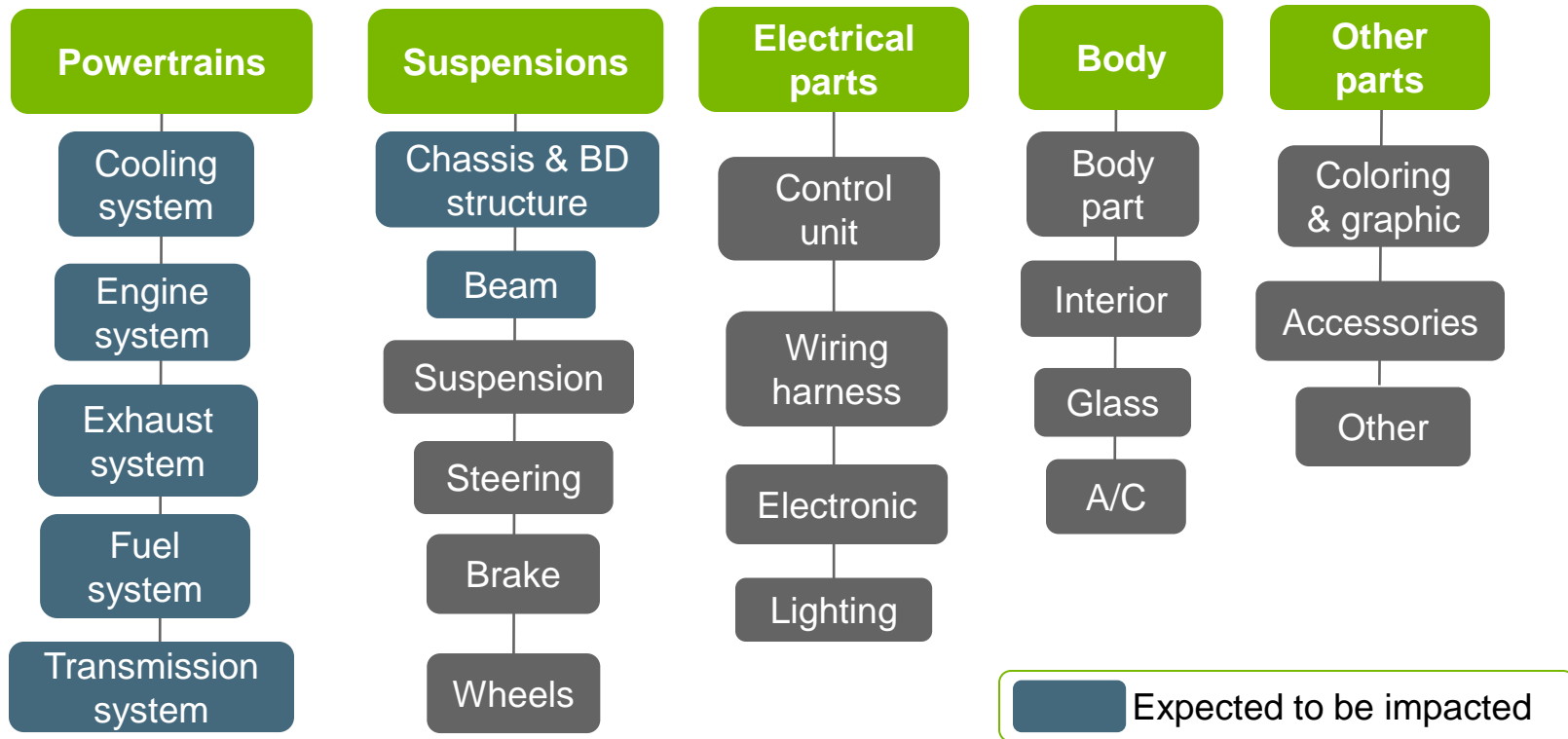
Challenges to current exports of Thai auto parts

- 2016: 40% of auto parts exported are powertrain components
→ Japan is the main destination and leading investor in Thailand's auto industry



Future demand in core components

Composition of component demand will change in line with the demand for new technology powertrains.



Supporting Policy

The government has released a new policy supporting xEV manufacturing

Type	Closing date	Import tariff	Excise tax	Specific parts	CIT
HEV	Already closed (2017)	Exempt machine tax	Cut 50% of excise tax (battery)	1) Battery	N/A
PHEV	Submit within Dec 2018			2) Traction *	Exemption start from 3-6 years
BEV			Excise tax reduce to 2% (battery)	3) BMS * 4) DCU * (Exemption for CIT)	Exemption start from 5-10 years (year 9th – 10th : technology transfer)

Investment Promotion for xEV Components

List of key components receiving incentives

1). Battery



2). BMS



3). DCU



4). Traction motor



5). Smart charging system



6). Portable xEV Charger



7). Fr./Rr. Axle for xEV Bus



8). On-board Charger



9). DC/DC Converter



10). xEV Connector w/Plug & Socket



11). Electrical Circuit Breaker



12). Inverter

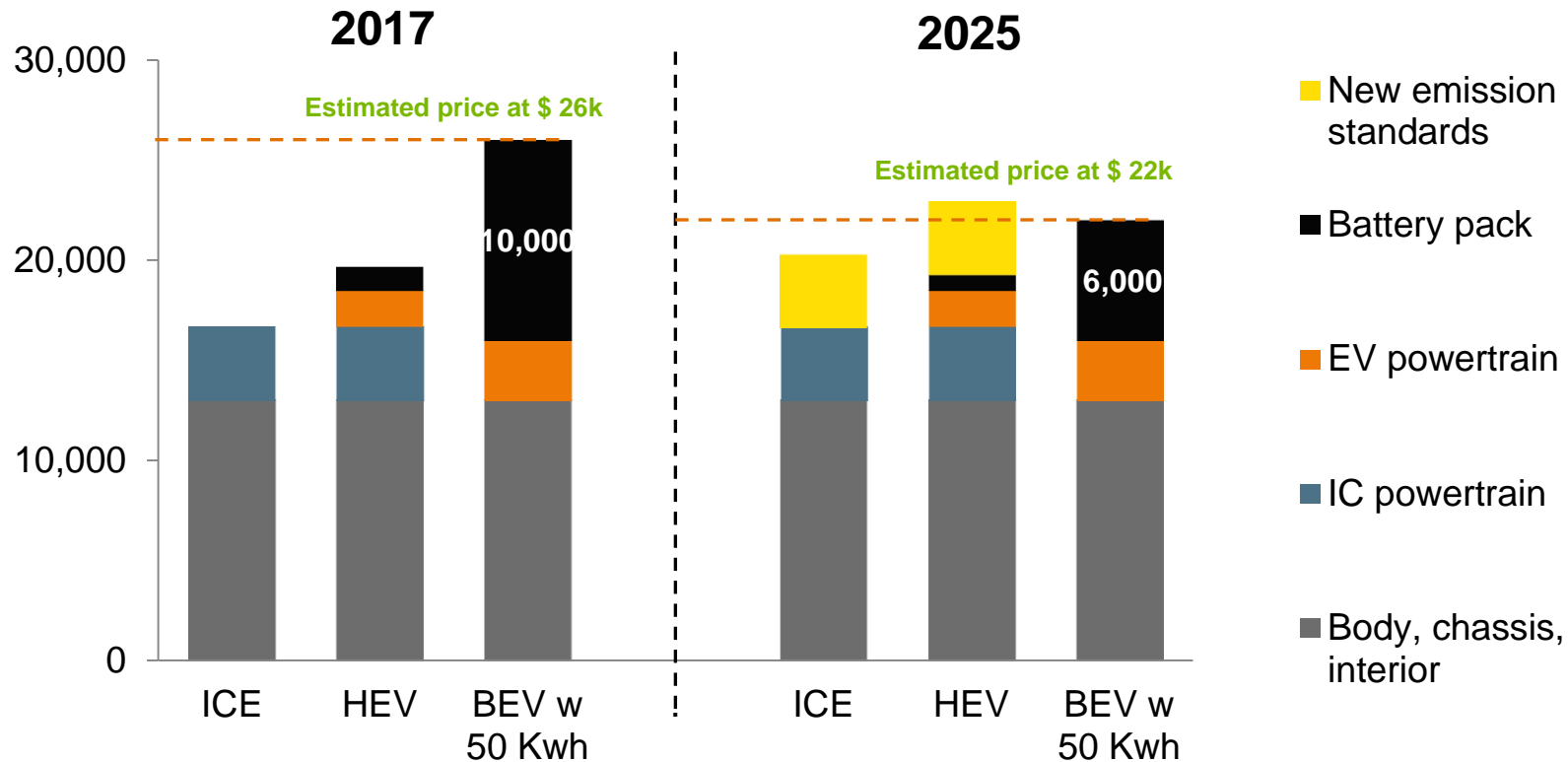


13). A/C system/parts



Electrified vehicle costs: It's all about the battery

- Battery costs estimated at 200 USD per Kwh now and 120 USD in 2025

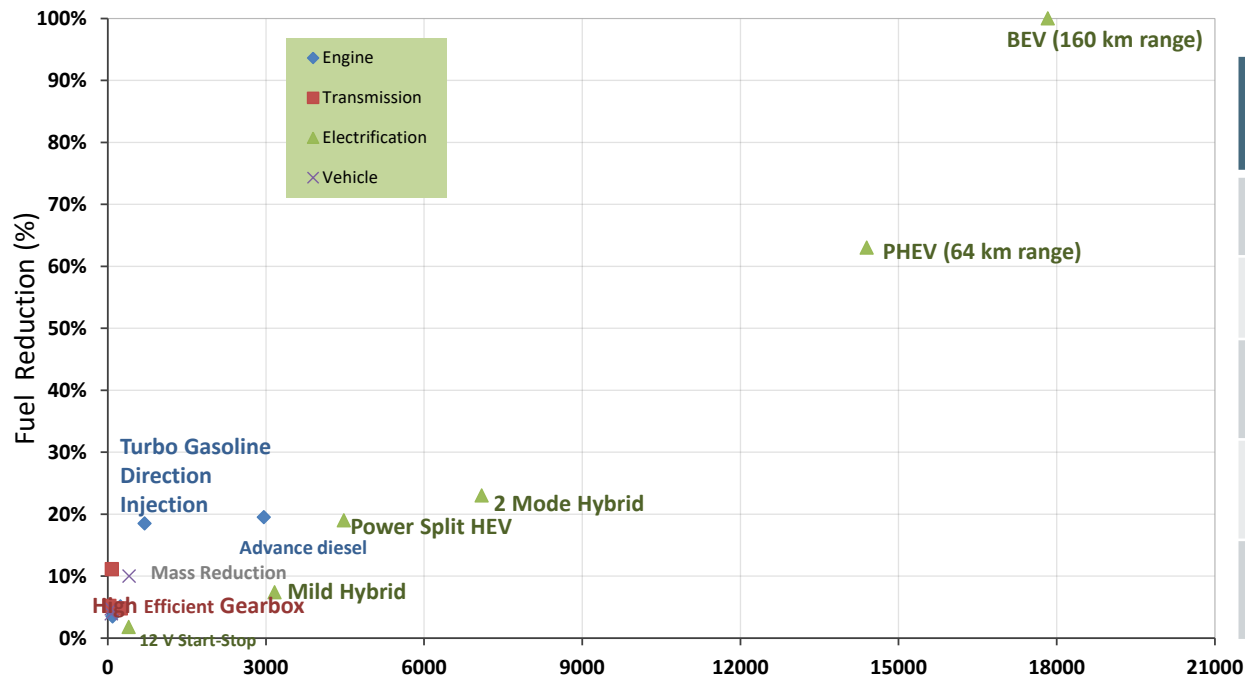




Challenges to xEV growth

Technology Costs (USD)

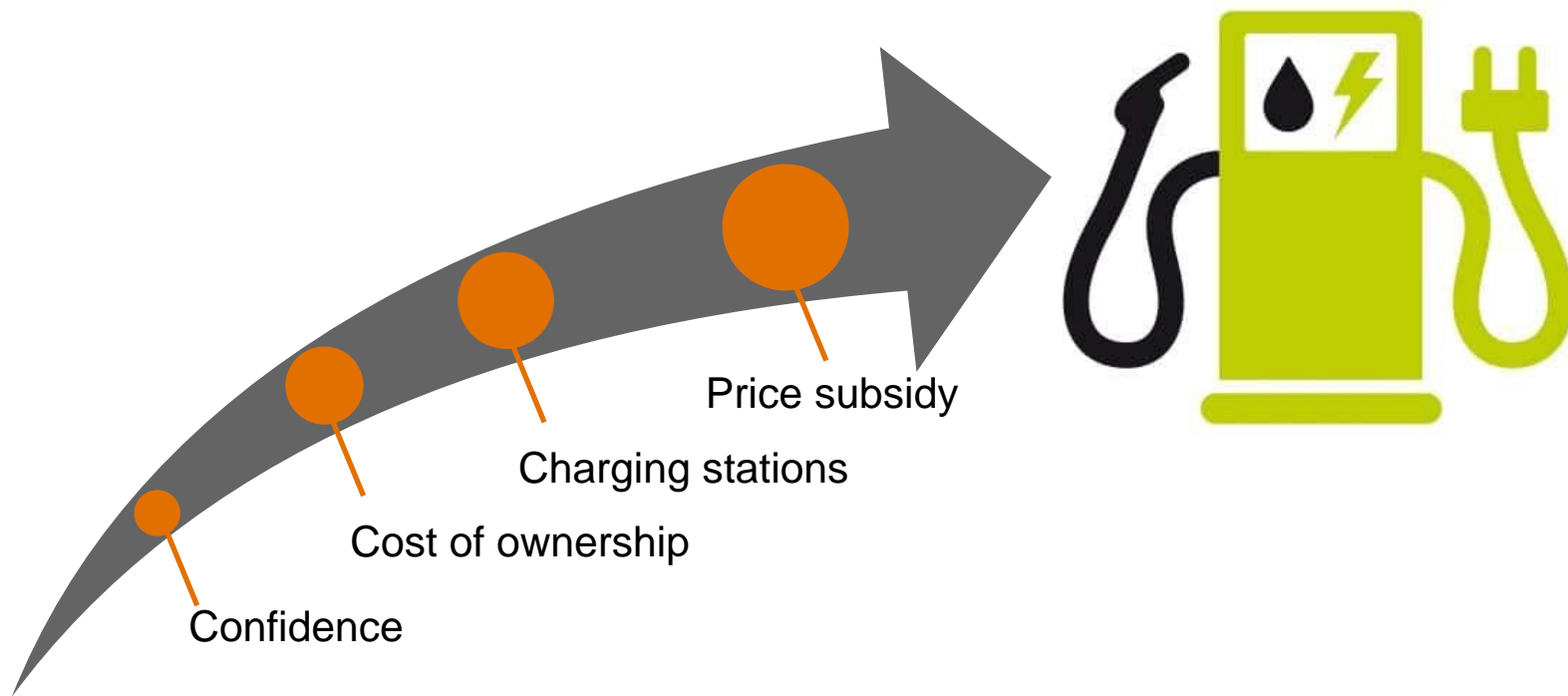
- Average total cost of development and manufacturing



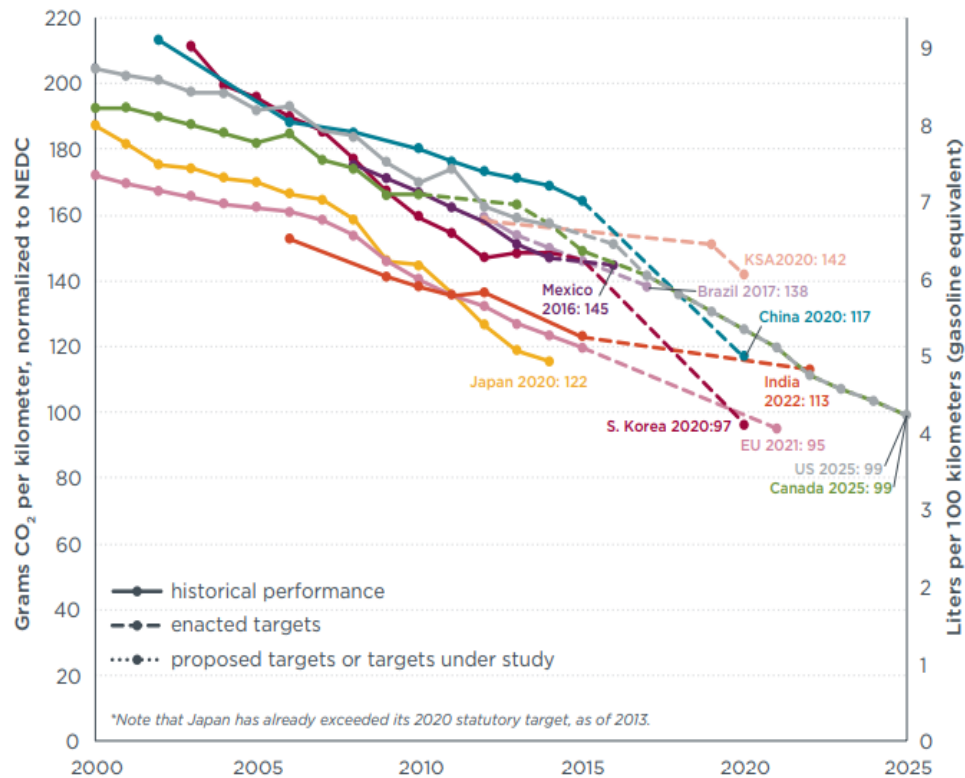
Type	Price (USD)	Batt (Kwh)
KONA (BEV)	46k	64
IONIQ (BEV)	39k	28
IONIQ (PHEV)	31k	8.9
IONIQ (FHEV)	22k	1.6
AVANTE (ICE)	17k	N/A

Anxieties Impacting xEV Purchase

- The below factors influence a customer's intention to buy an xEV
- To achieve more xEV growth, we need to reduce this anxiety



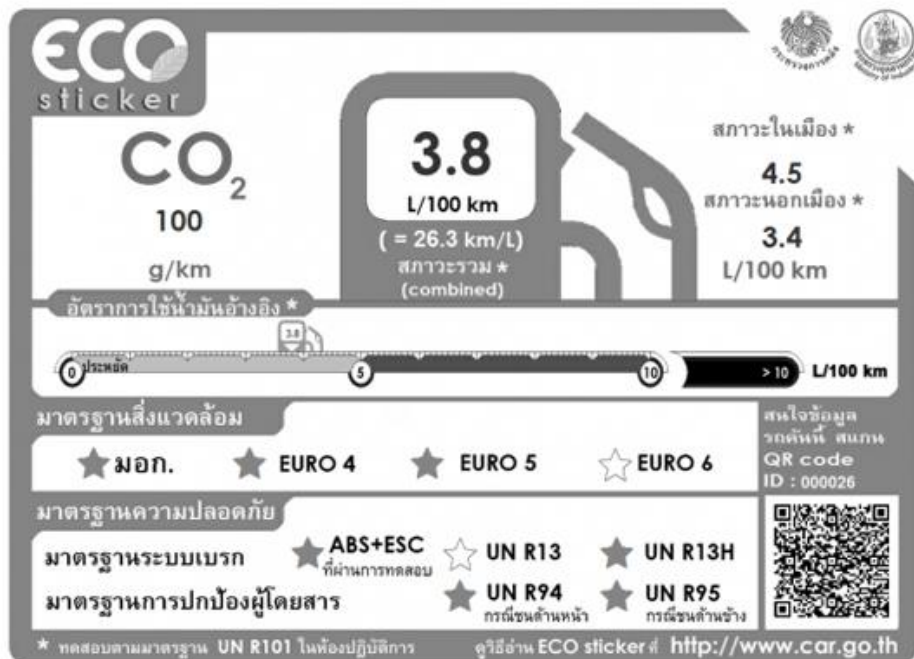
Global CO₂ targets do not mandate xEV



- EU 2021: 95
- Korea 2020: 97
- China 2020: 117
- India 2022: 113
- Japan 2020: 122
- xEV not required until CO₂ target drops to 70g/km

Stricter emission standards. But not enough ...

- xEV not required until CO₂ target drops to 70g/km
- Even some of the most fuel-efficient engines, Mazda SkyActiv D, still emits 100g/km



ASEAN: Serious lag in emissions standards



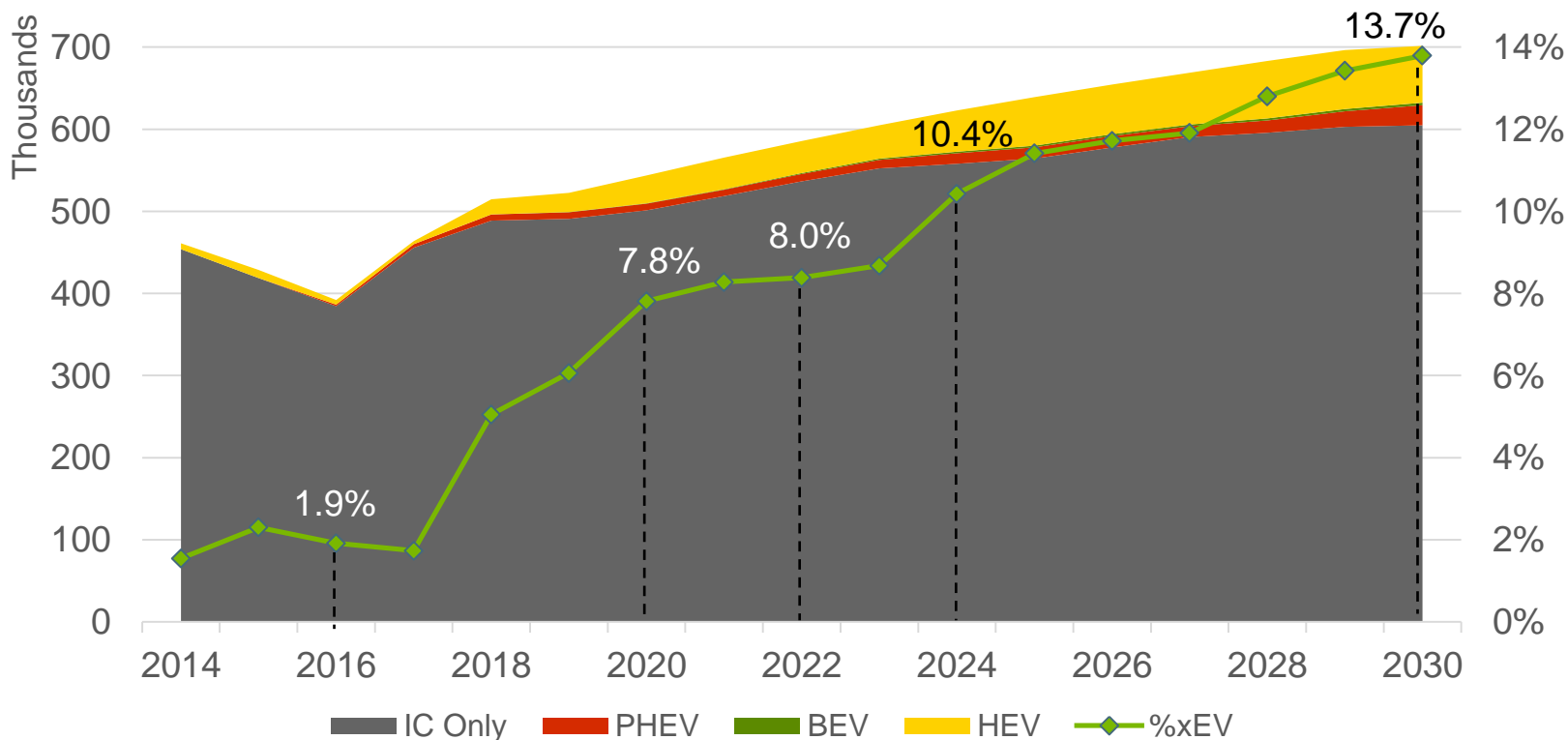
ASEAN	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Thailand	Euro3	Euro 4											Euro 5 (TBD)		
Indonesia	Euro 2							Euro 4 Gasoline Q4#2018 & Diesel Q1#2019							
Malaysia	Euro 2								Euro 4 (TBD)						
Philippines	Euro 2						Euro 4								
Vietnam	Euro 2					Euro 4						Euro 5 (TBD)			

SWOT Analysis for Building xEV Ecosystems



Thailand xEV PV Sales Outlook

- 8% of PV before 2022, pushed by Thailand's xEV program





Conclusions

Opportunities for Thai Auto Sector



xEV new business model

- Make the difference: software, data network, tracking system etc
 - New services providers: Battery swapping or battery leasing
-



xEV key components

- R&D in core technology: battery, traction motor, BMS, DCU etc
 - Strong supply base: OEMs and suppliers develop local supply of xEV parts
-



xEV infrastructure

- xEV charging stations
 - xEV Grid and power supply: Increase capacity – new jobs available
 - Manufacturing Standards: Specific equipment, testing, calibrations
-

Concluding Remarks: The Challenges Facing Thai xEVs



Factor	HYBRID (HEV,PHEV)	BEV
Price	<ul style="list-style-type: none">Relatively high, but more competitive with policy support	<ul style="list-style-type: none">Very uncompetitive, require high subsidy
Buyer	<ul style="list-style-type: none">Depreciation and TCO concerns	<ul style="list-style-type: none">Low resale value & TCOLow technology acceptance
Infrastructure & equipment	<ul style="list-style-type: none">Lower investment in core components like battery	<ul style="list-style-type: none">Require investment in charging stations and grid systemReadiness of 13 BEV parts
Government Policy	<ul style="list-style-type: none">Lack emissions regulations	<ul style="list-style-type: none">Considerable lack of emissions regulations & penalties for ICE on road and tax benefits



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Thank you