



PTT Global Chemical

Wayne Consulting

Mary Polidan | Sarah Winter | Anthony Cofrancesco | Sherman Wilhelm



Analysis



Snapshot of PTTGC Refinery and Shared Services Unit

independent • international • incisive
energypost

Oil & Gas Renewables Innovations EU Policy Transition Out

Bloomberg

Here's How Electric Cars Will Cause the Next Oil Crisis

A shift is under way that will lead to widespread adoption of EVs in the next decade.

By Tom Randall | Feb. 25, 2016

Wake up call for oil companies: electric vehicles will deflate oil demand

March 28, 2016 by Andreas de Vries and Salman Ghouri — 24 Comments



DESMOG

CLEARING THE PR POLLUTION THAT CLOUDS CLIMATE SCIENCE

Oil Investors: Now Is Probably The Time To Get Your Money Into Electric Cars

Mike Gaworecki | May 15, 2016



Year 2015

2% 7%



The Market Mogul

26th September 2016 10 minute read

Hugo St. John

The Electric Car Might Spell The Death Of Oil. Here's Why

The Death Of Oil

ANALYSIS

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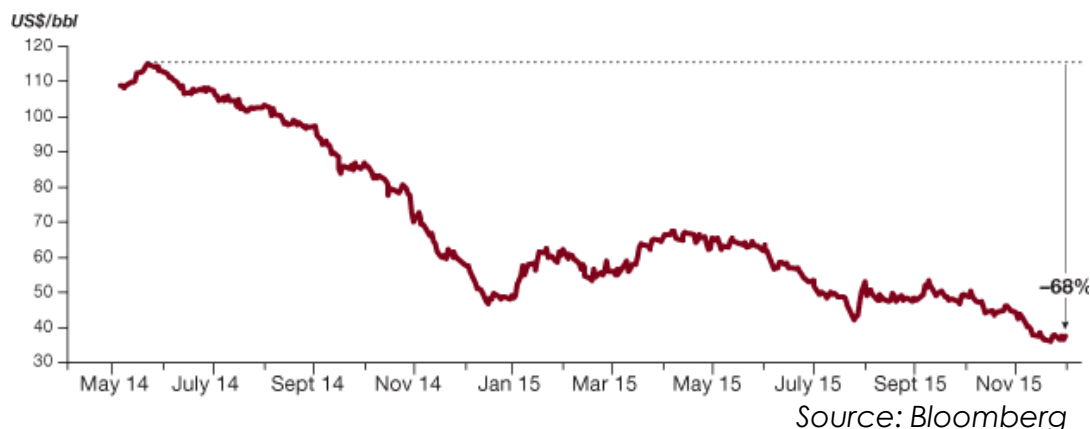
There is a need to take action in preparation for the risky future of the oil market

Drop in oil prices reflects rampant supply and weak global demand

Companies expected to cut global expenditures by 30% in 2016

\$200 billion worth of projects have been cancelled or postponed

Daily Brent crude oil price at close of business



PwC Recommendations:

Refocus organization on what is done best and how to best outpace competitors

Avoid arbitrary cost cutting measures and **channel funding into new areas of growth**

Exploit new technology to innovate, minimize costs, and help **contribute to achieving a lower-emissions environment**

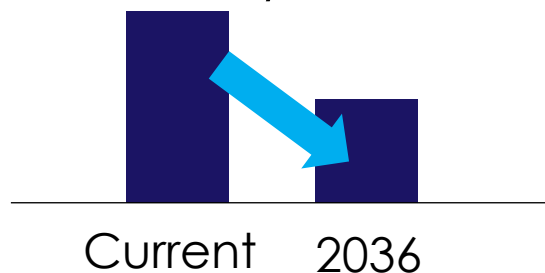


There is a clear drive by the Thai government to drive EV growth

Reduce energy consumption in transportation sector through promotion of energy-efficient vehicles

GOALS:

Reduce energy consumption by **46%**



1.2 Mil EV's
by 2036



Possible CO₂ tax to incentivize EV's

Potential development of 230 charging stations

NSTDA proposal for Thai auto industry to be a leader in EV production



Obstacles slowing adoption of EV's



High upfront cost



Resistance from major automakers



Lack of familiarity



Lack of charging stations



Lack of consumer knowledge



Low energy density of batteries

Source: Case packet

ANALYSIS

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Key obstacles are on track to be resolved



High upfront cost

✓ Comparable EV car & gasoline car prices by 2018



Resistance from major automakers

✓ Increase in EV adoption by automakers to stay competitive in the market



Lack of familiarity

✓ Rapidly increasing with automaker innovations



Lack of charging stations



Lack of consumer knowledge



Low energy density of batteries

Source: Case packet



Remaining obstacles likely to solve themselves over time



High upfront cost

✓ Comparable EV car & gasoline car prices by 2018



Resistance from major automakers

✓ Increase in EV adoption by automakers to stay competitive in the market



Lack of familiarity

✓ Rapidly increasing with automaker innovations



Lack of charging stations

➤ Governments and companies sponsoring charging station initiatives



Lack of consumer knowledge

➤ Automakers will close knowledge gap closer over time through advertising



Low energy density of batteries

➤ Companies discovering ways to achieve battery improvements

Source: Case packet

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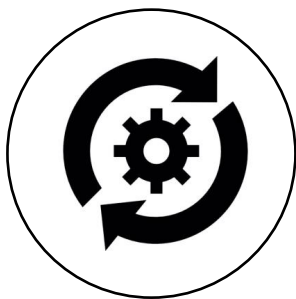
INNOVATE

FINANCIALS



Key Challenge and Recommended Strategy

What actions (if any) should PTTGC take to prepare for potential change in EV market?

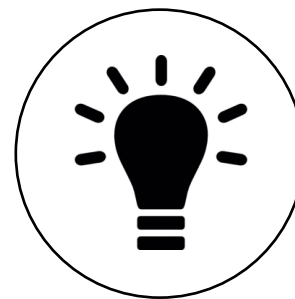


Optimize

Grow **existing areas** to adapt to new market conditions

Invest in lightweight material development

Focus investments in profitable revenue streams



Innovate

Exploit **new technology** to contribute to changing industry environment

Enter EV market through primary parts production



Strategy

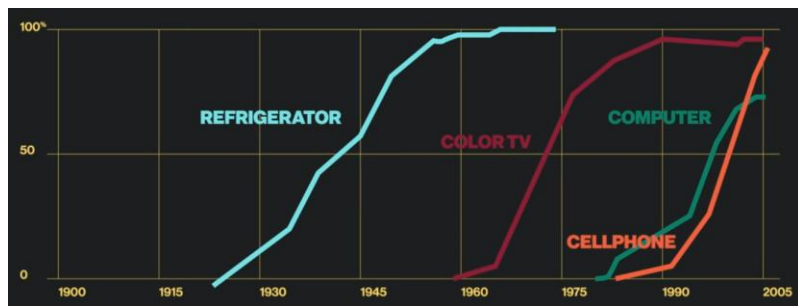


The EV Industry is on the verge of experiencing unprecedented growth

“The stone age did not end because we ran out of stones. It ended because we invented bronze tools, which were more productive.”

- Formal Saudi oil minister Sheik Ahmed regarding industry shift away from oil and gas

1. Tech growth is not linear



Source: Bloomberg

2. Consumers will buy EV if:

FASTER	FUNCTIONAL
CLEANER	STYLISH
CHEAPER	FUN
	CONVENIENT

Source: Forbes

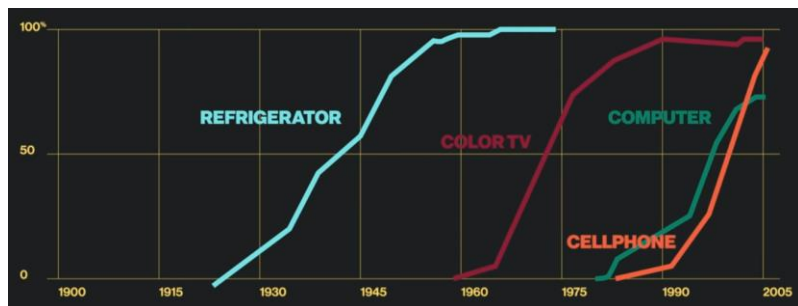


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FASTER **FUNCTIONAL**
CLEANER **STYLISH** **FUN**
CHEAPER **CONVENIENT**

Source: Forbes

3. EV technology has never been such an obvious choice



Tesla Model 3



Chevy Volt

VS.



Honda Accord



ANALYSIS

OPTIMIZE

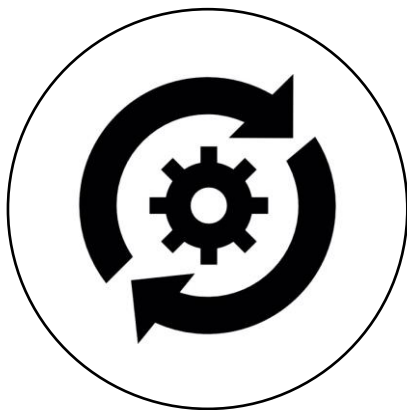
INNOVATE

FINANCIALS



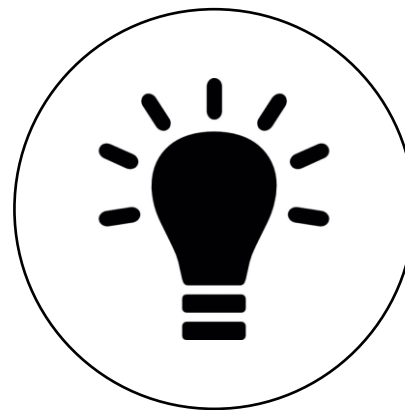


Strategic Overview



Optimize

Grow **existing areas** to adapt to new market conditions

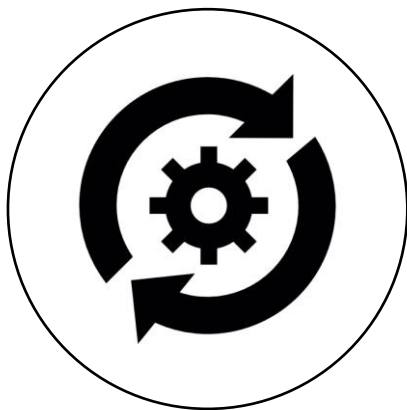


Innovate

Exploit **new technology** to contribute to changing industry environment



Strategic Overview



Optimize

Grow **existing areas** to adapt to new market conditions



Innovate

Exploit **new technology** to contribute to changing industry environment



PTTGC has the opportunity to increase profitability and diversify revenue streams

“Refinery is linked to oil price. In the past few years, there has not a been a significant change in revenue stream...refinery is still half of our (2015) revenue”

– Mr. Jittasak, Investor Relations Manager PTTGC



Source: Bank of Thailand

&




Source: Case Packet



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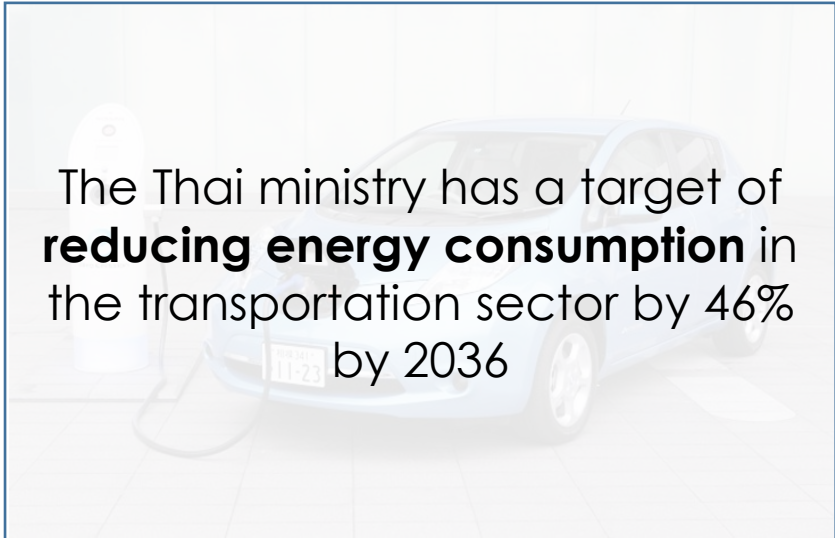
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Thai **fuel prices have dropped** across all sectors and are showing no sign of changing

Source: Bank of Thailand

&



The Thai ministry has a target of **reducing energy consumption** in the transportation sector by 46% by 2036


Source: Case Packet



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Source: Case Packet

Opportunities will be seized by improving products



Improve products by investing in R&D to further development of lightweight materials

Opportunities:

Develop
lightweight
material

Focus
investments
in profitable
revenue
streams

Why and How?

Develop lightweight material

How?

Why?



Invest in R&D to further
development
lightweight materials



DEVELOPMENT:

Utilize **partnership with PA9T** who currently invests in lightweight material

Focus on heaviest rotational mass in the car: the tires, wheels



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Why and How?

Develop lightweight material

How?

Why?

EFFICIENCY STANDARDS:

Reducing weight of a car by 10% improves efficiency by 6-8%

Source: MIT

“Companies need to innovate... and help achieving a lower-emissions environment”

Source: PwC

OPPORTUNITY:

Ability to sell parts manufacturers a new, efficient piece of material at a higher price



Utilize strategic selling to increase revenues in BPA and Ethylene markets

Opportunities:

Develop
lightweight
material

Focus
investments
in profitable
revenue
streams

Why and How?

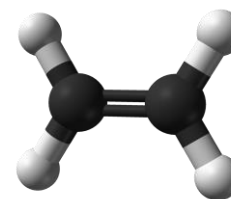
Focus investments in profitable revenue streams

How?

Why?



Hire or train sales team to better serve as **strategic sellers in the B2B bidding** process for contracts



Focus on **BPA and Ethylene markets** as key opportunities for revenue growth



Utilize strategic selling to increase revenues in BPA and Ethylene markets

Opportunities:

Develop
lightweight
material

Focus
investments
in profitable
revenue
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Why and How?

Focus investments in profitable revenue streams

How?

Why?

Market Share:

Bisphenol A



Phenol



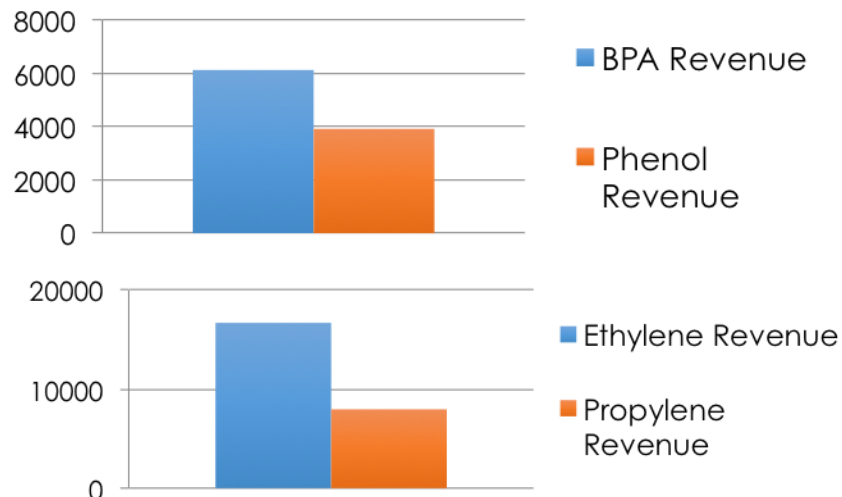
Ethylene



Propylene



2015 Revenue:



Source: PTTGC 2015 Annual Report



Opportunities will be seized by integrating technology and improving products

Opportunities:

Why and How?

Develop Lightweight Material

IMPACT:

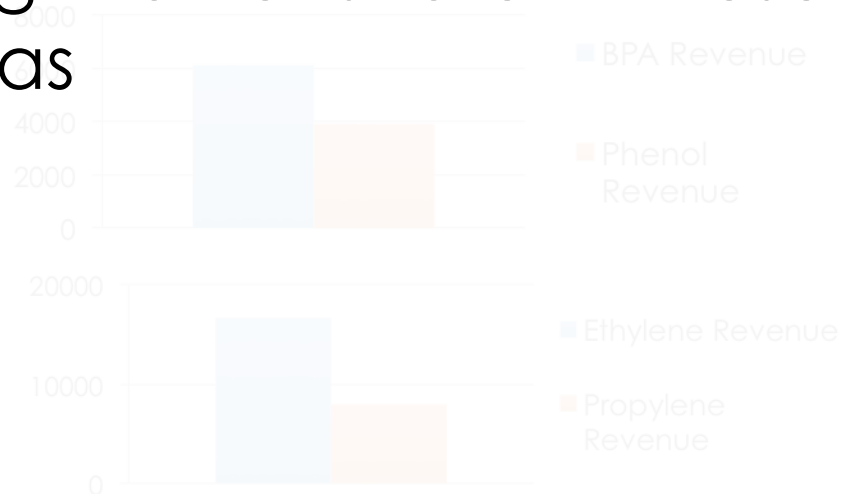
PTTGC can achieve higher profitability and diversification by growing market share in these areas

Develop lightweight material

Invest in profitable revenue streams

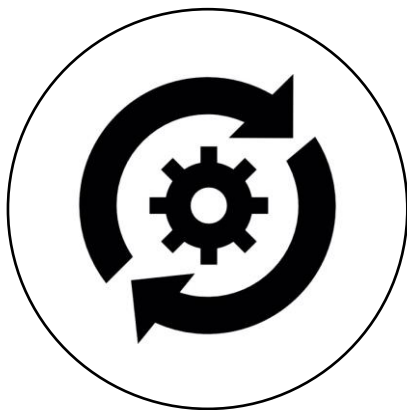


Propylene





Strategic Overview



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Grow **existing areas** to adapt to new market conditions



Innovate

Exploit **new technology** to contribute to changing industry environment

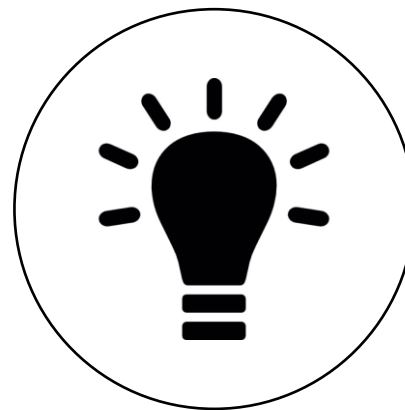


Strategic Overview



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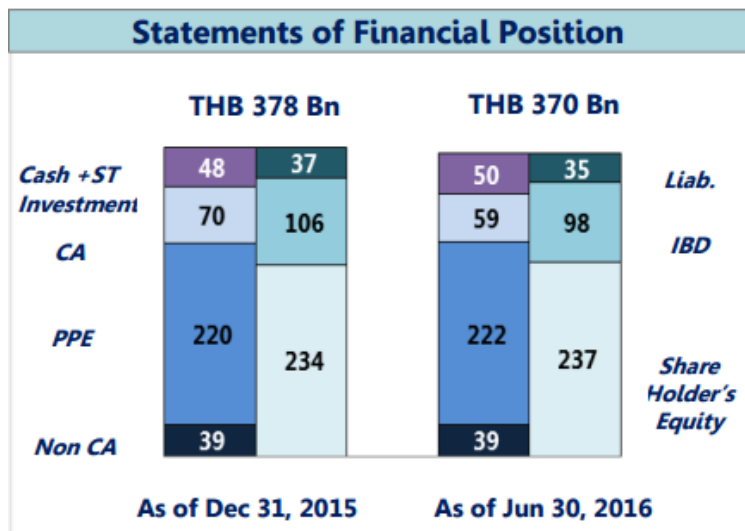
Innovate

Exploit **new technology** to contribute to changing industry environment



Entering the EV market is an obvious strategic play for PTTGC

PTTGC is in a **strong financial position** to build a foundation for innovation



Source: PTTGC Investor Presentation, Sept 2016



Entering the EV market is an obvious strategic play for PTTGC

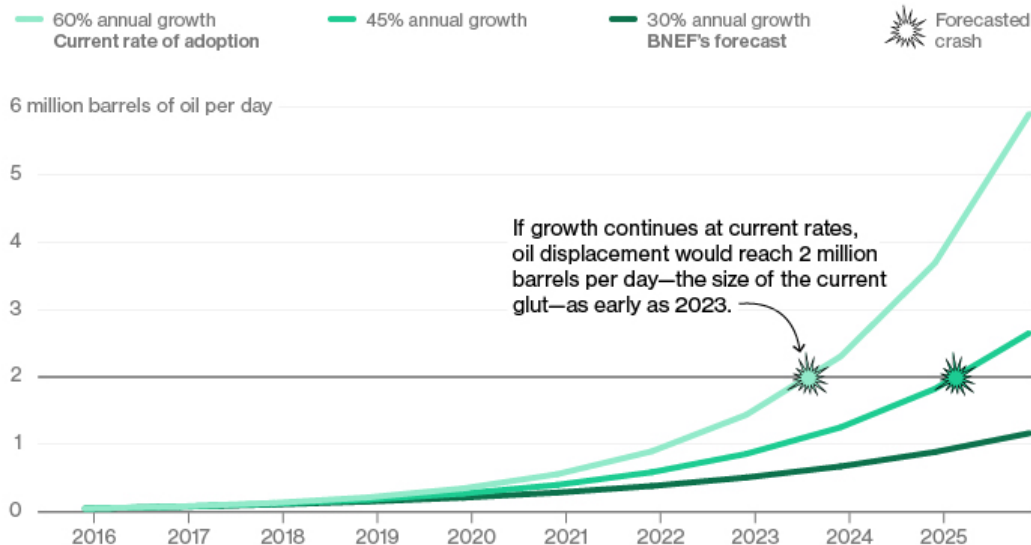
PTTGC is in a **strong financial position** to build a foundation for innovation

EV demand is expected to **grow 30%** per year for the next 20 years

Statements of Financial Position

	THB 378 Bn		THB 370 Bn		
	48	37	50	35	
Cash +ST Investment	70	106	59	98	Liab.
CA					IBD
PPE	220	234	222	237	Share Holder's Equity
Non CA	39		39		
As of Dec 31, 2015		As of Jun 30, 2016			

Source: PTTGC Investor Presentation, Sept 2016



Source: Bloomberg



The best opportunity to enter the EV market is through primary parts production

Huge demand for EV batteries in SEA by companies such as FOMM, Toyota & BMW



- FOMM requires 25,000 batteries in under 2 years
- Batteries are key cost drivers in EV's

Car companies shifting towards outsourced battery production



Source: Forbes



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Source: Forbes

Similar chemical companies are **recognizing opportunity** and branching into EV market



EUROPE

"LG Chem is seeking to tap Europe's booming electric car market by **setting up a battery plant** in Poland...with a plan to manufacture 100,000 batteries annually starting in 2019."

Source: Bloomberg Markets



UNITED STATES

"...our team has taken **on lightweight composite development**...The appetite for improved emissions and efficiency in the auto sector is fueling the need to think differently."

Source: Dow Chemicals Website



The best opportunity to enter the EV market is through primary parts production

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Similar chemical companies are **recognizing opportunity** and branching into EV market



- Li-ion batteries
- Motor drives
- Control units

SE ASIA

?



Source: Forbes

EUROPE



"LG Chem is seeking to tap Europe's booming electric car market by **setting up a battery plant** in Poland...with a plan to manufacture 100,000 batteries annually starting in 2019."

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UNITED STATES

"...our team has taken **on lightweight composite development**...The appetite for improved emissions and efficiency in the auto sector is fueling the need to think differently."

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PTTGC can innovate to become the first EV battery manufacturer in Southeast Asia

PTTGC's Strength match skills required for battery manufacturing



Scale

- Access to PTTGC's strong Senior management
- Opportunity to leverage PTTGC resources

Manufacturing

- Top 10 of Dow Jones sustainability indices
- Incredible value chain abilities

Location

- Easy access to SEA and other rapidly growing markets



Implement EV battery manufacturing by investing in Grabat



What does Grabat provide to PTTGC?

Tech Benefits

Grabat has the newest efficient battery

Production cost 77% cheaper

Understand how to manufacture

Do our companies align?

Mission Value

Commitment to innovation

Short and long term focus

Sustainability initiatives

Why would our companies work together?

Synergistic Opportunity

PTTGC can offer access to SEA market

PTTGC can use battery patent

Grabat is currently seeking partners

Source: Grabat

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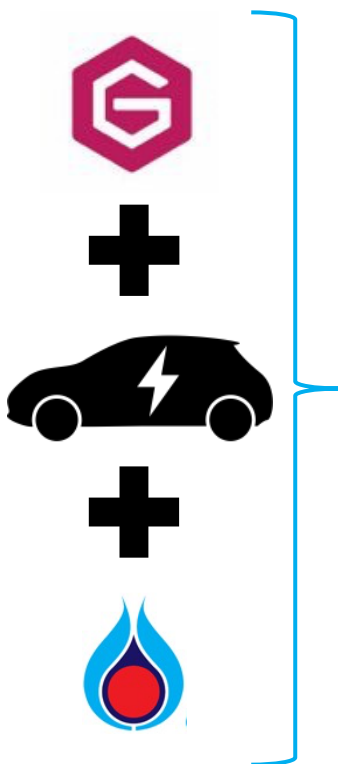
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PTTGC now has the ability to launch production of EV batteries

Manufacturing Plan



Implement “Electronic Power Solutions” Department

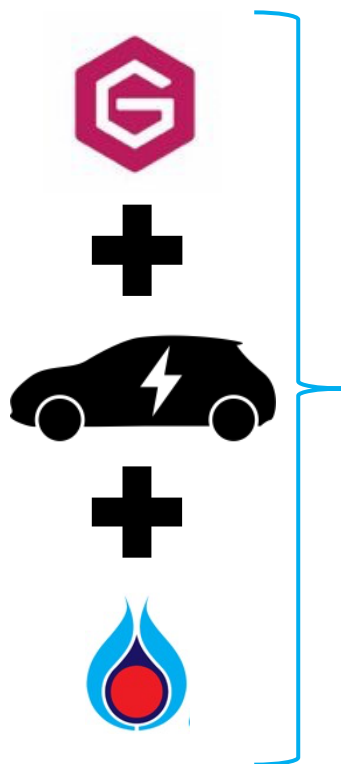
Buy manufacturing plant in Thailand

Product beta testing and government certifications

Secure initial purchase orders from FOMM and others



PTTGC now has the ability to launch production of EV batteries



Manufacturing Plan

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Outcomes

Become "First Movers" in the Thailand, and SEA, EV Battery market

PTTGC can produce 25,000 batteries per year

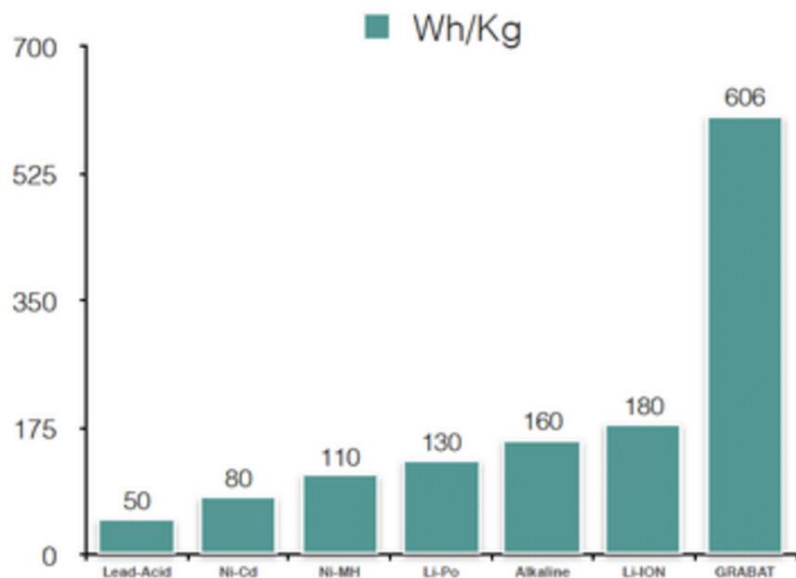
Opportunities for scale in capacity and sales



With Grabat, PTTGC can invest in creating revolutionary battery technology

Source: Economist

Grabat Lithium Sulfur



Source: Grabat

Energy:

4X

Greater than Li Ion

Weight:

66%

Lighter than Li Ion

Recharge:

33X

Faster than Li Ion

Source: RevoGreen

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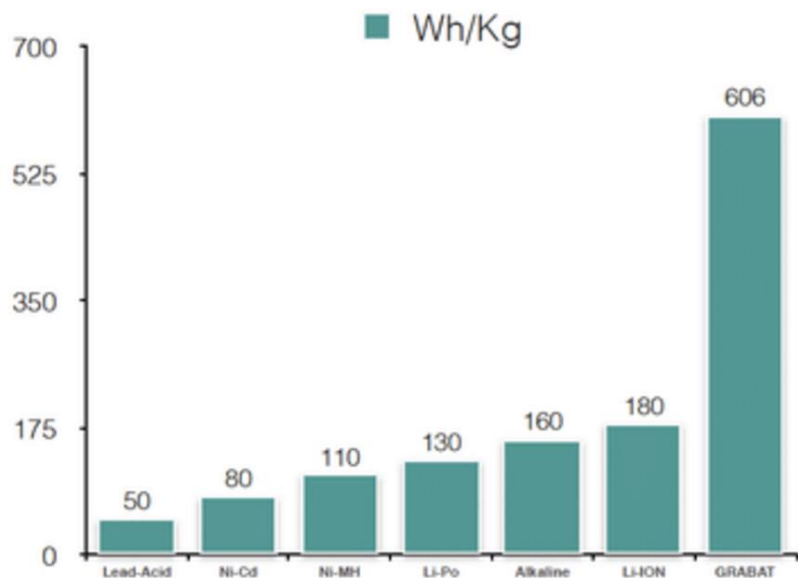




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Grabat Lithium Sulfur



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Energy:

4X

Greater than Li Ion

Weight:

66%

Lighter than Li Ion

Recharge:

33X

Faster than Li Ion

Source: RevoGreen

Lithium Oxygen Technology



Not practical until now



Impossible to overcharge



Up to 15X increase in efficiency



4X Increase in capacity

ANALYSIS

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How Optimize & Innovate work together to push PTTGC into the future

Optimize

1. Build market share in ethylene and BPA
2. Expand light weight wheel products

Overall impact:

Diversify revenue and expand product line

Innovate

1. Invest in battery manufacturing
2. Develop revolutionary battery solutions

Overall impact:

Enter EV market and develop competitive solutions



Financials



Implementation Timeline

Action
Steps

Begin initial talks with EV battery company Grabat

Invest R&D into lightweight car material

Hire team to create strategic planning sales goals

Optimize

Innovate

Today

2018

2020

2022

2024

2026

Invest in lightweight

R&D Test products

Begin selling new lightweight product

Continue R&D

Hire team

Train

Seek new ways to expand into the existing Thai market

Invest in Grabat

Secure purchase orders for products

Buy Factory

Begin sales of batteries

Monitor market and expand factory when needed

R&D Testing

ANALYSIS

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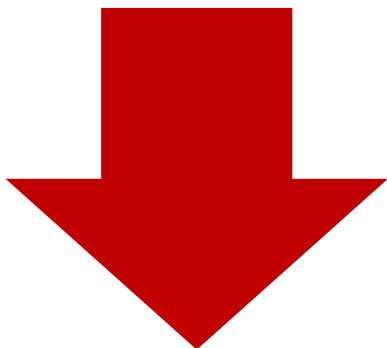
EV's provide opportunities for new products, as well as a new outlet for innovative materials

Positive



- Expected exponential growth in the EV market
- Early investment yields high profits in the future
- There exist new opportunities for using lightweight materials

Negative

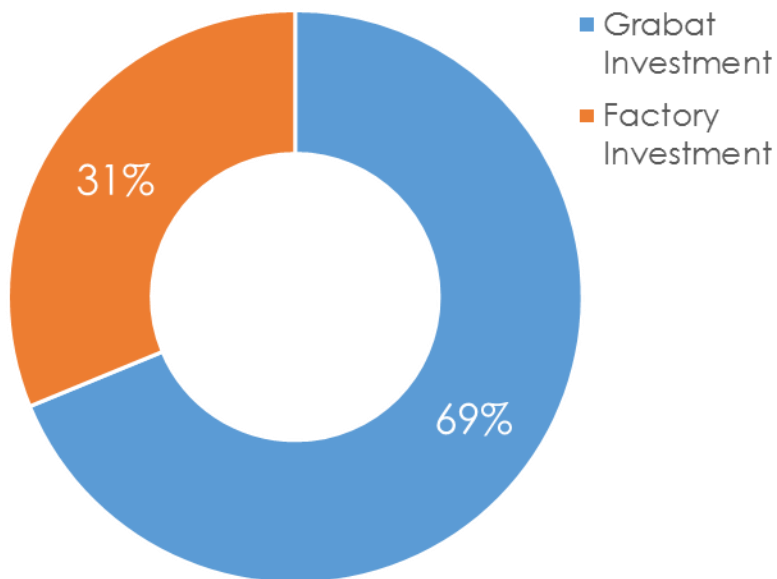


- EV adoption may be slow at first before gaining momentum
- High upfront investment in new technology and production methods

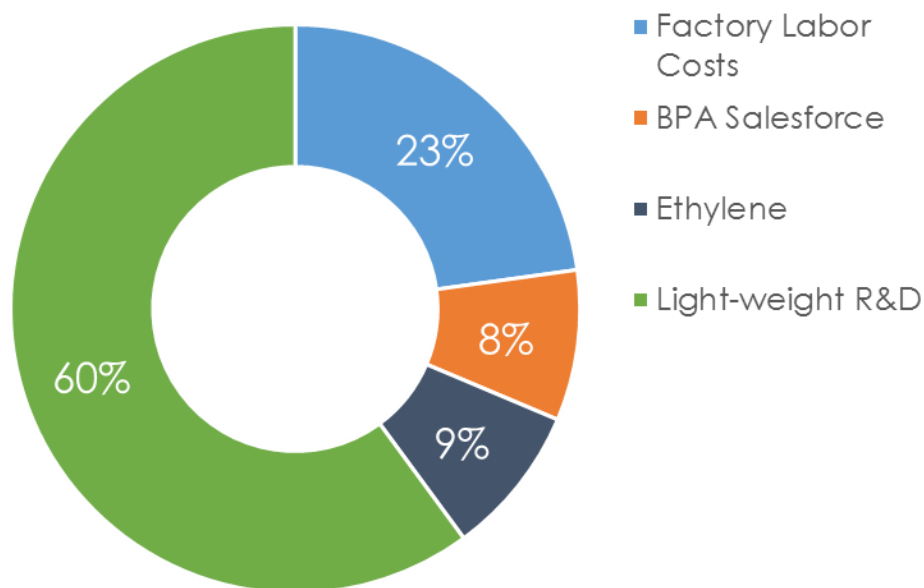


Upfront costs lead to stable future growth

Innovation Costs



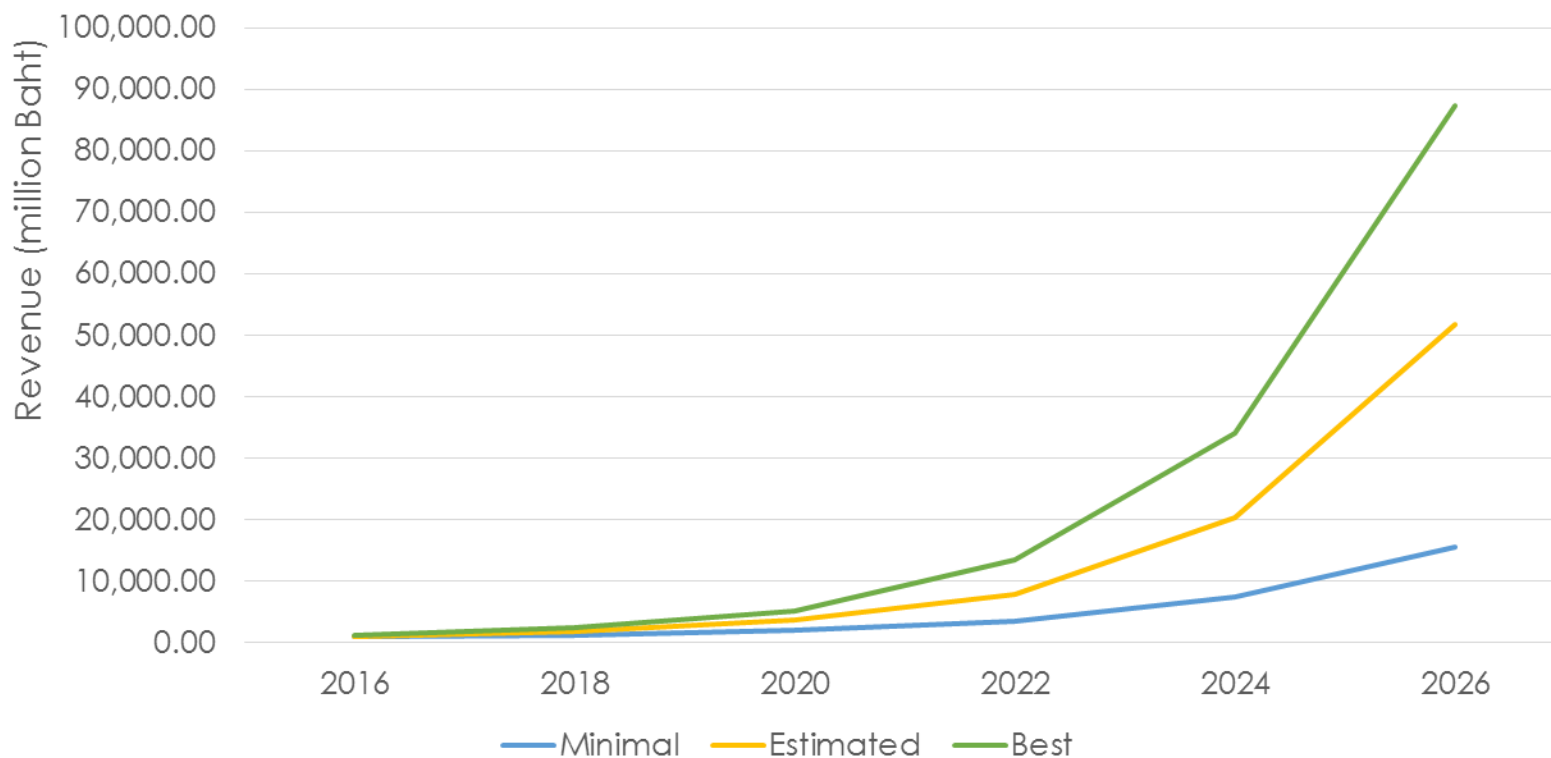
Optimization Costs



Total initial costs of 2 billion Baht drives revenue in future years



Exponential growth in EV market leads to substantial potential for PTT



Even with minimal EV adoption, large upside for PTT

Average 30% growth per year

Pay back Grabat investment within 2 years

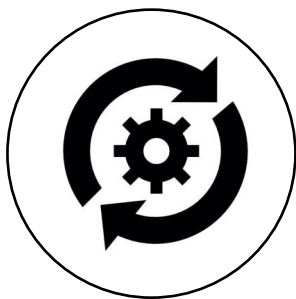


Conclusion



Key Challenge and Recommended Strategy

What actions (if any) should PTTGC take to prepare for potential change in EV market?

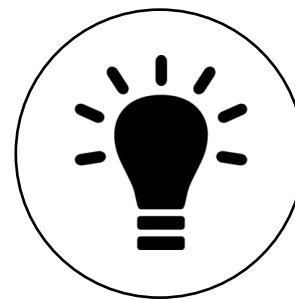


Optimize

Grow **existing areas** to adapt to new market conditions

*Invest in
lightweight
material
development*

*Focus
investments in
profitable
revenue streams*



Innovate

Exploit **new technology** to contribute to changing industry environment

*Enter EV market through primary parts
production*



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Does OPEC policy have an impact on prices?

OPEC promised to cut crude production by 700,000 barrels a day later this year, it's first major agreement since 2014

Analysts at the WSJ do not believe OPEC will follow through and the market will still be flooded

"The deal is too little, too late" – Oil prices will not rise above \$70 until at least 2018

Looking Ahead at Oil Prices

Where investment banks currently see the price per barrel of U.S. crude-oil futures in the next few quarters



Source: "OPEC Deal Fails to Lift Oil Price Forecasts." – Wall Street Journal



Charging station initiatives in Thailand

PTT has plans to invest in creating 20 charging stations next year – on top of the four already

As of June – 20 charging stations exist in Bangkok

Government:

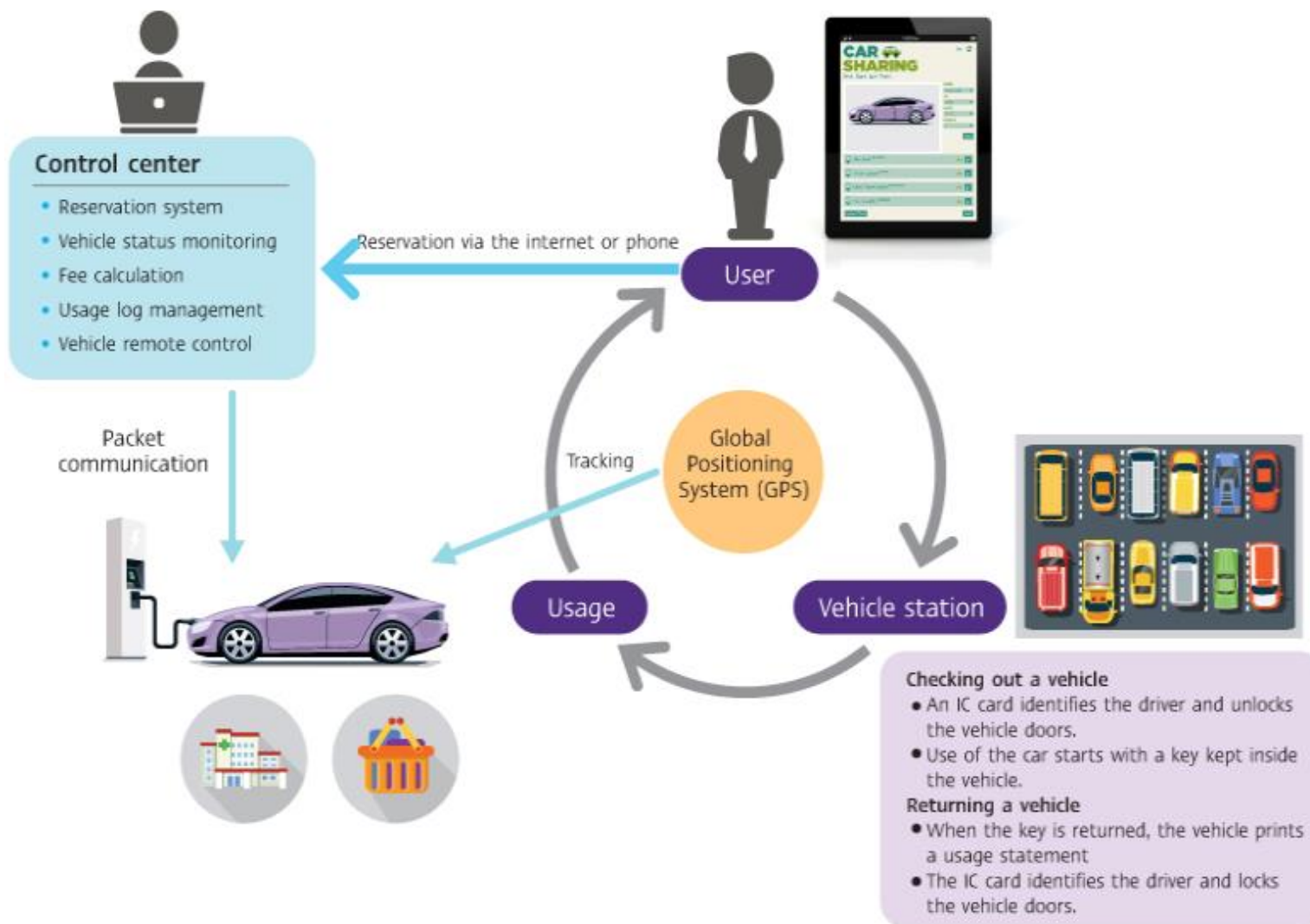
- Setting standards for car capacitor socket – Ministry of Industry
- 76 Million baht to set up the EV charging stations -Ministry of Energy

Metropolitan Electric Authority wants 10 quick charging stations to be in development

Electric Vehicle Charging Station market in SEA is to grow at CAGR of 24.89% over next 4 years



Business Model for Car Sharing



Source: Economic Intelligence Center - Siam Bank



How the Thai Government and PTT Global Chemical can work together in the EV market



Plan:
1.2 Million EV
Cars by 2036



Plan:
1000 charging
stations by
2036



Current:
Second phase
to roll out EVs
with help of
private sector



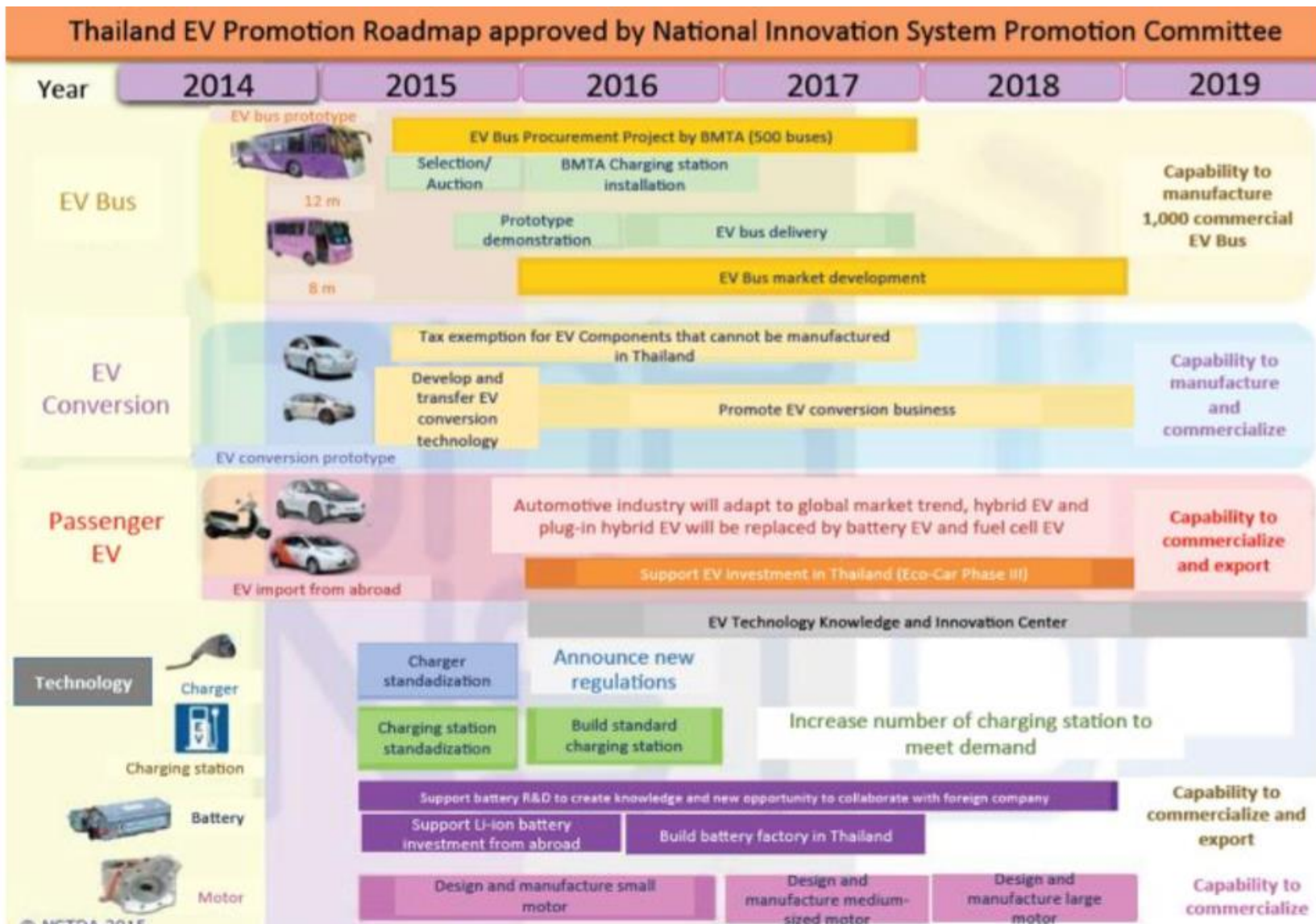
Current:
Met with Toyota,
Isuzu, Nissan and
Honda who
have reserves
but are **ready to**
support EV
manufacturing



"Thai is is ready to provide support for automakers in terms of investment promotion, financial assistance, R&D and HR development for the new industry, as well as infrastructure development"
-PM Prayut



Government Timeline of EV Innovation in Thailand

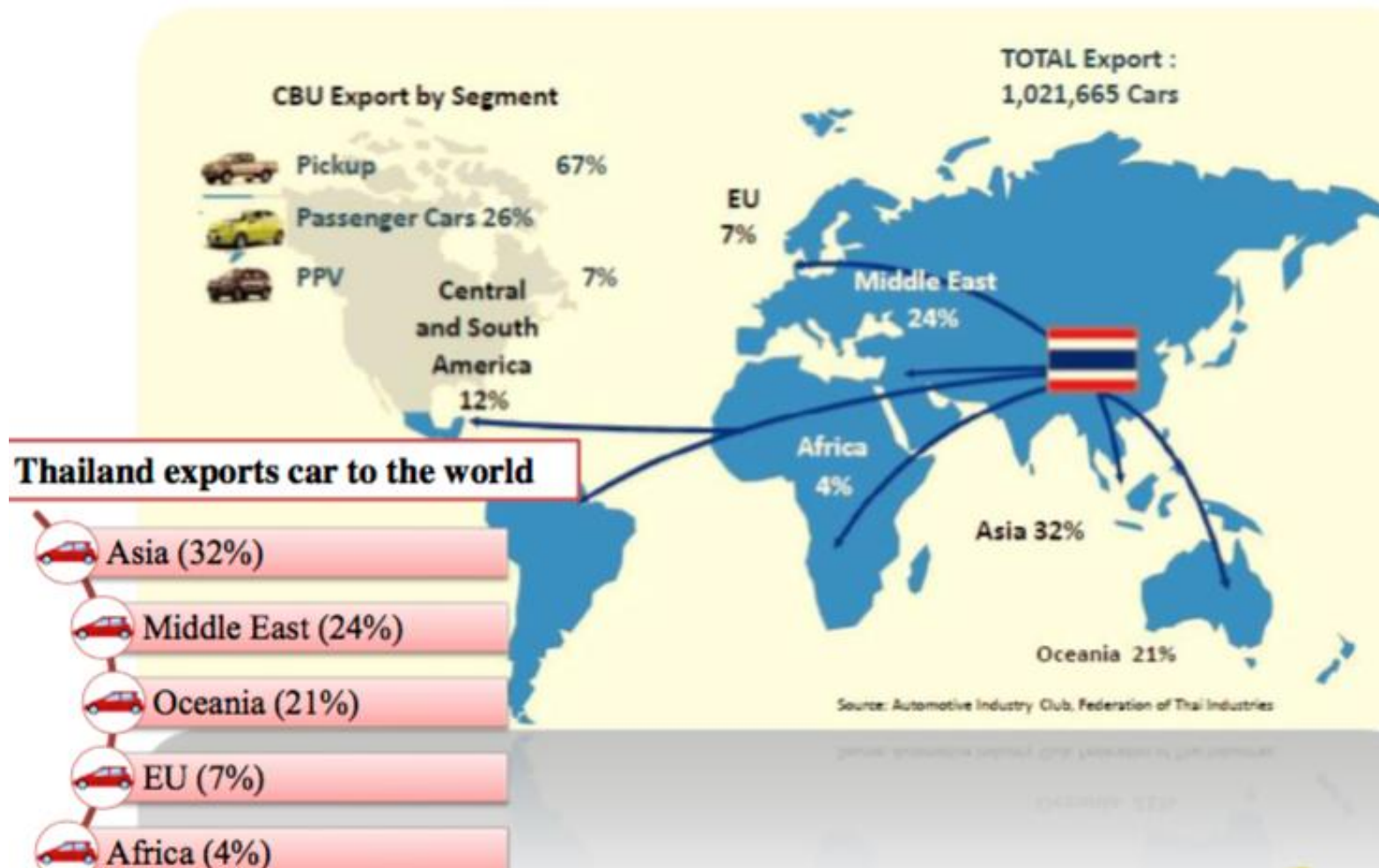


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ที่มา : สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ (สวทช.) ได้ริเริ่มความสนใจของภาคเอกชนในการพัฒนาระบบนวัตกรรมของประเทศ (กปร.) เมื่อวันที่ ๗ สิงหาคม ๒๕๕๘



PTTGC Potential for global markets in EV batteries



Source: Thailand Board of Investment



Why self driving cars are great for EVs

"Spend enough time around these self-driving vehicles and you notice that nearly all are hybrids or pure EVs."

Ubers self driving cars it's deploying in Pittsburgh are Hybrids

Google's - EVs

"EV's are easier for a computer to drive"

Services like Uber and Lyft want the lower cost per mile because of how often they can be driven

Self – Driving Cars are pushing demand for EVs

Source: USA Today, September 19th, 2016



Why this is different than the previous EV faze

2013 EV Demand

- Demand stayed flat at 3.6% from 2013 – 2014
- “Prestige had died down”
- EVs had higher sticker prices
- Strong economy actually had people buying SUVs

Current EV Demand

- Demand is growing internationally
- Comparable prices between EV and gas
- Similar MPG
- Government initiative (US and other) driving R&D and demand

Source: Time Magazine



Implementation Timeline

Action
Steps

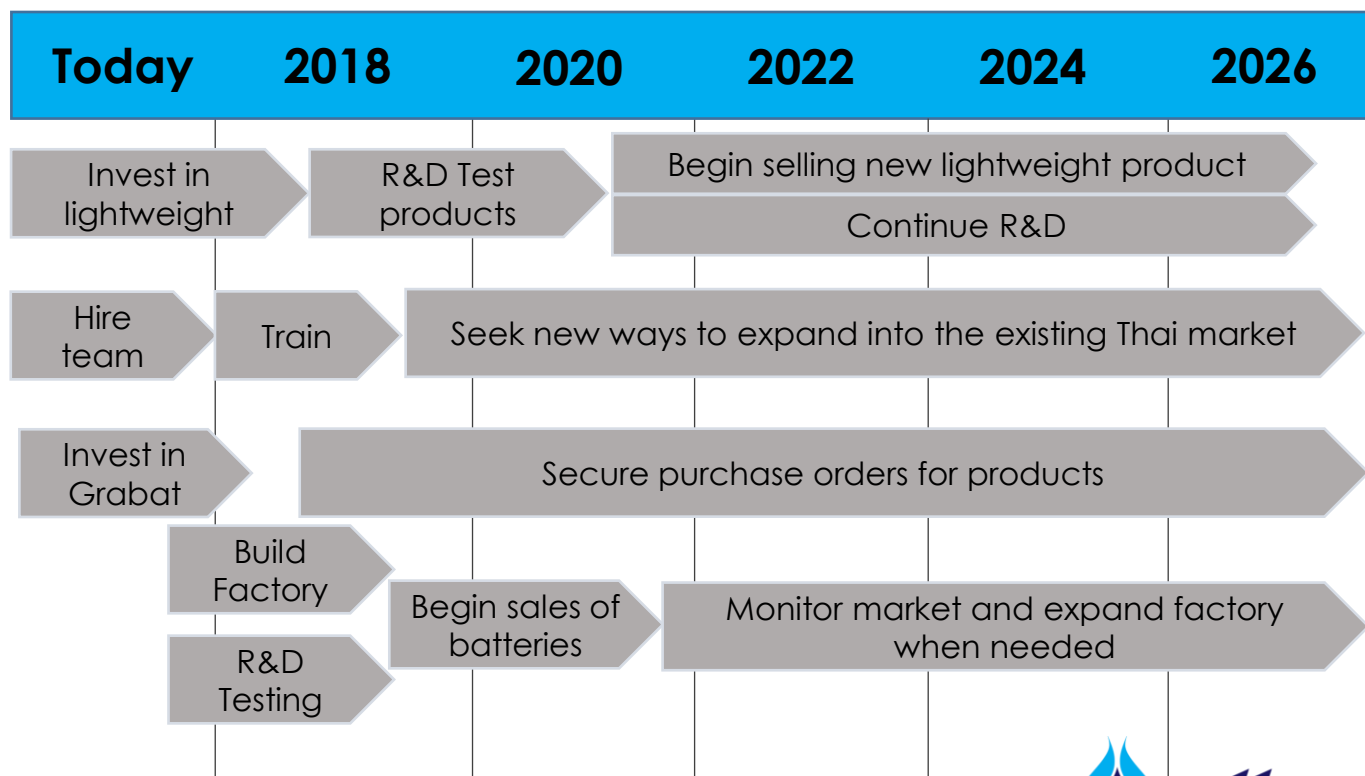
Begin initial talks with EV battery company Grabat

Invest R&D into lightweight car material

Hire team to create strategic planning sales goals

Optimize

Innovate



ANALYSIS

OPTIMIZE

INNOVATE

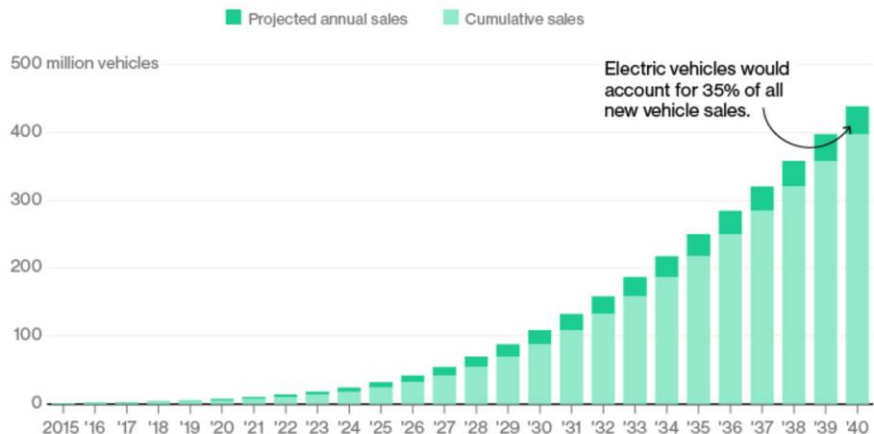
FINANCIALS



When EV Growth Is Anticipated To Accelerate

The Rise of Electric Cars

By 2022 electric vehicles will cost the same as their internal-combustion counterparts. That's the point of liftoff for sales.



Sources: Data compiled by Bloomberg New Energy Finance, Marklines

Bloomberg

Projected manufacturing timeline:



Giga Factory to begin mass production by 2018



Poland factory to have 100k capacity by 2018

MIT Technology Review

The 2020s Could Be the Decade When Electric Cars Take Over

A new analysis of battery costs predicts that EVs will start making significant gains in market share in the next few years.





Why Car Manufacturers Are Outsourcing Battery Production

In the news:



Nissan to pull plug on electric car battery production

Nikkei Asian Review - Aug 5, 2559 BE

TOKYO -- **Nissan** Motor will halt production of **batteries** for electric and hybrid vehicles, concluding that buying them from outside suppliers will ...



GM pulls plug on RHD Vauxhall Ampera-e

CAR Magazine - Sep 28, 2559 BE

GM **pulls plug** on RHD Vauxhall Ampera-e ... range – more than the current BMW i3, **Nissan** Leaf, Renault Zoe and VW e-Golf. ... Power comes from a 33kWh **battery** packed into the floor, so you've got space inside for five and ...

Problems with car companies producing EV batteries:

EV battery production can cannibalize existing business

Lack of R&D funding due to marketing priorities

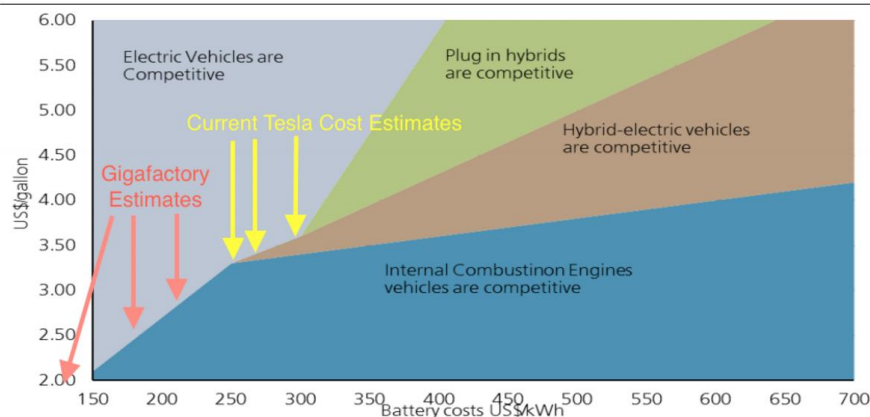
Limited ability to chase innovative technologies

Scale limited to immediate future needs



Why Did BMW Pull The Plug On Quick, Big Leadership On Electric Cars?

Figure 22: EV, H/EV and PHEV competitiveness versus ICE



Source: McKinsey, EIA



PTT Will Target Technology Companies Looking To Outsource Manufacturing

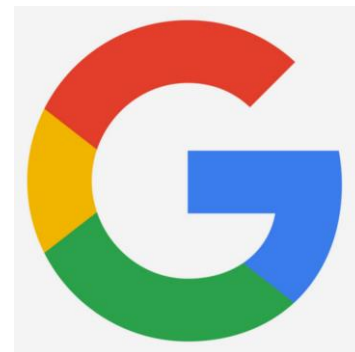
MIT Technology Review



How Might Apple Manufacture a Car?

Apple could subcontract the manufacturing required to produce a car and focus on the software, which is becoming ever more important.

Google X is currently developing sandbox concepts for **electric vehicles** to **focus on software** and outsource physical components



Current cars feature over **100M lines of code**

Electric vehicles will feature nearly **200M lines of code**

Key takeaway:

Technology companies will have massive demand to purchase top end batteries



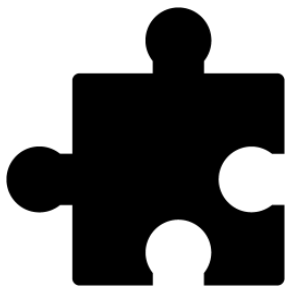
What If Li-O or Li-S Development Takes Longer Than Expected



Manufacture Li-Ion to existing design plans



Sell Li-O and Li-S batteries in smaller scale applications to bolster revenue



Continue to develop technology in order to mitigate key battery flaws



Why Grabat Will Be Interested In Partnership With PTT



Currently targeting partners to expand into mass market vehicle applications

Source: RevoGreen

Grabat is finalizing certifications and is looking for investors to begin rapid deployment.

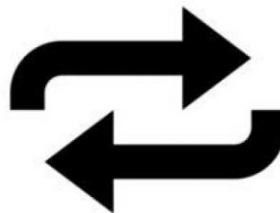


Recent company investment by Chint of \$18M for 10% stake

Source: RevoGreen



Limited experience in B2B sales and manufacturing value chain.





Static Mass vs. Rotational Mass In Transportation Efficiency

Static Mass:



For every savings in weight of 10%, vehicles see a 6%-7% increase in efficiency.

Car tires make up 10%-18% of gross vehicle weight making it a **ideal target** for weight reduction

Rotational Mass:



For every savings in weight of 10%, vehicles see a 12%-14% increase in efficiency.

This added increase in efficiency occurs during times of acceleration.

Particularly relevant in city driving situations where drivers are consistently stopping.



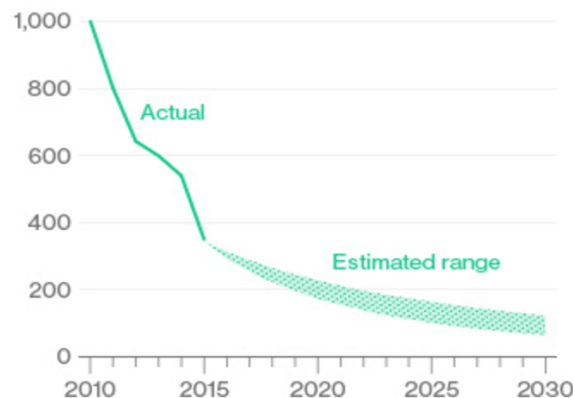
Why Batteries Are The Smartest Entry Into The EV Market

It's All About the Batteries

Batteries make up a third of the cost of an electric vehicle.
As battery costs continue to fall, demand for EVs will rise.

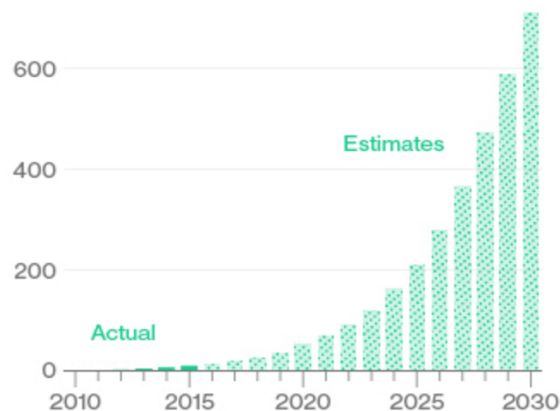
Cost for lithium-ion battery packs

\$1,200 per kilowatt hour



Yearly demand for EV battery power

800 gigawatt hours



Source: Data compiled by Bloomberg New Energy Finance

Bloomberg

Key takeaway:

Better batteries = cheaper EV



Why PTT Should Not Focus On Battery Inputs

Comparison chart

 Edit	Li-ion	NiCad
Nominal cell voltage	3.6 / 3.7 V	1.2 V
Cycle durability	400-1200 cycles	2,000 cycles
Specific power	~250~340 W/kg	150 W/kg
Charge / discharge efficiency	80-90%	70~90%
Self-discharge rate	8% at 21 °C, 15% at 40 °C, 31% at 60 °C (per month)	10% per month
Energy density	250-620 W•h/L	50~150 W•h/L
Specific energy	100-250 W•h/kg	40~60 W•h/kg
Disposal	Non-hazardous waste	Hazardous waste
Maintenance	Does not need periodic discharge	Requires full discharge before recharge
Weight	20%-35% less than Nicad	more
Memory effect	Do not suffer from memory effect	Suffer from memory effect

Li-ion makes occupies **87%** of the current light application battery market

Problems:

Battery technology is likely to change within the next 3 years

Crucial feedstock differences exist between various forms of batteries

Limited scalability and profitability in battery input market



Alternate Applications of Battery Technology Outside of EV For Risk Reduction

Transportation:



Hardware:



Consumer electronics:





Risks and Mitigations

EV adoption takes longer than expected

Government incentives don't push drivers to buy EV's or hybrids

Competition in materials and chemicals increases

Begin selling batteries to other types of buyers

Increase cost efficiency so vehicles can be sold more cheaply

Further increase R&D to remain a leader in the space



Investing in Grabat

Recent investment valued
Grabat at €180 million, or
฿ 6.98 billion

Propose investing ฿1.4 billion
in Grabat, which gives PTT a
20% stake in the company

To avoid taking out a loan
and paying interest, PTT can
use cash on hand to invest



Source: Transport Evolved

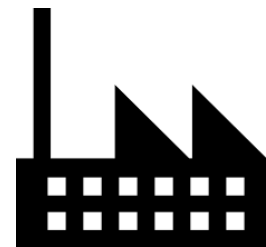




Deciding between buying and building



Buy used



Build new

634M Baht



Harder to customize

Faster production
timeline



1360M Baht

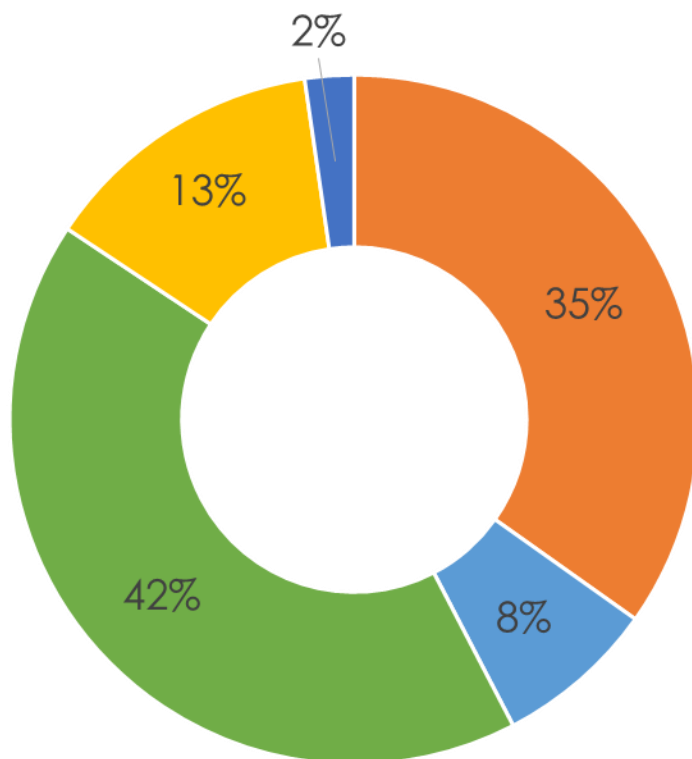
Use custom designs



Slower start due to
construction



New plant cost breakdown



Depreciation (30-yr
Straight Line):

฿ 45,280,000.00

- Industrial Building
- Electrical Systems
- Office spaces
- Additions
- Equipment

★ Based on estimates
from the Thai
embassy and a
19,000 sq. m. plant



Buying used plant breakdown

Buy price	฿ 603,000,000.00
Equipment	฿ 31,350,000.00
<u>Total</u>	<u>฿ 634,350,000.00</u>
<u>Depreciation (5-yr SL)</u>	฿ <u>126,870,000.00</u>

Source: Knight
Frank factory
sales



Labor cost breakdown

<u>Plant Manager (x2)</u>	<u>฿ 120,000.00</u>
<u>Engineer (x10)</u>	<u>฿ 200,000.00</u>
<u>Technician (x10)</u>	<u>฿ 130,000.00</u>
<u>Skilled labor (x20)</u>	<u>฿ 240,000.00</u>
<u>Housekeeper (x5)</u>	<u>฿ 45,000.00</u>
<u>Receptionist (x2)</u>	<u>฿ 24,000.00</u>
<u>TOTAL:</u>	<u>฿ 759,000.00</u>

Materials R&D and salesforce breakdown



BPA Sales force (x15)	฿	285,000.00
Ethylene Sales force (x15)	฿	285,000.00
R&D	฿	2,000,000.00
<u>Total:</u>		<u>2,570,000.00</u>

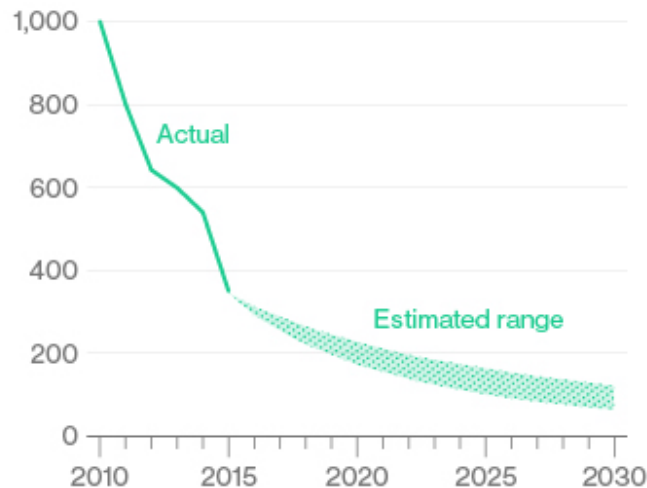
Battery efficiency drives EV demand

It's All About the Batteries

Batteries make up a third of the cost of an electric vehicle.
As battery costs continue to fall, demand for EVs will rise.

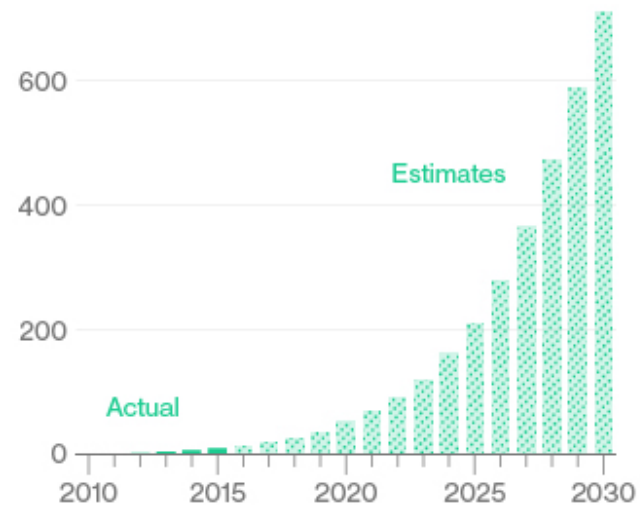
Cost for lithium-ion battery packs

\$1,200 per kilowatt hour



Yearly demand for EV battery power

800 gigawatt hours



Source: Data compiled by Bloomberg New Energy Finance

Bloomberg 



Estimated income statement

	2016 (2nd half)	2017	2018
Revenues from sale of goods and services rendered	163,307,213,485.00	413,683,206,972.62	423,737,003,536.41
Cost of sale of goods and services rendered	<u>(144,846,735,921.00)</u>	<u>(376,548,316,123.00)</u>	<u>(384,079,282,445.46)</u>
Gross Profit	18,460,477,564.00	37,134,890,849.62	39,657,721,090.95
Investment income	606,148,307.50	1,236,542,547.30	1,199,446,270.88
Other income	1,197,433,119.00	2,442,763,562.76	2,516,046,469.64
Selling expenses	(641,978,729.00)	(1,271,117,883.42)	(1,258,406,704.59)
Administrative expenses	(5,069,781,240.50)	(10,038,166,856.19)	(9,937,785,187.63)
Loss from impairment of assets	-	-	-
Provisions for business restructuring	-	-	-
Net derivatives gain	1,297,694,351.00	2,543,480,927.96	2,594,350,546.52
Net foreign exchange gain (loss)	(1,144,253,904.50)	(915,403,123.60)	549,241,874.16
Finance costs	(2,588,896,815.50)	(4,970,681,885.76)	(4,672,440,972.61)
Share of loss of investments in joint ventures	(7,241,417.50)	(14,772,491.70)	(36,931,229.25)
Share of profit of associates	<u>362,685,630.50</u>	<u>747,132,398.83</u>	<u>448,279,439.30</u>
Profit before income tax expense	12,472,286,865.00	26,894,668,045.80	31,059,521,597.38
Income tax expense	<u>(992,042,605.00)</u>	<u>(2,420,520,124.12)</u>	<u>(2,795,356,943.76)</u>
Profit for the year	11,480,244,260.00	24,474,147,921.68	28,264,164,653.61
Profit (loss) attributable to:			
Owners of the Company	11,329,871,607.00	24,324,893,049.68	28,114,438,119.61
Non-controlling interests	150,372,653.00	149,254,872.00	149,726,534.00
Basic earnings per share	2.51	5.36	6.19



Estimated income statement (cont'd)

	2019	2020	2021
Revenues from sale of goods and services rendered	433,860,735,633.14	444,021,587,358.88	451,230,694,602.34
Cost of sale of goods and services rendered	<u>(391,760,868,094.37)</u>	<u>(399,596,085,456.26)</u>	<u>(407,588,007,165.38)</u>
Gross Profit	42,099,867,538.77	44,425,501,902.62	43,642,687,436.96
Investment income	1,175,457,345.46	1,210,721,065.83	1,234,935,487.14
Other income	2,591,527,863.73	2,669,273,699.64	2,749,351,910.63
Selling expenses	(1,270,990,771.63)	(1,258,280,863.92)	(1,245,698,055.28)
Administrative expenses	(10,037,163,039.50)	(9,936,791,409.11)	(10,036,159,323.20)
Loss from impairment of assets	-	-	-
Provisions for business restructuring	-	-	-
Net derivatives gain	2,568,407,041.05	2,619,775,181.88	2,567,379,678.24
Net foreign exchange gain (loss)	(560,226,711.64)	(1,008,408,080.96)	302,522,424.29
Finance costs	(4,859,338,611.52)	(4,907,931,997.63)	(4,760,694,037.71)
Share of loss of investments in joint ventures	(22,158,737.55)	-	(44,317,475.10)
Share of profit of associates	<u>717,247,102.88</u>	<u>731,592,044.93</u>	<u>585,273,635.95</u>
Profit before income tax expense	32,402,629,020.05	34,545,451,543.29	34,995,281,681.93
Income tax expense	<u>(2,916,236,611.80)</u>	<u>(3,109,090,638.90)</u>	<u>(3,149,575,351.37)</u>
Profit for the year	29,486,392,408.24	31,436,360,904.39	31,845,706,330.56
Profit (loss) attributable to:			
Owners of the Company	29,335,106,054.24	31,285,735,526.39	31,692,868,681.56
Non-controlling interests	151,286,354.00	150,625,378.00	152,837,649.00
Basic earnings per share	6.46	6.88	6.97

Sensitivity Analysis



Worst

฿ 3,840MM

IRR = 17.2%

Expected

฿ 15,200MM

IRR = 30.1%

Best

฿ 25,900MM

IRR = 43.2%



Total market estimates

	15%	30% (BNEF estimate)	45%
2015	539,421	539,421	539,421
2016	620,334	701,247	782,160
2017	713,384	911,621	1,134,133
2018	820,392	1,185,108	1,644,492
2019	1,066,509	1,718,407	2,384,514
2020	1,386,462	2,491,689	3,457,545
2021	1,802,401	3,612,950	5,532,072
2022	2,343,121	5,238,777	8,851,316
2023	3,397,526	8,382,043	14,162,105
2024	4,926,413	13,411,269	22,659,368
2025	7,143,298	21,458,031	36,254,989
2026	10,357,783	34,332,849	58,007,982

*Bloomberg



Asian market estimates

	15%	30% (BNEF estimate)	45%
2015	157,288	157,288	157,288
2016	180,881	204,474	228,068
2017	208,013	265,817	330,698
2018	239,215	345,562	479,512
2019	310,980	501,065	695,293
2020	404,274	726,544	1,008,174
2021	525,556	1,053,488	1,613,079
2022	683,223	1,527,558	2,580,926
2023	990,673	2,444,093	4,129,482
2024	1,436,476	3,910,548	6,607,171
2025	2,082,891	6,256,877	10,571,473
2026	3,020,192	10,011,003	16,914,357

Battery revenue breakdown

	15%	30% (BNEF estimate)	45%
2017	775.93	1,374.91	1,710.51
2018	1,137.32	1,787.39	2,480.24
2019	1,608.52	2,591.71	3,596.34
2020	2,091.07	3,757.98	5,214.69
2021	2,718.39	5,449.08	8,343.51
2022	3,533.91	7,901.16	13,349.62
2023	5,124.17	12,641.86	21,359.39
2024	7,430.05	20,226.97	34,175.02
2025	10,773.57	32,363.16	54,680.03
2026	15,621.68	51,781.05	87,488.05

*Numbers in millions of Baht



Why PTT Should Not Focus On Battery Inputs

Comparison chart

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Alternate Applications of Battery Technology Outside of EV For Risk Reduction

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Hardware:



Consumer electronics:





Other Alternative For Battery Partnership

New lithium-oxygen battery greatly improves energy efficiency, longevity

New chemistry could overcome key drawbacks of lithium-air batteries.

Source: MIT



AMPTRANS

Inventors of Nano battery

Currently has working lithium oxygen batteries with **4X** capacity

Searching for strategic partners to manufacture and sell on global scale

Among **first** battery company to discover LiO functionality

Interested in deep R&D in more efficient battery solutions



Why Starting Slow Makes Sense With Battery Production

Henrik Fisker's First Electric Car Company Failed But He's Plotting A Comeback In 2017



Joann Muller, FORBES STAFF

I write about industrial innovation and the global auto industry [FULL BIO](#)

Fisker moved too quickly into the EV market, accumulated over **\$175M in debt** and filed for bankruptcy

December 3, 2013



Dow Exits EV Battery Business

DOW invested to heavily in 2013 and exited despite nearly **\$300M** in federal grants



What If EV Does Not Take Off:

Scenario 1:

1. Transition to sell non automotive batteries
2. Divest battery lab program
3. Continue to redefine company by building lightweight transportation plastics

Scenario 2:

1. Temporarily close or transition manufacturing facility
2. Build EV projections to determine if future growth is possible
3. Choose to divest batteries or wait until EV popularity regains momentum