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Thailand's Next-generation Vehicle Innovation Strategies: Alternative Directions and Policy Recommendations

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1. Partial success: quantitative achievements with low value addition

- Thailand is a **leading automotive manufacturer** regionally and globally, ranks the first among ASEAN countries and the **12th in the world** in 2014.
- Automotive industry contributes to **12% of GDP manufacturing in 2014** and the number of workers are around **9-10% of total employment.**
- For added value per vehicle, Thailand only **ranks 17th in the world with 6,354 USD/unit** and is far below than the average of 8,776 USD/unit of the global top 30 automakers.
- Local suppliers are mainly involved in **low value parts** such as body parts, accessories and others.
- This was inherited **from the supply chain localization policies** of Thailand in the past.

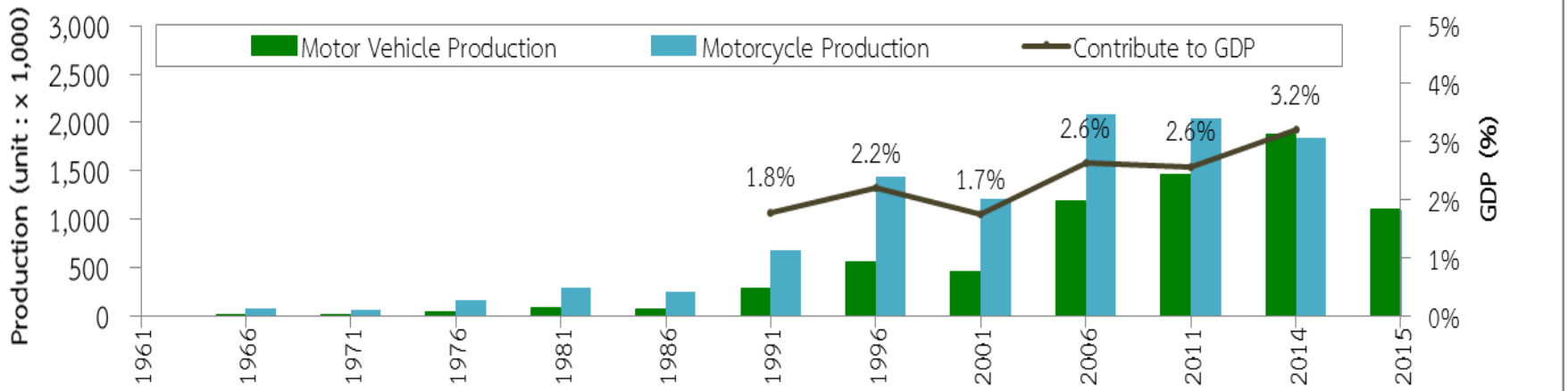
Comparison of Major Asian Automotive Industry Strategies

- Taiwan and South Korea have actively competed in the global export market while Thailand and Malaysia have focused on domestic market.
- At the same time, South Korea and Malaysia have promoted their own brand cars and Taiwan and Thailand have nurtured parts and components sectors.
- Thailand strategies can be summarized as supply chain localization by which Thai government has boosted local auto suppliers to the global assemblers in Thailand.

	Parts and components	**Own brand car**
Export Market	Taiwan	South Korea
Domestic Market	Thailand	Malaysia

2. Lack of adaptation capabilities in the uncertain and complex next-generation vehicle industry and market

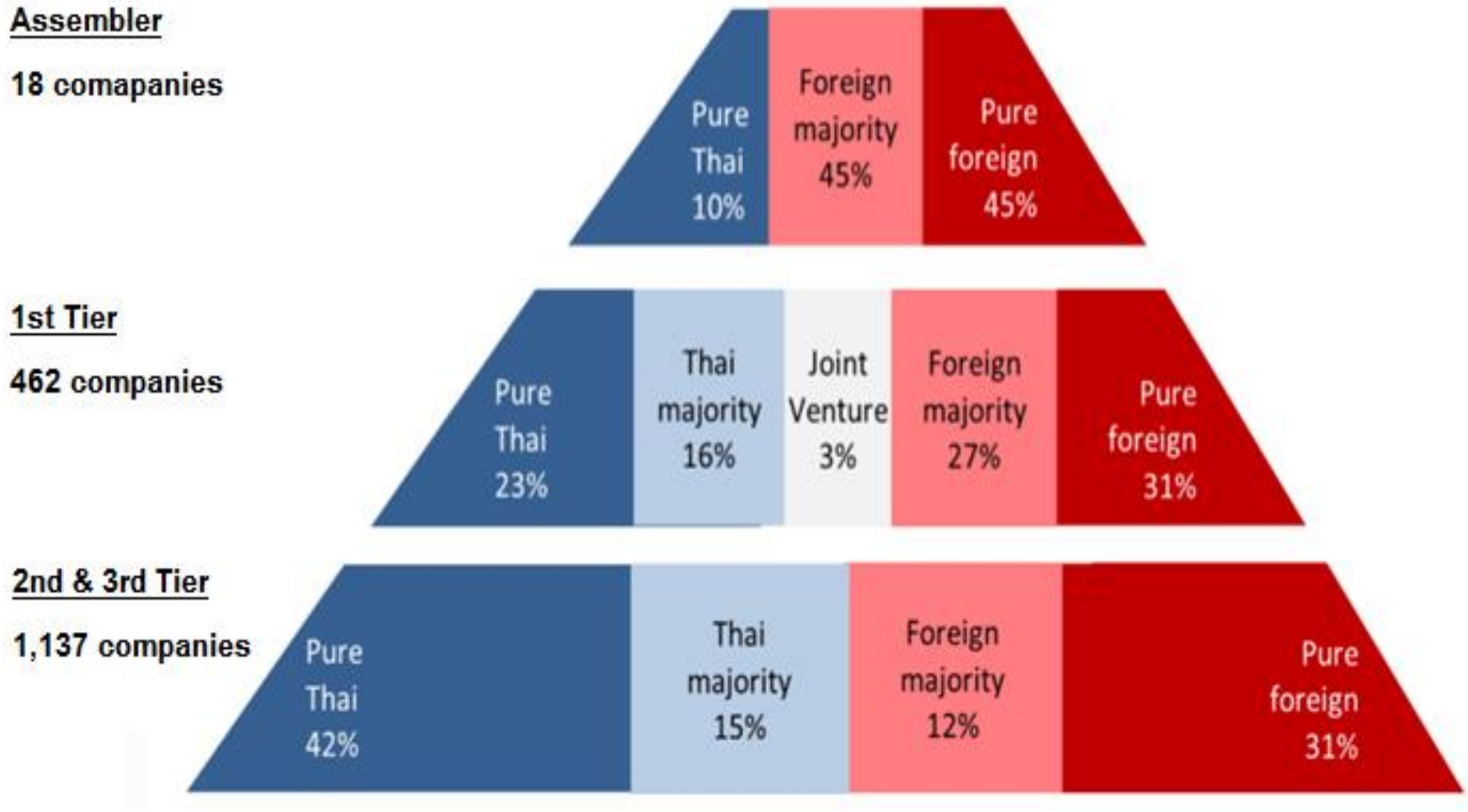
Past policy issues of Thai automotive industry



Source: AIC and NESDB; Analyzed by TAI

- ❑ Period 1 (1961-1970): Import substitution
- ❑ Period 2 (1971-1980): Introduction of localization
- ❑ Period 3 (1981 – 1990): Strengthening localization capacity
- ❑ Period 4 (1991 – 2000): Start of Liberalization
- ❑ Period 5 (2001-2010): Creating International Competitiveness and 'Product Champions'
- ❑ Period 6 (2011-present): Global green automotive production base with strong domestic supply chains

The structure of Thai automotive industry by tier and nationality



Source: TAI, A Study of Part Manufacturing Structure of Thai Automotive Industry as a Part of Automotive Information Project. Ministry of Industry, 2014.

Lack of adaptation capabilities

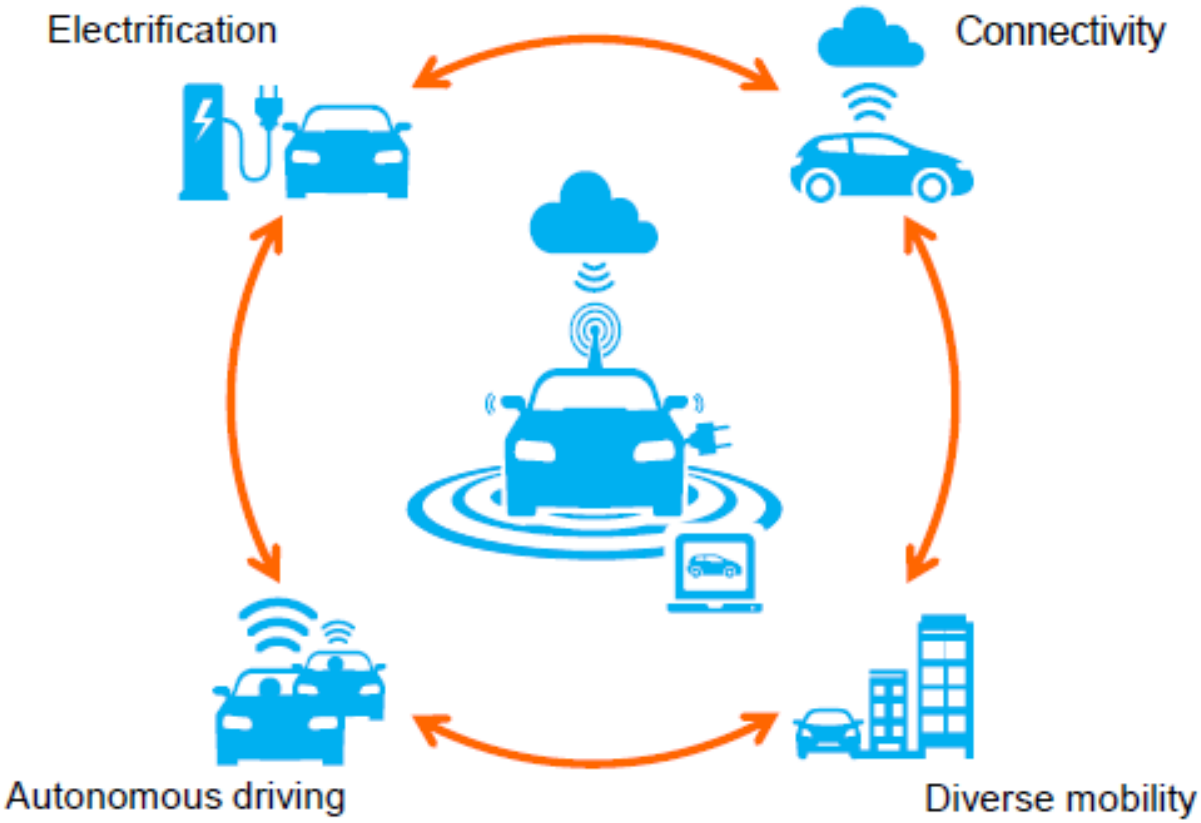
- In the beginning of supply chain localization, Thai suppliers produced auto parts and components with imported machinery and specification of foreign assemblers under the government LCR regulation.

- They could not build their own technological capabilities to design products.

- As new production systems such as module production were introduced Thai suppliers could not sustain their businesses with assemblers and then they were continuously degraded to second and third tier suppliers.

New transformation challenges in the context of market uncertainty and stakeholder complexity

- Crossroads to take the opportunities of the next generation vehicle industry or to fade out.



Source: Automotive Revolution-perspective towards 2030, McKinsey&Company, Stanford University, PEEC Sustainable Transportation Seminar April, 1, 2016

3. Critical review of current policies: EV only and same supply chain localization without specific coordination mechanism

Electric vehicle promotion focused

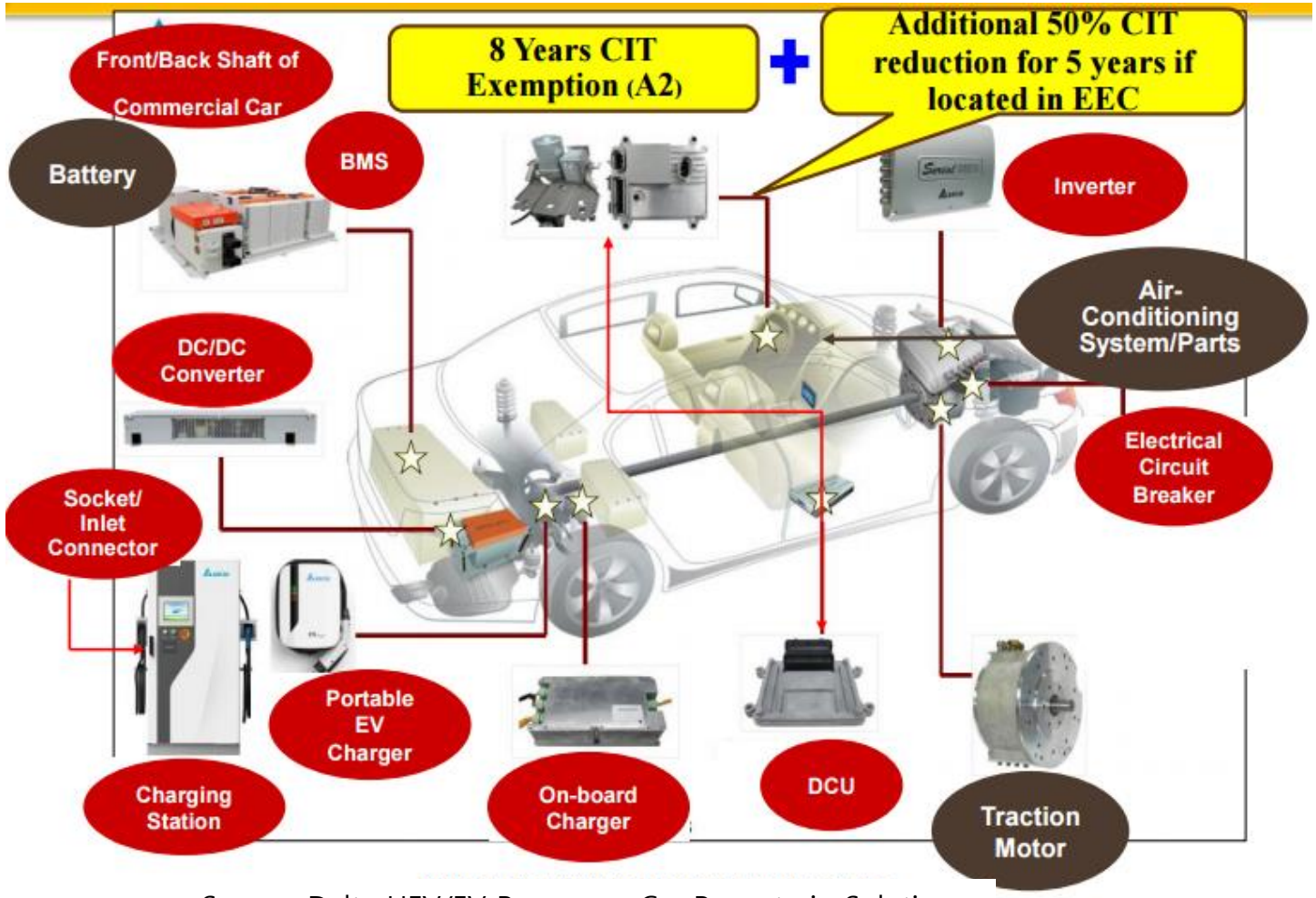
- Since late 1990s, Thailand Automotive Institute (TAI) established and a few national auto plans including two **Automotive Master Plans** endorsed.

- Thai government has been working to ramp up Thailand's competitiveness in the auto sector by promoting **local electric car production** in Thailand.

- The hybrid vehicle (HEV) model of the **Toyota Camry Hybrid** was sold for the first time in 2009 and the **Toyota Motor** Thailand was the first EV manufacturer in the country.

- The **National Reform Council (NRC**) has submitted a reform proposal to promote **electric vehicles** of Thailand in 2015.

Besides EV passenger cars, E-bus and charging station, **the 2017 Board of Investment of Thailand (BOI)** new promotion schemes focus on EV parts manufacturing for HEV, PHEV, and BEV.



Source: Delta HEV/EV Passenger Car Powertrain Solution

- The recent development is only focused on **EVs and same supply chain localization strategies** are pursued under the leadership of BOI, which is not sufficient for the sustainable development of the industry.

- Thai government needs to **build local capacity** and hence to **create critical mass** to further the next-generation vehicle industry promotion.

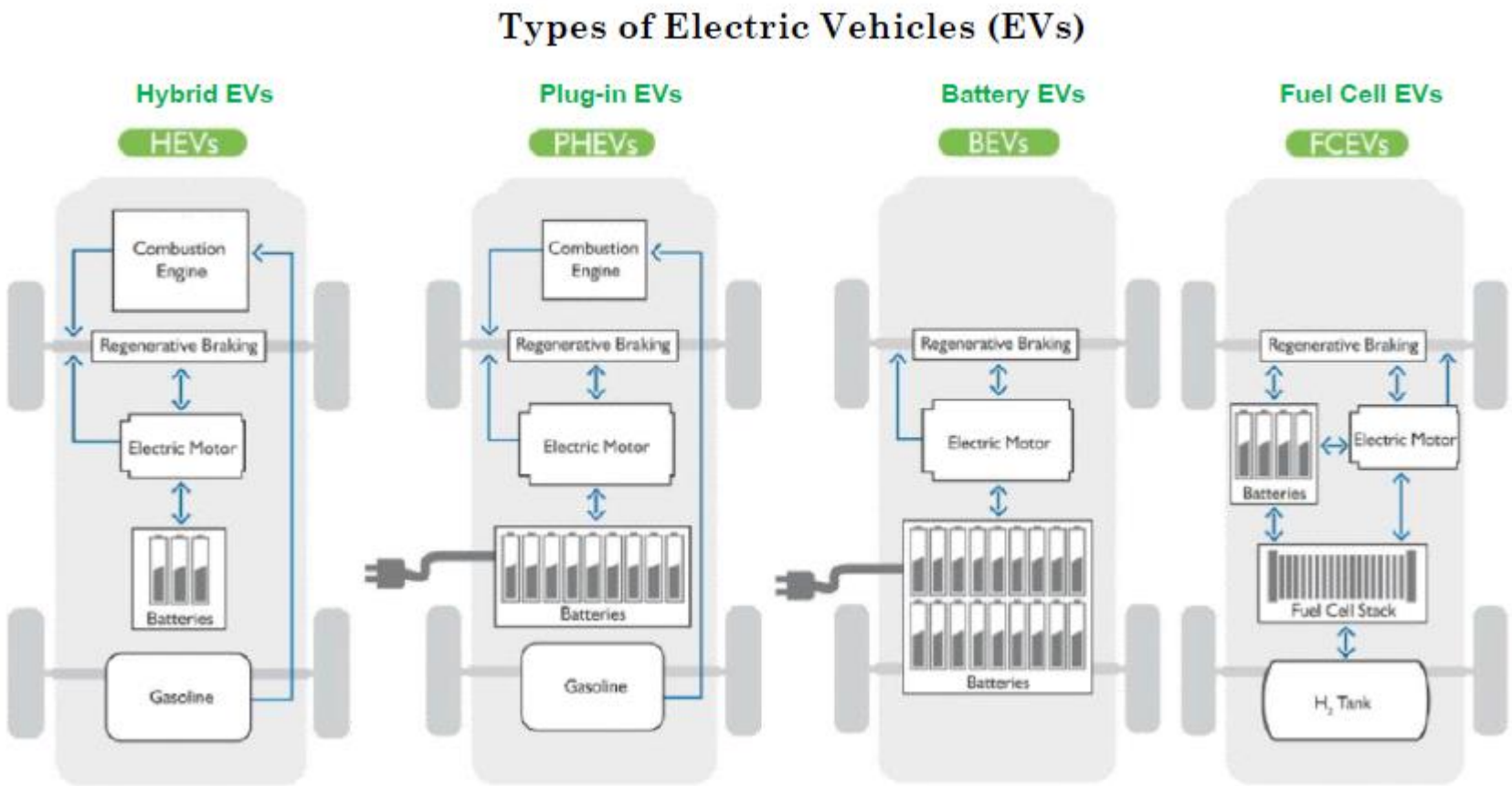
- It requires specific **policy coordination of infrastructure development and procurement among relevant ministries and agencies;** Energy Policy and Planning Office (EPPO) plans for EV charging stations and the 2015 national energy plans of the Ministry of Energy focu sed on reduction of energy consumption in the transportation sector

4. Technology and industry trends and Thai responses

Electric vehicle: regulatory pressure on market development

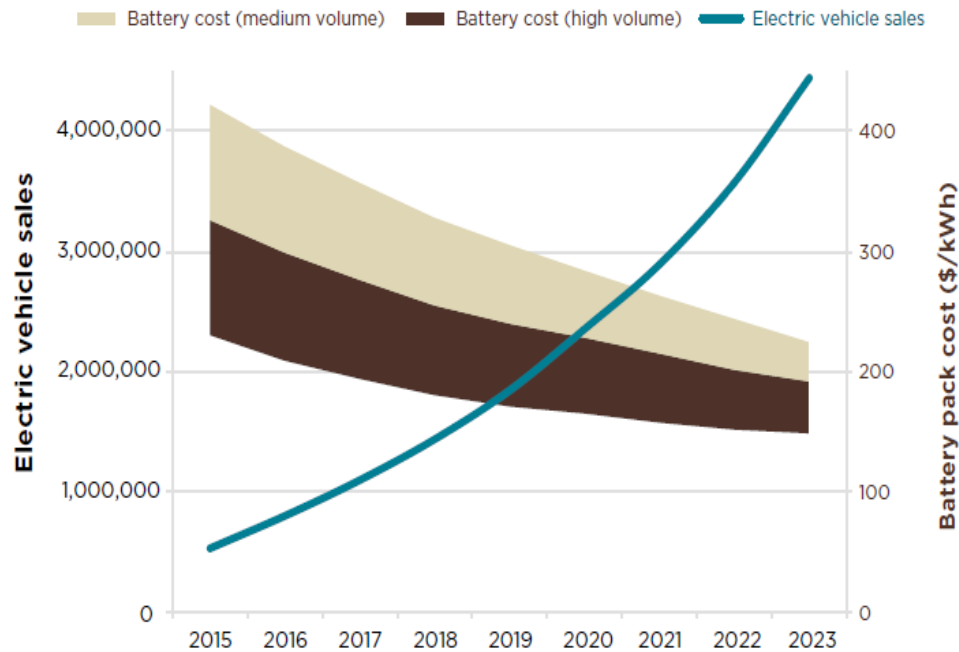
Technology Trend

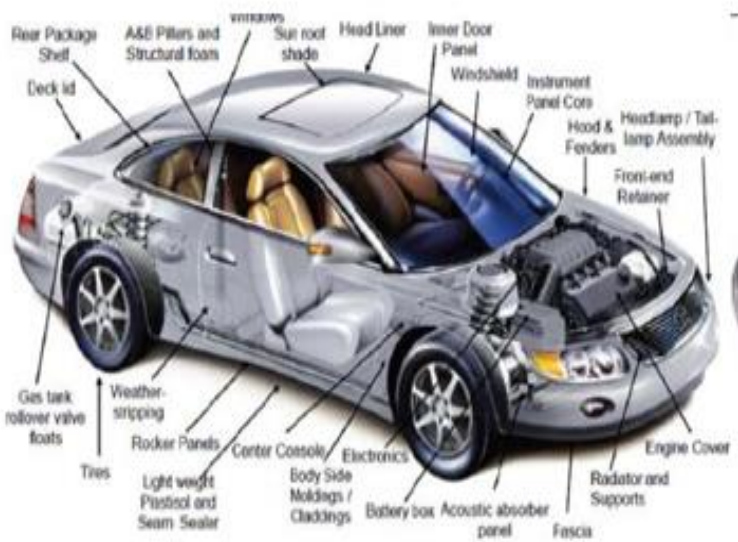
Environmental awareness is a keen interest which has been driven by climate changes, high fuel price, environmental compatibility and safety. Especially electric vehicles are recognized to achieve zero-emission vehicles. Electric powertrain, power electronics, and batteries are key technologies of EV.



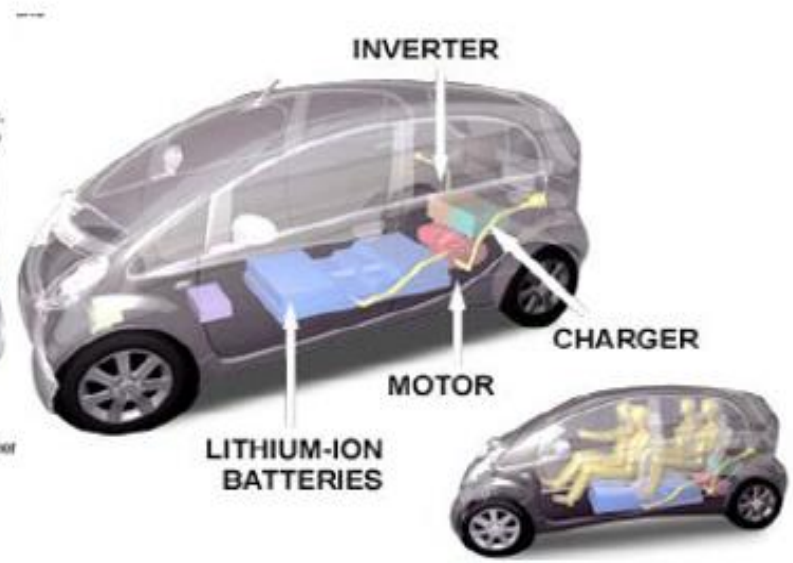
Source: Shukla, A, DolceraWiki (2009). A Market Study on Hybrid Vehicles and the Concept of V2G

- Energy storage and management are crucial technological components and costs of Li-Ion battery cells and peripheries are key, which will decrease.
- Number of EV parts and components will also be sharply decreased to around 1,000 from more than 20,000 of conventional vehicles.





Conventional vehicle



Electric vehicle

Industry Trend: Major players

- Most conventional car assemblers are focused on transition models of HEVs and PHEVs because charging infrastructure is not ready while technology ventures like Tesla are leading BEVs production.
- A few East Asian producers are dominating battery market and Tesla is trying to produce its own battery with their energy storage system.
- European companies especially German companies are leading the market.

Players	
Assemblers	HEVs: Daimler, Honda, Toyota, PSA, Ford, FIAT PHEVs: Volkswagen, BMW, Mercedes Benz, Toyota, and Daimler BEVs: Tesla, BYD, Nissan, Volkswagen, Mitsubishi, BMW, Kandi, Z otye, Ford, GM
Suppliers	Battery: Panasonic, AESC, LG Chem, BYD, and Tesla
Charging station	Schneider Electric, Nissan, ABB, Signet, Blink, Efacec, Aeroviron ment, Eaton, Bosch, BTC, Addenergie, Bosch Automotive Serv ice Solutions Inc, Valent Power

Related Technologies are smart grid communication and renewable electricity and RE charging stations.

Major Thai stakeholders focus areas and characteristics

EV prototypes and charging stations are developed by NSTDA and Thai Universities in partnership with foreign venders while private EV producers are building relationships with foreign assemblers from Japan and China.

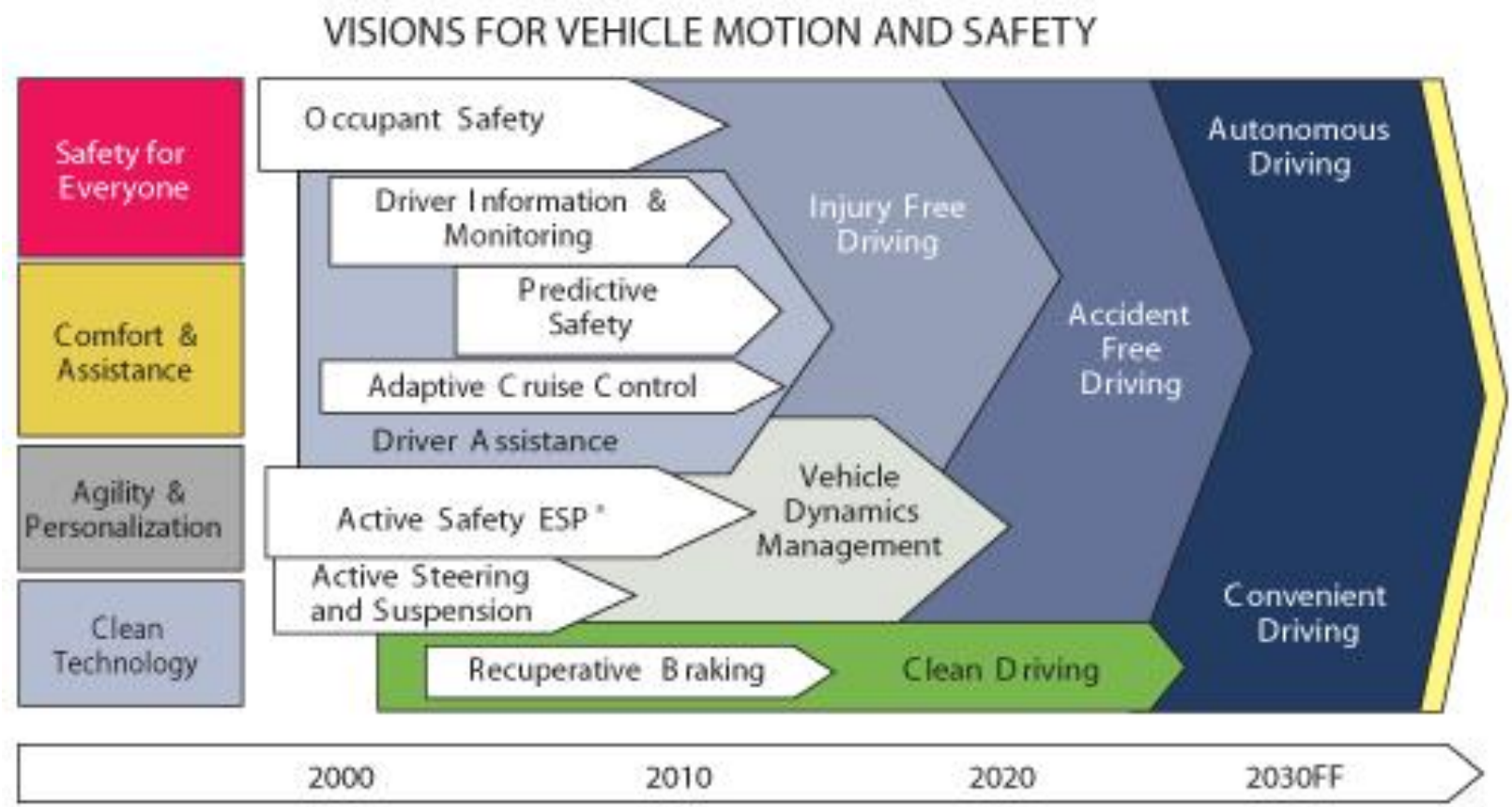
	Focus Area	Characteristics
NSTDA	• Energy Sector: Battery Pack and Battery Management System (BMS) • Auto Sector: Motor and Power Train, Driving Control System, Structure and Body • Infrastructure: Charge System	• Development of prototypes and charging station for demonstration • A certain capacity on motor development
University	• KMUTT: Auto and Energy Clusters with EV Charging • KMILT: Charging System • CU: Charging station for Smart Grid & Smart Mobility	• Focused on charging station demonstratio n with support of foreign vendors • KMUTT MOU with FOMM (Japanese) to li nk Thai suppliers for small electric passe nger car production
Industry	• PTT: Charging station (6 stations -> stations) • E-trans: E-tuk tuk, E-motorcycle • Vera: Battery electric passenger car • TEV, CherdChai, Singkhon: Electric bus	• Foton (Chinese) MOU with TEV to transfer technologies of battery and motor • E-trans: lack of engineering capacity
EVAT	• Moderate budget of EPPO to support for 100 charging station in first three years	
TAI	• Testing Center	

EVAT: Electric vehicle association of Thailand

Autonomous driving/connected car: A race between conventional automotive companies and new players

Technology Trend

Development direction of a device or system for safe driving



Source: Bosch GmbH, Stuttgart, Germany, during EuMW 2012. Automotive Radar: From Its Origins to Future Directions. Retrieved from http://www.microwavejournal.com/ext/resources/images/Figures/2013/Sep/9M27/9M27Fig11x500.jpg

Industry Trend

At least three industries of auto, ICT and electronics are competing in autonomous driving. ICT companies such as Apple, Google and Induct have already demonstrated autonomous driving through working prototypes and pilots while auto companies are focusing on ADAS and electronics companies are developing parts and components for autonomous cars.

	Major Players	Technology Focus
Auto	• Automotive companies (Audi, BMW, Daimler, Ford, GM, Nissan, Toyota, Volkswagen, Volvo, etc.)	• Advanced Driving Assistant System (ADAS) including components, modules and systems for automatic braking, reactive cruise control, lane assist, blind spot alert and various other
ICT	• Apple, Google and Induct • QHX, Delphi, CISCO Systems, Continental Automotive, Covisint, Codha Wireless (V2X communications), AutoTalks (V2X communications), Mobileye, Nvidia	• Infrastructure/roadside/external systems for autonomous vehicles • Infra red and high definition systems, sensors/LidAR/radar components, V2X - V2V • Networking and vehicle IOT • Infotainment, vehicle telematics • Website / Publication / Media • Software, operating platforms and development tools
Electronics	• A few global electronics companies Nokia, Samsung and others	• Electrical/electronic components, modules & assemblies inductors, resistors, capacitors, fuses and other passive components used within various modules for autonomous vehicles and other related applications • Semiconductors • Cameras and Imaging devices components

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Thai is not ready for autonomous driving

- Researches on autonomous driving by NSTDA and Thai Universities are limited for industrial commercialization.
- While autonomous driving impact on Thai OEMs and suppliers is limited in the short-term, there is no doubt that the demand for more powerful, connected and versatile cars will grow.

	Major Players	Achievements and Limitations
NSTDA (NECTEC)	• Intelligent transportation systems (ITS) • Big Data, IoT platform and Cloud	• Lab scale ITS and IoT platform for demonstration • Capacity development on OpenStack cloud in partnership with foreign vendors for price negotiation and new service accommodation • No specific mechanism for industrial commercialization
University	• Smart Mobility Research Center at CU • KMUTT ICT, Automotive and Energy clusters	• EV, driving simulator, fuel cell, intelligent transportation system and active safety focused • Lack of industry partnership

Smart mobility: Creating robust strategies in times of radical change

Technology Trend

- Smart mobility: On-demand mobility system that would allow customers to choose among public and private transport providers and assemble the fastest or cheapest way of getting anywhere they need to go at any time.

- Global automotive industry has faced a fundamental shift in consumer attitudes towards vehicles. In the future, the increased asset utilization of shared vehicles, and especially "mobility as a service" and/or robocabs will be articulated in the form of smart mobility.

- To secure a large share of the profit pool, companies need to control the technologies, services and platforms such as Ride-sharing/ride-hailing, Robocabs/taxi services, Mobility planning platforms, and Booking/payments

Industry Trend

- Digital marketplaces such as Uber which link self-employed drivers with customers and collect a fee for making the connection are disrupting existing transportation market while global smart city providers (Cisco, IBM, MS, Schneider Electric and Siemens) and automakers (Audi, BMW, Daimler and Ford) are aligned with them.
- This model extends to ridesharing/car pooling and car sharing businesses a nd will evolve to link with driverless technologies to accommodate robocap services.

	Players	Trends
Ride hailing	• Uber, Haxi, LYA, Gett, OLA	• Disrupt conventional taxi and car rental industries • Disrupt car ownership and public transports • Ill-defined regulatory framework • Relatively low entry barriers, but fierce competition • Winner-take-all
Ride sharing /Carpooling	• Vride, Waze, Bla bla car, Karnet, Sccop	• Disrupts public transit, car ownership • Often incentivized by policy planners because environment al friendly • More popular in Europe • Critical mass of community members a must

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Industry Trend

	Players	Trends
Carsharing	• Getaround, Zipcar, Car2go, Enterprise Carshare, Reach now, Maven	• Short-term car rental with unattended access and inclusive of gasoline and insurance. Distinction with car rental becoming blurred. Disrupts car rental industry • Started in Europe, it has experienced exponential growth in US until 2010's, challenged by other mobility services • China the greatest potential for growth? (Car2go in Chongqing, 78K members in 2 months)
Robocabs / taxi services	• Grab, Uber	• Companies who offer Driverless/Self driving Taxis & Ride hailing services • Car Hire and Rental Companies who offer or specialize in Driverless / Autonomous / Self driving cars, Vans and other Vehicles
Booking Payment	• HopOn	• Smart mobile payment for public or private transportation
Other Players	• Indra, INRIX, Iteris, Kapsch, ParkHelp, Parkopedia, Q-Free, Streetline, Transdev, TravelAi, Urban Engines, Urbiotica, Verizon Communications	

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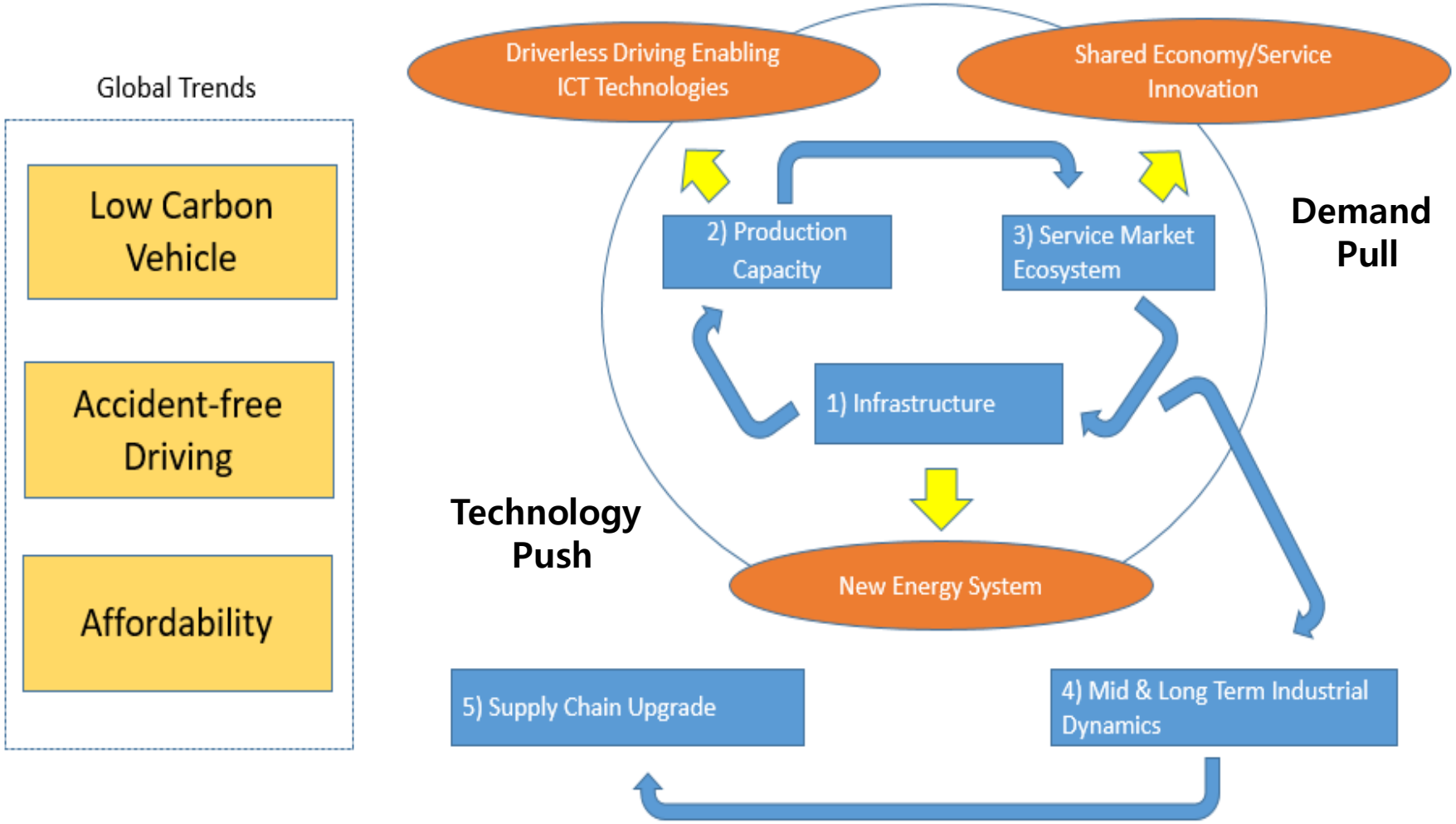
Thai is at very early stage to explore the smart mobility

- Foreign companies such as Uber and Grap are dominating ride hailing services while domestic companies of Haup and LILUNA has just launched car sharing and ride sharing businesses in a form of cloning model.
- Smart mobility is part of the smart city projects but is not clearly linked to promote smart mo bility business.
- Smart mobility is upcoming and its impact on the traditional Thai society and automotive indu stry is evident, a plan to accommodate mega trend of smart mobility is necessary.

	Stakeholders	Achievements and limitations
Industry	• Uber, Grap (Ride hailing) • Haup (Car sharing) • LILUNA (Ride Sharing)	• Haup has business in five BTS and MRT stations and six Universities in Bangkok. • LILUNA has just launched its ride sharing app but the business is illegal.
Government	• EPPO (Smart Cities-Clean Energy Project)	• Demonstration projects in a few universities in partnership with private urban development companies
Other	• Society of Automotive Engineer-Thailand (TSAE)	• Only conference on innovation for smart mobility

5. Alternative innovation direction and policy recommendations

Alternative innovation direction: stepping stones for double edged sword of demand pull and technology push



Recommendations 1: Core technological capabilities building with leveraging infrastructure development

- The initial conditions of Thailand are not favorable to accommodate the next generation vehicle opportunities; no core technologies of battery and motors for EV, connected vehicle technologies and domination by foreign platform service providers such as Grap on top of low market affordability.

- It is highly recommended to start with technological capability development leveraging infrastructure procurement opportunities. Electricity charging technologies (Specific normal charge), energy storage technologies and smart grid technologies are tentative priorities to build the capacity.

- Thai may create international public and private partnership programs to localize those technologies and strategic foreign partnership and relevant human resource development plans should be aligned.

- Policy coordination with other ministries such energy ministry on energy efficiency and charging system is critical for the success of initial capacity development. There is no innovation strategies in other Ministerial programs since their focus is to just provide direct solutions.

Recommendation 2: Design and production capacity development (vehicle production)

- The market structure of EV is composed of premium EVs and economic model of EVs. For the former market, a few global brands such as Tesla dominate while the market entry threshold is low for the latter model.
- Thai government may utilize a few of EV procurement markets such as E-tuk tuk, E-motor bike, E-Microbus to promote local production of EVs in partnership with local university workshops, local conventional auto suppliers and foreign core parts and components suppliers such as battery and motor. With this, local producers can build design and production capacity to transition to next generation vehicle industry.
- As with energy efficiency and charging station of the Energy Ministry, the procurement of E-tuk tuk does not consider the promotion of local production, which requires policy coordination to achieve the next generation vehicle industry promotion in Thailand.
- It is also required to develop business models of the local workshops for sustainable design and production in Thailand.

Recommendation 3: Service market system with ecosystem innovation

- Thai service market has natural barriers of language and culture. A few of cloning platform service providers started their businesses in Thailand including e-commerce, e-payment, e-book and others. The cloning services have structural limitation for scale-up expansion and most of them are to be sold to other foreign companies.

- Next generation vehicles will be based on machine 2 machine communication technologies to facilitate various platform service market creation. Even those cloning services can be leveraged to build service ecosystem by which the next generation industrial promotion can be helped. A relevant services such as Haup, the car sharing service, need be incentivized.

- A smart mobility and logistics program can be strategically designed to facilitate the service ecosystem development, by which local villages can be connected for their agricultural products delivery to major city markets.

Recommendation 4: Mid and long term industrial dynamic capability

- To build the three future technology capabilities, a kind of double edged sword strategy is recommended since Thai does not have full capacity to start with any of those technologies; demand pull and technology push.
- From the first three recommended policy programs, Thai will build a certain critical mass of energy related technologies, design and production capacities and service innovation. These will generate bottom-up demand for mid and long term industrial dynamics.
- Thai government may provide multi-year research and development programs to harness these bottom-up demand, which is technology push strategies. These may be incorporated as a form of road map for next ge neration vehicle industry.

Proposed technological tree by groups:

- Infrastructure and energy group: EV charging station with specific standard and protocol, energy storage, battery packaging and BMS, smart grid and electricity network management
- Design and production group: motors and others
- Service innovation groups: business models

Recommendation 5: Supply chain upgrade with clarified and collective innovation direction

- Local auto suppliers are not sure whether they can have enough demand for their products and reluctant for further investment. Government potential financial supports for technology development and human resource supports cannot be fully utilized and if used, they will only sustain their businesses a little longer.
- The previous four recommendation programs will provide a kind of collective goal and strategies for the local auto suppliers so that uncertainty will be dramatically decreased and they will be induced to participate in the next generation vehicle innovation program.
- Government may incorporate the collective goals and strategies in the form of master plan and relevant set of programs with which local suppliers are induced to choose their individual survival and adaptation programs.
- The priority beneficiary will be the second tier venders since most of the first vendors are foreign majority and pure foreign suppliers. For most of second and third tier suppliers, partnership with university workshops is recommended for design and production of electric vehicles.