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Original Article

Examination of lightweight hybrid electric vehicles in the long term utilizing system dynamics modeling approach

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Abstract

Severe environmental impacts and high carbon dioxide emission are serious issues of the automotive industry around the world. Various green technologies are adopted to improve the vehicle's performance and to lower environmental impacts. This includes the use of lightweight materials in the hybrid electric vehicle production to reduce the vehicle's weight, save energy cost, and lower the carbon dioxide emission. This study examines the trend of lightweight hybrid electric vehicle (LHEV) sales in Thailand in the long term, utilizing the system dynamics modeling approach. The developed dynamics model considers production capacity in terms of material availability and budget allocation and demand from green and potential customers. The simulation results show that the LHEV sales in the initial stage were low due to low budget allocation for LHEV production. When more customers are interested in the LHEVs, the sales amount increases and becomes triple in the next 20 years. The results pinpoint that price range of LHEVs must be suitable, compared with its previous models, to attract more customers in the market. The company may also consider promoting the LHEVs through a number of activities and schemes to raise the green image of the company, and attract more customers in the long term.

Keywords: automotive industry, carbon dioxide emission, lightweight hybrid electric vehicle, potential customers, system dynamics modeling

1. Introduction

Thai automotive industry represented about 12% of the country's GDP and contributed over 600 billion Baht in revenue in 2017 (Yongpisanphob, 2017). It is ranked the first automotive assembler in Southeast Asia (Yongpisanphob, 2017). Moreover, the sales are expected to increase by two times in 2020 (Thailand Board of Investment, 2017). With high growth of the industry, however, it is one of the highest fossil fuel consumers, and the largest contributor of carbon dioxide (CO_2) emission in the world (Khan & Kar, 2009). Light-duty vehicles use the oil-fuelled engines with high amount of CO_2 up to 3.1 million tons per year (Energy Policy and Planning Office [EPPO], 2019).

The CO_2 emission problem is a serious issue of the automotive industry around the world. Around one-fifth of CO_2 emission in Europe, for example, is generated from this industry. In Canada, the automotive industry is the largest source of CO_2 emission, accounting for 25% of the total emission (Khan & Kar, 2009). In China, the automotive industry occupies 10% of the total emission and is expected to consume double of its fuel consumption in 2030 (Dong, Hua, & Yu, 2018).

With serious issues of CO_2 emission, many developed countries adopt green technologies to improve the environmental performance (Nilrit, Sampanpanish, & Bualert, 2017). Hybrid electric vehicle (HEV) is a successful green product increasingly used in developed countries, as it emits 25% less CO_2 than conventional vehicles (FEV Engine Technology, 2005). Many countries record high HEV sales in recent years. In USA, for example, the HEV sales are accounted for 27% of the global market share (The Global Energy Assessment [GEV], 2012). The HEV sales in China, in the same way, increased by 62% in 2017 (Thornton, 2019). In developing countries, the trend of HEV sales is also increased, though there are some limitations, such as financial

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problems and customers' lack of information (Khan & Kar, 2009). In Thailand, an increase of HEV sales was 18% in the past three years with the highest increasing rate of 25% in 2018 (Electric Vehicle Association of Thailand [EVAT], 2018).

Apart from the HEVs, other green technologies are also employed to improve green performance (Nunes & Bennett, 2014). Alexander (2016), for example, suggested three green technology trends driving the automotive industry, such as reduce, reuse, and recycle scheme, and the use of HEVs. Nunes and Bennett (2014), on the other hand, mentioned that lightweight materials can increase fuel efficiency and diversification of the vehicles. Sutherland and Gunter (2004) added that the use of lightweight materials, such as aluminum and magnesium reduces energy consumption in the assembly plant. Nissan Company replaces traditional steel platform and vehicle's body with aluminum. This new model reduces fuel consumption and CO_2 emission by 20% and increases the company's sales by 35% in 2014 (The Aluminum Association, 2018).

To further reduce and enhance green performance in Thai automotive industry, this study aims at examining the use of lightweight material in HEVs (LHEVs) to enhance the green performance, reduce CO_2 emission, and increase sales in the long term. System dynamics (SD) modeling approach is utilized to investigate causal relationships among key criteria of LHEVs, and their influences on the LHEV sales and CO_2 emission in the long term. It is expected that the study results show the trend of LHEV sales and CO_2 emission, thus providing the automotive industry a guideline to effectively plan for the LHEV production and CO_2 emission in the long term. The research steps of this study are as shown in Figure 1.

2. Materials and Methods

2.1. Factors affecting the LHEVs

A number of research studies mention factors affecting green performance and LHEV technology. Ferraz, Buhamra, Laroche, and Veloso (2017), for example, mentioned factors, namely aluminum availability and budget as important in green technology implementation. Chowdhury, Upadhyay, Austin, and Belal (2016) stated that HEV customers are associated with an increase in the LHEV demand in the market. Boston Consulting Group (BCG, 2011) commented that factors affecting customer purchasing decision include corporate social responsibility (CSR) activities, ISO 14001 accreditation, and product price. Key factors affecting the LHEVs are summarized in Table 1. They are performed with the SD modeling approach to examine the LHEV sales in the long term.

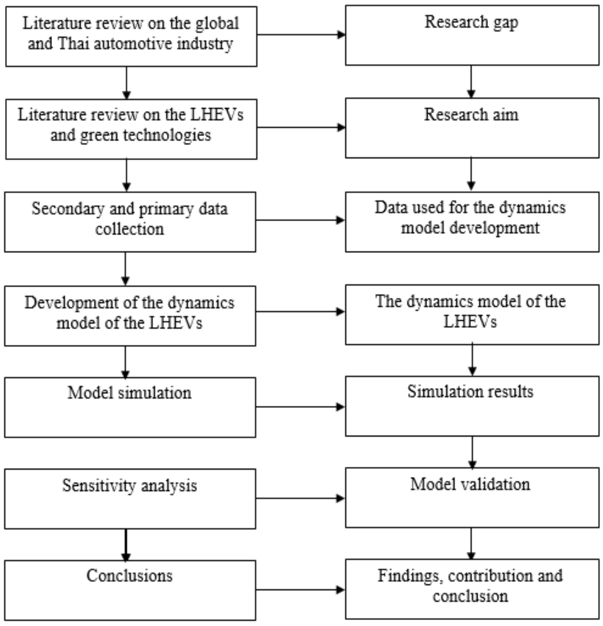

Figure 1. Research steps of the study

Table 1. Factors affecting LHEVs

Factor	Description	Reference
Budget	The investment on LHEV production.	Potosí-Guerrero *et al.*, 2016; Chowdhury *et al.*, 2016; Georage, 2017; Kim and Chai, 2017; Toyota, 2017; Honda, 2017; Interview, 2018
Aluminum availability	The use of aluminum to replace steel in the LHEV production	Potosí-Guerrero *et al.*, 2016; Georage, 2017; Kim and Chai, 2017; MetalMiner, 2018
HEV customer	HEV customers who might be interested in the LHEVs.	Kamath *et al.*, 2013; Hussain *et al.*, 2014; Chowdhury *et al.*, 2016; Markline,2017; Toyota, 2017; Honda, 2017; Nissan, 2017
Repurchase customer	Customers who will repurchase the LHEVs after the maximum life span of the products.	BCG, 2011; Chuanwan and Katewongsa, 2010; Ferraz *et al.*, 2017; Interview, 2018
Additional LHEV	Potential customers who are willing to purchase LHEVs.	Kamath *et al.*, 2013; Hussain *et al.*, 2014; Chowdhury *et al.*, 2016
Green image	Green image, reflecting by the accreditation of the ISO 14001 standard, to raise the number of additional LHEVs.	Khanna *et al.*, 2010; BCG, 2011; Hussain *et al.*, 2014; Chowdhury *et al.*, 2016; Georage, 2017; Kim and Chai, 2017; Interview, 2018
In-process CSR	The CSR activities, especially the in-process activities, to promote the LHEVs.	BCG, 2011; Hussain *et al.*, 2014; Georage, 2017; Kim and Chai, 2017; Toyota, 2017; Interview, 2018
In-trend product	The availability of LHEVs in the market.	BCG, 2011; Chowdhury *et al.*, 2016; Potosí-Guerrero *et al.*, 2016
Price range	Range of LHEV selling prices.	Georage, 2017; Kim and Chai, 2017; Ferraz *et al.*, 2017; Interview, 2018
Carbon dioxide emission	The expected CO_2 emitted from the LHEVs.	Potosí-Guerrero *et al.*, 2016; Kim and Chai, 2017; Toyota, 2017; Honda, 2017; Nissan, 2017; Nilritl *et al.*, 2018

2.2. Data collection

Secondary and primary data are used in the dynamics model development. Secondary data are retrieved from several literatures. The amount of aluminum in Thailand, for example, is around 61,000 tons (MetalMiner, 2018). According to Toyota (2017), HEVs and LHEVs emit lower CO_2 than conventional vehicles by 65 and 71 grams/km, respectively. Chowdhury, Upadhyay, Austin, and Belal (2016), mentioned that the training in the ISO 14000 series is necessary to achieve a better environmental standard.

Primary data are achieved through in-depth interviews during the period of October 2017 to February 2018. Twelve experts provide data related to the dynamics model development. They are asked to provide information, such as budget allocated for the LHEV production, CSR activities to enhance the green image, and repurchase period. Examples of interview questions are "*What is the optimal budget for LHEV production?*", "*What are CSR activities used to raise customer awareness of green products?*", and "*What is the common repurchase period?*" Raw data are illustrated in the Appendix.

2.3. System dynamics modeling

Key factors affecting LHEVs are used in the dynamics model development utilizing the SD modeling approach. SD is a tool that helps in understanding the structures and behaviors of the system. It shows the interrelationships of the system, thus making it useful for the users to make an accurate decision. It has been conducted in a wide variety of fields. Musi, Anggoro, and Sunarsih (2014), for example, utilized the SD modeling to determine the alternative policies for a better forest management in Indonesia. On the other hand, Manasakunkit and Chinda (2016) developed a municipal solid waste model to manage waste, and suggest policies for effective waste management in Bangkok, Thailand. Mutingi, Mbohwa, and Kommula (2017) evaluated the energy system strategies to identify energy formulation problems. In this study, the SD modeling is used to develop the dynamics model of the LHEVs to examine the trend of LHEV sales in the long term.

2.4. Dynamics model of LHEVs

The dynamics model of LHEVs consists of three sub-models, namely the LHEV supply, LHEV demand, and final LHEV sales sub-model.

2.4.1. LHEV supply sub-model

In LHEV supply sub-model, the maximum LHEVs that the company can produce is calculated based on the availability of aluminum, both local and import, and the available budget for LHEV production as shown in Figure 2.

Table 2. Data used in dynamics model development

Factor	Item	Data
Budget	- Maximum vehicles from the available budget (MVB) - Budget (B)	- Initial budget: 333 million Baht - Budget increasing rate: 4.6 % per year
Aluminum availability	- Maximum vehicles from the available supply (MVAS) - Available local aluminum (AST) - Aluminum required per vehicle (ARV) - Maximum vehicles from the import supply (MVIS)	- Local aluminum cost: 25,785 Baht - Maximum aluminum in Thailand: 61,000 tons - Average aluminum required per vehicle: 0.82 tons - Import aluminum cost: 43,594 Baht
HEV customer	- Regular HEV customers (RHEVD)	- Initial regular HEV customers: 11,200 units - Regular HEV customers increasing rate: 5% per year
Repurchase customer	- Repurchase customers (RPHEVD)	- One-vehicle family: 14.8 % of total families - One-vehicle families increasing rate: 0.3% per year - Repurchase period: Every 10 years
Additional LHEV	- Additional LHEV customers (ALHEVD)	- Maximum additional customers: 63% of HEV customers
Green image	- Green image customers (GALHEVD) - Green image budget (GB)	- Maximum additional customers: 6% of HEV customers - Budget required for ISO 14001 training: 14,000 Baht per person
In-process CSR	- In-process CSR customers (CALHEVD) - In-process CSR budget (CSRDB)	- Maximum additional customers: 34% of HEV customers - Additional LHEVs based on CSR: 144 Vehicles per CSR activity - Budget required for CSR activity: 275,000 Baht per CSR activity
In-trend product	- In-trend customers (TALHEVD)	- Maximum additional customers: 10% of HEV customers
Price range	- Price range (PALHEVD) - LHEV price (LHEVP) - HEV price (HEVP)	- Maximum additional customers: 13% of HEV customers - Acceptable price range between LHEV and HEV: 1.33 - Average price of HEVs in Thailand: 1,719,000 Baht
Carbon dioxide emission	- Less CO_2 emission of the LHEVs compared with HEVs (COLHEVH) - Less CO_2 emission of the LHEVs compared with conventional vehicles (COLHEVC)	- LHEV CO_2 emission: 78 grams/km - HEV CO_2 emission: 92 grams/km - Conventional vehicles CO_2 emission: 157 grams/km

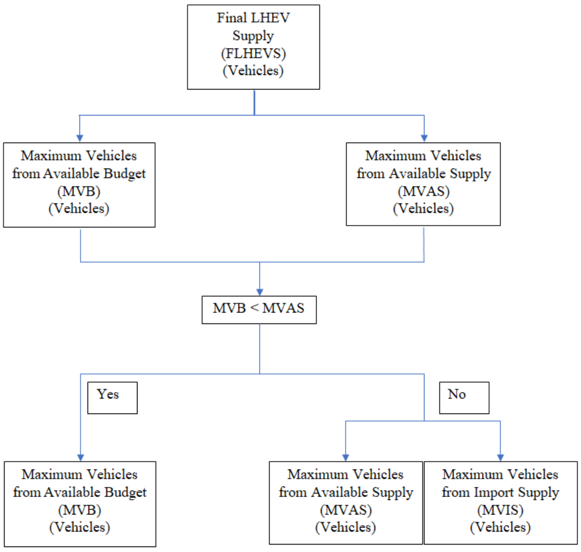

Figure 2. LHEV supply sub-model flow

The use of local aluminum in the LHEV production incurs a higher cost of 29,723 Baht per vehicle than the conventional production (MetalMiner, 2018). With the available budget for LHEV production, the number of LHEVs expected to be produced are then calculated, as shown in Equation 1.

$$MVB = ROUND\ [(B\ /\ 29{,}723)\text{-}0.5] \quad (1)$$

where MVB is the maximum number of vehicles that can be produced from the available budget (in vehicles), and B is the budget allocated for LHEV production (in Baht). The MVB is then compared with the maximum vehicles that can be produced using local aluminum supply (MVAS), as shown in Equation 2.

$$MVAS = AST\ /\ ARV \quad (2)$$

where MVAS is the maximum number of vehicles that can be produced from the local aluminum in Thailand (in vehicles), AST is the available local aluminum (in tons), and ARV is the aluminum used in producing an LHEV (in tons/vehicle). If the MVB is higher than the MVAS, replying that the number of LHEVs that can be produced based on the available budget capacity is higher than those that can be produced using local aluminum, and then the import aluminum will be considered. This incurs higher production cost, which is 43,594 Baht per LHEV, see Equation 3.

$$MVIS = (B\text{-}(MVAS*29723))/43594 \quad (3)$$

where MVIS is the maximum number of vehicles that can be produced from the import aluminum (in vehicles). The final LHEV supply (FLHEVS) is then calculated, as shown in Equation 4.

$$FLHEVS = IF\ MVAS > MVB\ THEN\ MVB\ ELSE\ MVAS + MVIS \quad (4)$$

where FLHEVS is the final LHEV supply (in vehicles).

2.4.2. LHEV demand sub-model

In this study, it is assumed that LHEV customers are those who currently use the HEVs. Demand of LHEVs then comes from HEV customers (HEVD) and additional LHEV customers (ALHEVD) (Figure 3).

2.4.2.1 HEV customers

HEV customers (HEVD) consist of regular HEV customers (RHEVD), and repurchase customers (RPHEVD). According to Markline (2017), the number of HEVs in 2018 was 11,200 units, with an average increasing rate of 5% per year. These values result in the RHEVD calculation as shown in Equation 5.

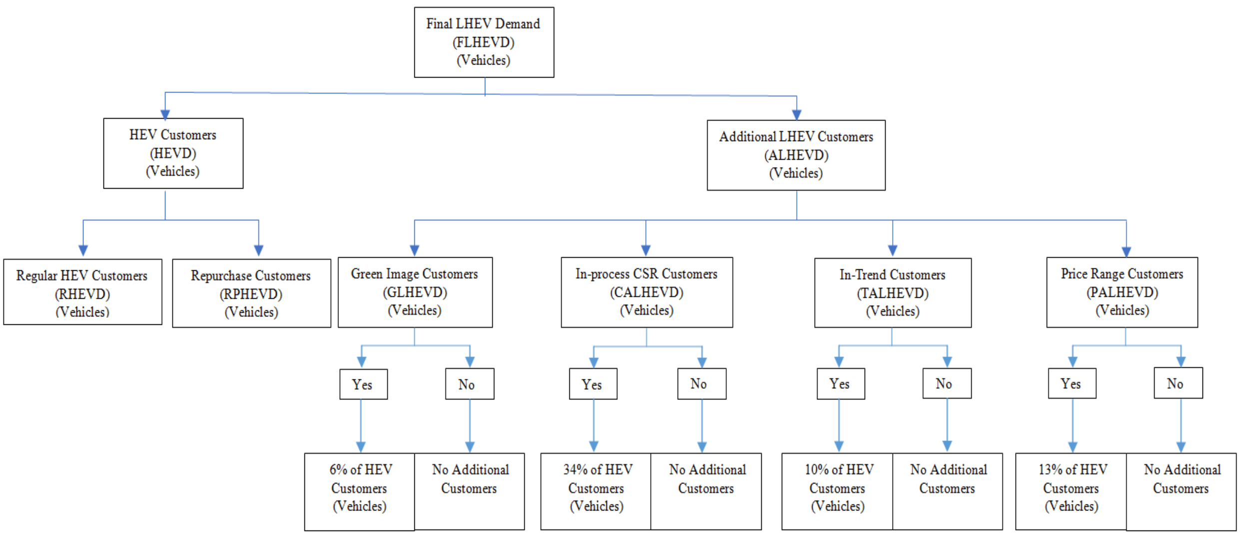

Figure 3. LHEV Demand Sub-Model Flow

$$RHEVD = (11200 * 1.05^{(Y-1)}) – RPHEVD \quad (5)$$

where RHEVD is the regular HEV customer who intend to purchase LHEVs (in vehicles), Y is year (in years), and RPHEVD is the number of customers who will repurchase LHEVs after 10 years (in vehicles).

Repurchase customers (RPHEVD) represent one-vehicle families who consider repurchasing LHEVs after its 10-year life, see Equation 6. According to Chuanwan and Katewongsa (2010), about 14.8% of total families in Thailand have only one vehicle in a family. Those families, once purchased the LHEVs, will repurchase the vehicle in the next 10 years, based on the maximum life span of the vehicle (Toyota, 2017), see Equation 6.

$$RPHEVD = DELAY(FLHEVSL * (0.148 + ((0.003)(Y-1))), 10) \quad (6)$$

where FLHEVSL is the final LHEV sales (in vehicles). HEVD is then the summation of RHEVD and RPHEVD as shown in Equation 7.

$$HEVD = RHEVD + RPHEVD \quad (7)$$

2.4.2.2 Additional LHEV customers

Additional LHEV customers (ALHEVD) are those who might be interested in the LHEVs. According to BCG (2011), four factors affecting LHEV purchasing decision include green image (GALHEVD), LHEV corporate social responsibility (CALHEVD), in-trend market (TALHEVD), and LHEV price range (PALHEVD), see Figure 3. These could add up to a maximum of 63% of HEV customers.

A green image of a company is achieved through the ISO 14001 accreditation in this study, as it is a major environmental-related standard implemented around the world. According to BCG (2011), an additional of 6% of HEV customers might be interested in LHEVs if the company is accredited with the environmental-related standard. In this study, budget used in the ISO 14001 implementation (GB) is the leftover budget of the LHEV production, if any, as seen in Equation 8. Accredited with the ISO 14001 raises the company's green image, saves the production cost, especially the water cost in the production processes, and adds additional LHEV customers by a maximum of 6%, see Equation 9.

$$GB = IF\ MVAS > MVB\ THEN\ (B - (MVB * 29723))\ ELSE\ (B - ((MVAS * 29723) + (MVIS * 43594))) \quad (8)$$

where GB is the budget for the ISO 14001 training (in Baht).

$$GALHEVD = IF\ GB >= 14000\ THEN\ 0.06 * FLHEVD\ ELSE\ 0 \quad (9)$$

where GALHEVD is the number of additional customers intended to purchase LHEVs based on the ISO14001 accreditation (in vehicles).

According to Saluja (2018), CSR is categorized into three types, including in-process, after-process, and as-process. The in-process CSR may be performed to raise customers' awareness in LHEVs, thus increasing the LHEV demand of up to 34% (BCG, 2011). In this study, budget used in the in-process CSR activities derives from saving in water cost during the LHEV production (CB). Each CSR activity costs an average of 275,000 Baht, and may attract 144 customers (Toyota, 2017), see Equation 10

$$CALHEVD = IF\ (ROUND(CB/275,000) * 144) > 0.34 * FLHEVD\ THEN\ 0.34 * FLHEVD\ ELSE\ (ROUND(CB/275,000) * 144) \quad (10)$$

where CALHEVD are the additional customers intended to purchase LHEVs based on in-process CSR activity (in vehicles).

The in-trend product has the influence on customers' purchasing decision (BCG, 2011). If the total supply of LHEVs is higher than the total demand in the market, replying that the LHEVs are available in the market, then up to 10 % of HEV customers may purchase the LHEVs, see Equation 11.

$$TALHEVD = IF\ FLHEVD < FLHEVS\ THEN\ 0.10 * LYFLHEVD\ ELSE\ 0 \quad (11)$$

where TALHEVD are the additional customers intended to purchase LHEVs based on the in-trend product (in vehicles), FLHEVDis the final LHEV demand (in vehicles), FLHEVSis the final LHEV supply (in vehicles), and LYFLHEVD is the last year's final HEV demand (in vehicle s). According to Toyota (2017) and Honda (2017), price of the new vehicle model should not be higher than 33% of its previous models to attract more customers of up to 13% (BCG, 2011), see Equation 12.

$$PALHEVD = IF\ LHEVP/HEVP <= 1.33\ THEN\ 0.13 * FLHEVD\ ELSE\ 0 \quad (12)$$

where PALHEVD are the additional customers intended to purchase LHEVs based on the price range (in vehicles), LHEVP is the LHEV price (in Baht/vehicle), and HEVP is the HEV price (in Baht/vehicle). The ALHEVD is then achieved, as shown in Equation 13.

$$ALHEVD = (GALHEVD + CALHEVD + TALHEVD + PALHEVD) \quad (13)$$

where ALHEVD are the additional LHEV customers (in vehicles). Final LHEV demand (FLHEVD) is then calculated by summing HEVD and ALHEVD, see Equation 14.

$$FLHEVD = HEVD + ALHEVD \quad (14)$$

2.4.3. Final LHEV sales sub-model

The FLHEVS is compared with the FLHEVD to achieve the final LHEV sales (FLHEVSL), see Equation 15.

$$FLHEVSL = IF\ FLHEVD > FLHEVS\ THEN\ FLHEVS\ ELSE\ FLHEVD \quad (15)$$

2.4.4. CO_2 emission

The FLHEVSL represents the number of LHEVs in the market. With the use of LHEVs, less CO_2 is emitted, as shown in Eqs. 16 and 17.

$$COLHEVH = FLHEVSL * (92 - 78) \quad (16)$$

$$COLHEVC = FLHEVSL * (157 - 78) \quad (17)$$

where COLHEVH is the reduction of CO_2 emission compared with HEVs (in grams/km) and COLHEVC is the reduction of CO_2 emission compared with conventional vehicles (in grams/km).

3. Simulation Results

The dynamics model of LHEVs is simulated for 20 years, reflecting a common market cycle (Budd, 2018). Figure 4 shows that with the limited budget from the company in the beginning LHEV sales is limited by the supply amount. With more budget allocated for LHEV production, the company can produce more vehicles, and meet with the LHEV demand in the next 6 years. It is expected that the number of LHEVs in the market in the next 20 years become triple i.e. from around 11,200 units in 2019 to 37,000 units in 2039.

Figure 5 shows that the final LHEV demand (FLHEVD) comes mainly from HEV customers (HEVD), which represent about 53% of the FLHEVD. Nevertheless, additional customers (ALHEVD) add more LHEV demand, and stimulate the LHEV market in the long term.

Closer examination of additional customers (ALHEVD), as shown in Figure 6, reveals that more customers tend to purchase LHEVs when the price range is appropriated (PLHEVD) and the vehicles are available in the market (TALHEVD).

Figure7 shows that with more LHEVs in the model, the CO_2 emission reduces in the long term compared with the HEVs and conventional vehicles.

4. Discussion and Conclusions

Attempts have been made in the automotive industry around the world to reduce environmental impacts through green production and processes. LHEV is an alternative way to reduce CO_2 emission and raise the environmental standard in the industry. This study develops the dynamics model of LHEVs utilizing an SD modeling approach. The model examines the trend of LHEV sales through demand and supply which are affected by a number of key factors, such as available material, price range, budget allocation, and green image.

The simulation results show that with more supply of LHEVs in the market, the demand and sales increase. The total sales become double in the next 10 years, and triple in the next 20 years. This is consistent with Statista (2020) that EV sales in Asia are double in 10-year period. Short-term plan, therefore, could be on maintaining the HEV customers' satisfaction so that they repurchase the vehicles in the future. Long-term plan, on the other hand, could be on promoting the vehicles to the potential customers. Promotion schemes should focus on the vehicles' environmental performance with the competitive price. The study results recommend the range of the LHEV price of not higher than 33% of the older HEV models to attract the new customers. To achieve the specified

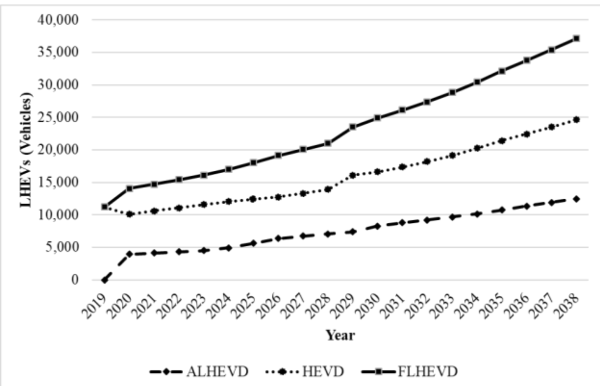

Figure 4. Simulation results of the final LHEV sales in the next 20 years

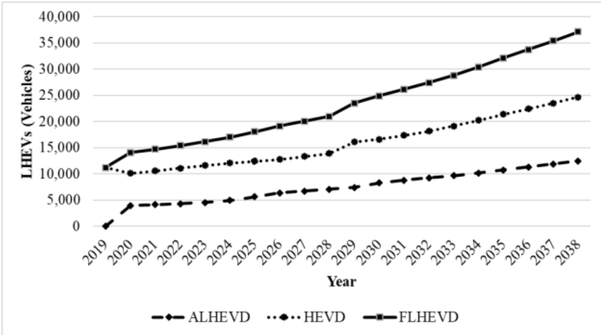

Figure 5. Simulation results of the final LHEV demand

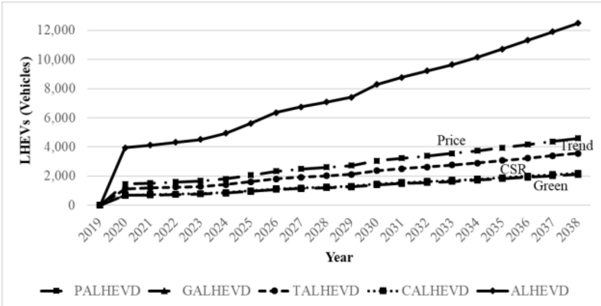

Figure 6. Simulation results of the additional LHEV demand

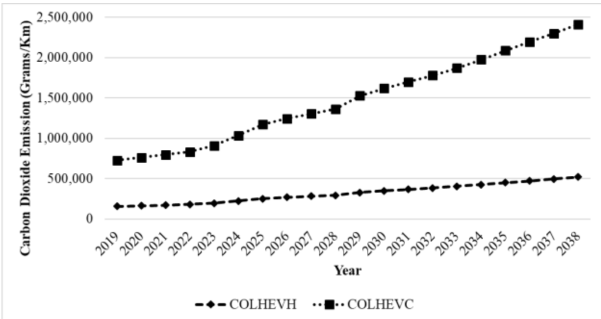

Figure 7. Reduction of CO_2 emission

price-range, the company should focus on using local aluminum in the production. Government may also assist in controlling the aluminum price in the market, and negotiating with partnering countries for future possible collaboration to reduce, for example, import and excise taxes.

Though conducting the study in Thailand, the study results show that key factors affecting the LHEVs can be applied in other countries, especially developing countires in Asia. Bjorek and Lu (2019), for example, considered price and in-trend brand as important in study the EVs in China. Liao *et al.* (2016), similarly, mentioned brand and CO_2 emission as key customers' perception of using the Evs. Afroz *et al.* (2015) commented that the use of recycle materials in the EVs production, similar to LHEV in this study, could enhance the customer's intention to purchase the EVs in Kuala Lumper, Malaysia.

5. Limitations

The LHEV model in this research is conducted based on the Thailand environment which considers the major factors in Thailand practice. In the academic version, the study of LHEV production is still limited and most data is still in the developing stage. Therefore, some data in this research is predicted based on the previous version of the new implement technology. Due to some classified information, some values used in this model are not originated from Thailand and retrieved based on the interviewee's opinion and mostly in Asia. However, our factors included in the study are covering the major aspects of LHEV production in other studies in the world.

Due to limited time, some factors which are included in other studies in other countries, such as government incentive, product satisfaction, and loyal customers are not included in this study. The data in the LHEV model should be adjusted before applied in different countries or products. However, the adjustment of the data in this model required basic knowledge in system dynamics modeling. Therefore, the automotive industry or related organization can develop the whole supply chain model by using this model as the base model of implementing the lightweight material in HEVs.

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Appendix

Examples of raw data from the in-depth interviews

Interviewee	Interview Question			
	What is the optimal budget for LHEV production?	What are CSR activities that can be used to raise customer awareness of green products?	What is the average repurchase period?	What must be convinced in the ISO 14001 accreditation?
#1	Depend on the project	In-process CSR such as customer responsible operation, and campaign	Around 5-10 years	Budget, training, green activity
#2	Depend on the project	In-process CSR such as after service, and campaign	Around 5-10 years	Budget, training, green activity
#3	300 million Baht	In-process CSR such as after service, and campaign	Around 5-10 years	Budget, training, green activity
#4	300 million Baht	In-process CSR such as promotion, and campaign	Around 5-10 years	Budget, training, green activity
#5	Depend on the project	In-process CSR such as green promotion, and campaign	Around 5-10 years	Budget, training, green activity
#6	300 million Baht	In-process CSR such as stakeholders satisfaction, and campaign	Around 5-10 years	Budget, training
#7	300 million Baht	In-process CSR such as improve green work place, and campaign	Around 8 years	Budget, training
#8	300 million Baht	In-process CSR such as improve employees' participation and happy workplace	Around 8 years	Budget, training
#9	Depend on the project	In-process CSR such as increase employee satisfaction, and campaign	Around 5 years	Green technology
#10	Depend on the project	In-process CSR such as improve CSR network	Depend on the customers	Training, green product
#11	Depend on the project	In-process CSR such as Increase customer satisfaction	Depend on the customers	Training, management
#12	Depend on the project	In-process CSR such as reduce waste campaign and promotion	Depend on the customers	Technology, green product