

CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA



Absolute Assembly Co. Ltd.

- Chachoengsao, Thailand
- Automotive/renewable energy
- www.energyabsolute.co.th
- Analysis period: 2019-2023

Electric Vehicles for Public Transport

Business Spotlight

Absolute Assembly Co. Ltd. (Absolute Assembly) is a subsidiary of Energy Absolute Public Company Limited which is the leading renewable energy company of Thailand. Absolute Assembly pioneered the design, development, and manufacturing of commercial e-vehicles (EVs) in Thailand. It has succeeded in building a supply chain and supportive business ecosystem using Thai businesses and suppliers, from lithium-ion battery production up to commercial EV assembly, particularly of e-buses, e-ferries, and e-passenger vehicles (multi-purpose vehicles (MPVs)).

The company's competitive advantage lies in its rapid battery-charging technology which can charge vehicle batteries from zero to 80% in 15 minutes, developed by Taiwan-based Amita Technologies, which is majority owned by Energy Absolute. Absolute Assembly could thus pioneer the production of commercial EVs, primarily for fleet use, for which it has set up a factory with annual capacity of 9,000 commercial EVs. The company has delivered more than 2,000 commercial EVs, primarily e-buses to replace internal combustion engine (ICE) buses in Bangkok, supporting the transition to clean public transport in Bangkok under the branding of MINE reflecting its 'Mission No Emission'.

Most of these e-vehicles are being operated in Bangkok Metropolitan region through Thai Smile Bus Company Co. Ltd. EV services have expanded to other provinces outside the Bangkok Metropolitan Region. The second planned mode of expansion is based on diversification of production to related commercial EVs which will use the same core technology, such as shuttle buses, government cargo vehicles, school buses, and coach buses. At the regional level, the company believes that the ASEAN Free Trade Agreement will benefit the company, enabling it to sell commercial EVs to neighbouring countries, particularly Indonesia, Vietnam, and Malaysia.

Keywords

Commercial electric vehicles, Fast charge lithium-ion battery, EVs

Innovation

Product/service design, Manufacturing, Use and maintenance, End of life management, Resource circularity, Resource efficiency, Resource substitution

Analysis of Absolute Assembly Co. Ltd.

Context and baseline

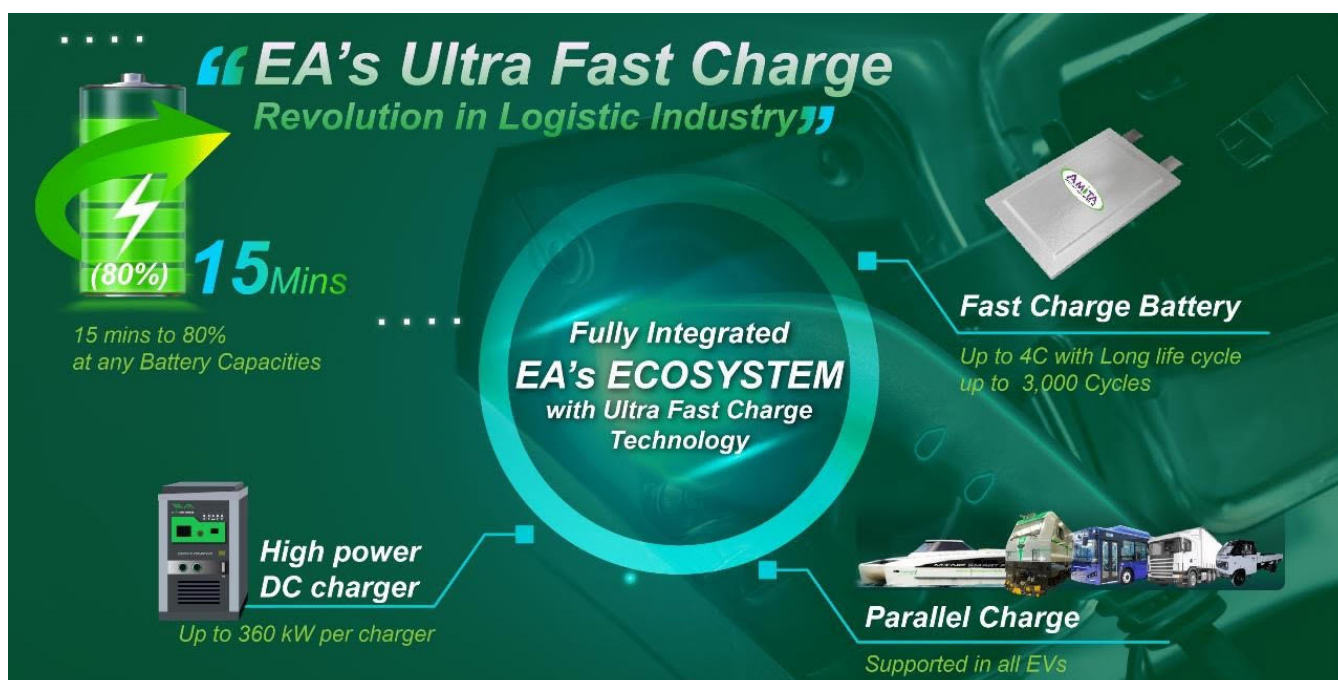
With a population approaching 11 million in 2020, Bangkok is the fifth largest city in Southeast Asia. During 2017–2022, public buses accounted for 66%–80% (by year) of total public transport journeys. Most buses have been operating since the 1990s, running with internal combustion engines (ICE), powered by diesel and/or natural gas. Negative impacts include noise, air pollution and safety concerns.

The Thai government has formulated a national policy for a long-term low-emission transition of the transport sector, known as Thailand's EV30@30 mission. This policy aims to increase the share of electric vehicles (EVs) to 30% of automobile production in Thailand, including the domestic manufacture of the EV batteries. This would equate to the production of 725,000 EV cars and pick-ups plus 675,000 EV motorcycles during 2026–2030. The interim target for 2025 foresees the annual production of 18,000 commercial EVs (bus/truck) in Thailand.¹

In 2006, Energy Absolute Public Company Limited was established to generate renewable energy including solar, wind, purified glycerine, and biodiesel energy.² In 2013, it was registered with the Stock Exchange of Thailand under the name of Energy Absolute Public Limited Company with more than 50 subsidiaries. In 2021, the company identified an opportunity to benefit from the Thai Government's incentives and support to 'S-Curve', or new generation industries, which included the automotive sector.³

In addition, the company has been a founding member of the Thai Renewable Energy Association (RE100 Thailand Club), a driving force in renewable energy and energy efficiency in Thailand, focused on maintaining Thailand's industrial competitiveness.

The company is contributing to the acceleration of technologies related to both renewable energy and the transition from conventional internal combustion automobiles to EVs. The company has built an E-mobility eco-system starting from investing in a lithium-ion battery factory, vehicle assembly operation, and the development of EV charging stations. By December 2021, the first phase of the Energy Absolute's battery factory had a capacity of 1 GWh, the largest factory in Southeast Asia to produce from cell to pack with high-energy density, enabling longer vehicle range, lower weight, and lower battery price. Another subsidiary of Energy Absolute, Absolute Assembly Co. Ltd. Thailand, has since constructed a commercial EV assembly factory with the ability to expand to assembling 9,000 vehicles annually. Another component of Energy Absolute's integrated EV system is the installation of 2,658 high quality and reliable EV charging stations for E-vehicles (DC ultra-fast charge, 360 kW with an EV cloud system) under the brand of EA Anywhere stations.



1 <https://www.nationthailand.com/blogs/special-edition/40000851>

2 Six renewable power plants in operation with a total capacity of 664 megawatts (MW). Total manufacturing of biodiesel, purified glycerine, and by-products, up to a production capacity of 650,000 litres per day.

3 <https://www.truedigitalpark.com/en/insights/articles/15/10-thai-s-curve-industries>

Innovation

In 2020, the e-bus and e-ferry prototypes of Absolute Assembly received the best design and production award from the National Innovation Agency (NIA), a public organisation, on the basis of the high capacity of their cell-to-pack batteries, their durable structure for heavy use, their capability to deliver longer range based on their high-energy density, and the fast charging of the battery. The final design of the company's Mission No Emission (MINE) bus model incorporates a 250–350 kWh lithium-ion battery that can be 80% charged in 15 minutes, which is much faster than those of competitors (45 to 60 minutes). The e-bus can accommodate up to 100 passengers and has a range of up to 250–350 kilometres per charge. Raw materials, and the high quality and precision of vehicle production, result in resilience in tropical climates and increased safety. The buses incorporate universal design standards to enhance mobility for the disabled, and include information features such as Global Positioning Systems (GPS) enriched by Artificial Intelligence systems (including for battery management), an electronic ticketing system, and security in the e-buses, including CCTV, to increase the comfort and safety of passengers. Of course, the main feature of the MINE buses is that the tailpipe air emissions are eliminated, thus generating zero PM 2.5, and they are quiet. They are an exemplary circular economy product in that the batteries can be recharged on a daily basis for approximately 3,000 charging cycles.

In 2023, about 2,200 airconditioned e-buses of the Thai Smile Bus Company, operated by Energy Absolute Public Company Limited, were operating on 123 routes in Bangkok Metropolitan and its five adjacent vicinity provinces, serving nearly half of the Bangkok Metropolitan Transport Authority's (BMTA) total public bus routes.

They accommodated 300,000 passenger trips per day, and the e-bus service is considered very attractive to passengers.⁴ To serve e-buses and e-trucks, the company developed more than 20 dedicated bus- and truck-charging stations providing direct current (DC) to the battery of the EV.

As further innovations, Energy Absolute has also designed and started the commercialisation of 1,000 kg payload MT30 mini e-trucks, the MINE Smart Ferry, and e-locomotives (for passenger or freight trains), each built around the company's proprietary lithium-ion battery technology, combined with efficient motors, and country- and application-specific designs to maximise performance in specifically targeted mobility segments.

Circular Economy impact

The development of EVs for Thailand's public transport system contributes to the key circular economy strategies of resource efficiency, resource circularity and resource substitution.

Resource efficiency, or the efficient use of all materials, energy and water and minimisation of waste and emissions, is most evident in the use phase of the EVs. The e-buses have been designed and optimised for energy efficiency, to minimise battery size while maximising vehicle range, through the inclusion of energy efficient components and systems (motor, air conditioning, lighting, brake energy recovery, etc.), monitoring and optimisation of battery and electric systems, and lightweighting and efficient aerodynamics of the entire vehicle. Compared to ICE buses, the EVs have no internal combustion engine and hence do not emit any air pollution (greenhouse gases, soot, PM 2.5) or noise from their drive engines. Nevertheless, the recharging of batteries with grid electric power increases indirect GHG emissions, hence the net GHG emission reduction is dependent on the structure of the power generation. It is estimated that each e-bus in regular city public transport duty will reduce net GHG emissions by 100 tonnes/year over a period of at least 10 years.

Resource efficiency is also achieved in the manufacturing process during painting, which consumes the highest volume of water resources in vehicle production. In 2023, through technical monitoring of water quality, the company started to reuse water and save water consumption in the painting process by about 30%.⁵

EV public transport is an enabling technology for substitution to renewable energy, or resource substitution, because switching to renewable power generation for EV charging would mitigate all GHG emissions. Achieving this goal is dependent on the clean energy transition at large, for which Energy Absolute is one of the key business players in Thailand with its extensive wind and solar energy assets.

The company is also contributing to resource circularity, or the repeated recovery and reuse of end-of-life materials. Specifically, the Li-ion battery is developed for reuse upon exhaustion of its initial lifetime as an EV battery, which is expected to be more than 3,000 charging cycles. The EV battery can then be recovered from the EV, and refurbished and remanufactured into a stationary battery for energy storage, e.g. for a rooftop solar energy system. On the other hand, the battery which does not meet the

⁴ <https://www.infoquest.co.th/2023/347258>

⁵ One Report, Energy Absolute Public Company, 2023, https://www.energyabsolute.co.th/annual/OneReport_2023EN.pdf

company standard would be submitted to elemental mineral extraction process and utilisation.

For end of life of EVs, the company is considering the development of recycling facilities and setting up an ecosystem to maximise the second life of batteries and other components of EVs.

Business and market impact

The commercial EV business of Absolute Assembly has significantly increased revenue proportion of the conglomerate business group among biodiesel business, renewable energy power plant business, electrical vehicle business, lithium-ion battery development, manufacturing and distribution business, and other service businesses from 8.07% in 2021 to 30.97% in 2023. On the other hand, the decline of revenue proportion of biodiesel business from 40% in 2021 to 17.87% in 2023.⁶

The company has manufactured more than 2,000 commercial EVs, primarily e-buses to replace ICE buses in Bangkok, supporting the use of clean public transport in Thailand. In 2024, the company anticipates delivering 3,300 commercial EVs, increasing to 5,600 in 2025, and 8,000 in 2026.

Under a carbon-emission credit trading agreement of 2020, Switzerland-based KliK Foundation will purchase carbon reduction credits of 5 million Tonnes of Carbon (TCO₂) generated by Thailand-based Energy Absolute through the International Transferred Mitigation Outcomes (ITMOs) under the Paris Agreement, Article 6.2. The arrangement is based on 100 tonnes carbon credit annually over 10 years period, for each operational EV. The company has delivered greenhouse gas emission reductions as ITMOs from the Bangkok E-Bus Programme across the country. It is the first issuance of ITMOs for use in Nationally Determined Contributions (NDC) use under the Paris Climate Agreement which was a beacon moment for climate action and received the approval from Thailand Greenhouse Gas Management Organisation ('TGO') for greenhouse gas mitigation. The amount of emissions reduction during October 2022 to December 2022 is 1,916 tonnes of carbon dioxide equivalent (tCO_{2eq}).⁷

The Bangkok Metropolitan Council is preparing to enact a law, based on a 2030 time horizon, on the transition from diesel and natural gas buses to electric buses in Bangkok Metropolitan area under the 'Future Bus Act' which targets replacement of ICE buses with battery EVs.⁸ The company is the

first mover in this business area, and so is likely to have the opportunity to be the front runner for providing EVs for the public transportation system in the Bangkok Metropolitan area and elsewhere in Thailand. In addition, the company plans to provide various types of mass transportation equipment such as shuttle buses, cargo vehicles, school buses, and coach buses.

At regional level, the company believes that the ASEAN Free Trade Agreement will benefit the company by facilitating access to large commercial e-vehicle markets in neighbouring countries.⁹ Facilitating rapid increase in consumption of commercial e-vehicles is the fact that the price of lithium-ion batteries is continuing to decrease.

Stakeholders

Driven by the Thai investment regulations on vehicle manufacturing, the e-buses consist of at least 40% locally sourced materials, including EV batteries. Many local suppliers are involved, not only large-scale factories, but also small and medium-sized enterprises supplying components such as car mirrors, seats, wheels and electronic components and systems, including air conditioners. These suppliers have significantly upgraded their technologies and skills, driven by EV manufacturing specifications and increasing demand for EVs. The manufacturing of commercial EVs makes contributions to Thailand's climate goals by transitioning the transportation mix in favour of e-buses, and contributes significantly to Thailand's policy to develop the EV industry.

Direct employment by the company provides benefits to 1,000 local people in Chaochoengsao Province.

In 2023, the company received a loan of the Asian Development Bank (ADB) of THB 3.9 billion (about EUR 91 million). In addition, the Japan International Cooperation Agency (JICA), and the Export-Import Bank of Thailand (EXIM Thailand), with ADB as the mandated lead, arranged support to mobilise both international and domestic private sector capital.¹⁰

EVs and components have been tested and certified for safety standards by several organisations, such as the certification of the e-ferry by the Marine Department, the testing of hybrid locomotives by the State Railway Authority of Thailand, and the meeting of standards for batteries in 2023 by the Thailand Industrial Standards Institute and UNR100 standard for battery quality and safety in each series of e-vehicles.

6 Ibid.

7 https://www.energyabsolute.co.th/annual/OneReport_2023EN.pdf, p. 18.

8 <https://www.kaohooninternational.com/sustainability/525432#:~:text=%E2%80%98Energy%20Absolute%E2%80%99%20aspires%20to%20be%20the%20Thai%20Government%E2%80%99s,EV%20buses%20within%20seven%20years%2C%20according%20to%20analysts.>

9 <https://thethaiger.com/news/business/thai-firm-energy-absolute-predicts-20-revenue-growth-by-2024-driven-by-ev-demand>

10 <https://www.eqmagpro.com/adb-energy-absolute-sign-3-9-billion-thai-baht-deal-for-e-bus-purchase-enhancing-sustainable-transport-in-thailand-eq/>

Implementation

Due to their experiences in providing components to the established car manufacturer with internal combustion engines, local suppliers did not accept that there was significant domestic demand for EVs. Accordingly, they were reluctant to invest in developing the necessary technology and skills. As the first mover in commercial e-vehicle innovation and production in Thailand, Absolute Assembly faced challenges in onboarding component suppliers. Although local suppliers enjoy logistical advantages given their proximity to the company and lack of tariff barriers, this did not sufficiently counterbalance their lagging technologies.

It remains a challenge to persuade bus operators to switch to EVs. In the near future, and even with high demand for commercial EVs, the upgrading of fleets will face financial challenges because the cash flow generated by commercial EVs is minimal compared to financial returns from the renewable energy generation businesses.¹¹



¹¹ <https://asia.nikkei.com/Business/Automobiles/Thai-clean-power-provider-hears-skeptics-rides-electric-bus-bet>

¹² Ibid.

Takeaways

Diffusion of a new circular economy product is dependent on accessing big actors that generate large impacts and enable economies of scale, in this case, the bus fleet operation of the Bangkok Metropolitan Transport Authority. A strategy that initially targets niche markets with limited scale is not advisable.

Companies need to make high-quality products that will drive behavioural change, for example, that EV buses are equipped with quality features, such as air conditioners, CCTV security and easy access.

Suppliers are crucial, and should be promoted for the country technology development, but may be problematic in terms of the quality of their products, and scaling up production.

The government banks and financial institutions need to assist the small- and medium-sized bus operators in the switch from internal combustion vehicles to EVs to overcome financial challenges.

Competitors are welcome: they expand the industry faster and drive technological change.¹²



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