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SOBIE AVIATION

WHITE PAPER

The Future of Super Short-Haul Air Travel in Southeast Asia

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Foreword

The Aviation Studies Institute, based at the Singapore University of Technology and Design, has been established to address the needs of aviation stakeholders and advance the development of aviation in the Asia-Pacific region. In this paper we focus on Southeast Asia and consider the future of the region's super short-haul air transport services.

As the economies and populations in Southeast Asia grow, the demands placed upon the transportation networks has evolved. Significant attention has been paid by regional organisations and individual states into transport infrastructure investments. New road and rail links have been established in several parts of the region with more to follow. Several airports have been expanded and several new airports are being constructed.

Airline and airport route networks will adjust correspondingly and reflect changing travel behaviours, as well the influence of government policies.

Economic development appears to be the main driver behind the demand for transport, whilst government policies have influenced the transport landscape. However, will improvements to ground transport infrastructure reduce the current reliance on air transport? Could an increasing emphasis on the UN Sustainable Development goals by policy makers and rising concerns for environment sustainability by the traveling public, bring about additional influences? Are government policies aligned?

This White Paper has been commissioned by the Aviation Studies Institute to assess the status of 'super short-haul' air traffic passenger services, and weigh up the future outlook. It forms the first of a two-part analysis that considers the broader integration of transport connectivity in Southeast Asia.

The paper's author, Brendan Sobie, is a well-known thought leader in air transport developments.

This topic complements an area of work undertaken by the Aviation Studies Institute. The institute has been performing research and developing user-friendly software to predict future passenger flows through airport and airline route networks based upon changes to transport connectivity and macroeconomic conditions.

We hope that you find the analysis and recommendations provided useful and thought provoking.

Mr Jamie Bloomfield

At the Aviation Studies Institute we are keen to utilise research to solve real-world challenges and work with industry partners to translate our outcomes into industry-wide capabilities. If we have capabilities you want to leverage, if there is an improvement you would like us to investigate, a partnership opportunity you would like to explore, or a way we can help aviation in Asia-Pacific to develop further, please get in touch:

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You can also find more details on our website: https://asi.sutd.edu.sg/

On behalf of the Aviation Studies Institute, Assistant Professor Nuno Ribeiro recently completed research into Airfield Management and Economics.

If you are keen to learn more about this work, please let us know.

Assistant Professor Nuno Ribeiro has an interest in developing and applying operations research methods, such as optimisation, machine learning and simulations to support the decision-making processes in transportation system management.

His work has received attention from academia and industry stakeholders reflected in several research awards, such as the Anna Valicek Medal by the AGIFORS in 2018, best the PhD dissertation by INFORMS-AAS in 2019 and the best paper award by INFORMS-AAS in 2020.

Nuno received his Ph.D. in Transport Systems in 2019 from the University of Coimbra (Portugal). During his stints as a Ph.D. student, he also held visiting research positions in MIT and Carnegie Mellon University.

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About the Author

This paper was authored by Brendan Sobie. Brendan is an independent analyst who has been working in the aviation industry for over 20 years. He is a prolific author, having written several white papers, studies and commentaries on aviation issues across Asia over the last few years. He has provided strategic aviation-related advice to a wide range of organisations including airports, airlines, aircraft leasing companies, development banks, investment banks and IT suppliers.

Brendan is widely recognized as a thought leader on aviation issues in Asia-Pacific, giving frequent presentations and is often quoted by the international media. He previously served as chief analyst for CAPA from 2011 to 2019, based in Singapore, and as an editor for Flightglobal from 2000 to 2011, based in the USA, Singapore and UK. He holds a degree in industrial and labour relations from Cornell University in New York, USA.

Brendan Sobie

Introduction

This white paper examines the super short-haul segment of the Southeast Asia aviation industry and looks at potential opportunities to grow and transform this segment, particularly as new zero emissions aircraft and propulsion technologies become available. A super short-haul route is defined in this paper as a route of less than 500 km.

Globally the super short-haul segment accounts for about 30% of scheduled domestic flights and about 9% of scheduled international flights (based on OAG data for 2023). In terms of seats, the super short-haul segment accounts for about 21% of the global domestic market and 6% of the international market. The average number of seats globally on a scheduled super short-haul flight is about 98 seats on a domestic flight and about 124 seats on an international flight.

The data used in this study excludes unscheduled flights and flights operated by air taxi operations. Flights with aircraft of less than 19 seats are usually in the air taxi category and fall under a different set of regulations than scheduled air carrier flights. In Southeast Asia there are some scheduled flights using small aircraft with as few as 19 seats although 99% of super short-haul flights use aircraft with at least 70 seats. There are air taxi or charter operators using aircraft with less than 19 seats, but this segment is very small in Southeast Asia and is generally not captured in airline schedule databases.

Electric vertical take-off and landing aircraft (eVTOLs) are also a different segment and are not included in this study. eVTOLs, which have generated interest from several Southeast Asian airlines and governments, are essentially air taxis providing urban air mobility with a small number of seats (usually four or five).

This paper analyses current fixed wing scheduled operations and future opportunities in the super short-haul segment (flights of less than 500 km). These flights are generally between two airports although scheduled seaplane flights can also qualify in some cases. There is potential for electric seaplane operations in Southeast Asia but only some of these would be scheduled as sightseeing and charter flights with seaplanes are more common.

Executive Summary

In Southeast Asia as well as globally, the super short-haul segment has been slower to recover from the pandemic than other segments, resulting in a decline in the portion of flights that are super short-haul. Globally scheduled domestic super short-haul flights were 82% recovered in 2023 (compared to 2019) and international super short-haul flights were 78% recovered. This compared to an overall domestic recovery rate of 93% for all types of scheduled flights and an overall international recovery rate of 87% (based on OAG data for 2023 vs 2019).

The seat capacity recovery rate has been higher due to the average aircraft gauge increasing. Globally, seat capacity in the international super short-haul segment was 88% recovered in 2023, nearly matching the overall international market recovery rate of 90%. Domestic super short-haul seat capacity was 87% recovered, significantly lagging the 101% overall domestic recovery. This suggests that super short-haul domestic flights have become less popular in the post-pandemic period – perhaps driven by an increased focus on sustainability with some passengers reconsidering whether they need to fly, particularly on routes where other modes of transport are available. Some countries, particularly in Europe, have been encouraging passengers to use other modes of transport when travelling short distance. France in May 2023 even began banning some domestic flights between cities that are connected by train services in less than two and a half hours. Other European countries have also experienced a significant shift in domestic travel from air to rail.

In Southeast Asia, the domestic super short-haul segment also has recovered more slowly than the overall market and with the average aircraft gauge increasing. The number of domestic super short-haul flights in Southeast Asia was only 68% recovered in 2023 while seat capacity was 73% recovered. This compared to a 79% recovery rate for frequencies and 84% for seats in the overall Southeast Asian domestic market. The recovery rates in Southeast Asia's international super short-haul market have been slightly above average but this is a much smaller market.

Southeast Asia's portion of super short-haul flights globally has declined but the region's global share of total capacity has also declined as it has recovered slower than most other regions. In 2023, Southeast Asia accounted for 6% of the global super short-haul market based on international frequencies, 8% based on international seats, 9% based on domestic frequencies and 11% based on domestic seats.

Southeast Asia has a relatively large super short-haul domestic market. The super short-haul segment accounted for 40% of Southeast Asia's total scheduled domestic frequencies and 9% of scheduled international frequencies in 2023. It accounted for 32% of Southeast Asia's total scheduled domestic seats and 7% of scheduled international seats.

Given the relatively large size of the domestic super short-haul market it is surprising there have not been any commitments from Southeast Asian carriers for zero emission short-haul aircraft. It is this segment of the market where net zero carbon goals are achievable in the relatively not too distant future.

Several Southeast Asian airlines and countries have committed to sustainable aviation fuel (SAF), which should result in gradual emission reductions over the next several years. However, SAF is not a solution for zero emissions and its impact will be relatively small for at least the next several years given supply or feedstock issues.

It will also be at least a decade or two before zero emission aircraft and propulsion technology is available for most aircraft. There will be continued incremental improvements to existing technology, but in most segments of the market no gamechangers are likely for the foreseeable future. However, the super short-haul segment is an exception as there is near-term potential to adopt new propulsion technology on very short flights, particularly on small aircraft.

Small electric and hybrid electric aircraft are now under development and being sold, providing airlines with options for replacing smaller turboprops or launching new regional operations with an environmentally sustainable approach that was not previously possible. Hydrogen and electric conversion kits are also now under development and being sold for turboprops of all sizes, providing airlines with options for converting even large turboprops (such as the ATR 72 and De Havilland Canada Dash 8-400).

Turboprops accounted for 39% of total super short-haul flights in Southeast Asia in 2023, including 43% of domestic flights and 14% of international flights. The ATR 72 by far the most common turboprop in Southeast Asia, accounting for 33% of all super short-haul flights in 2023. The remaining proportion is made up of several other types of turboprop aircraft.

Globally the turboprop share of super short-haul flights is lower. In 2023, turboprops accounted for 36% of all super short-haul flights globally, including 24% of international flights and 38% of domestic.

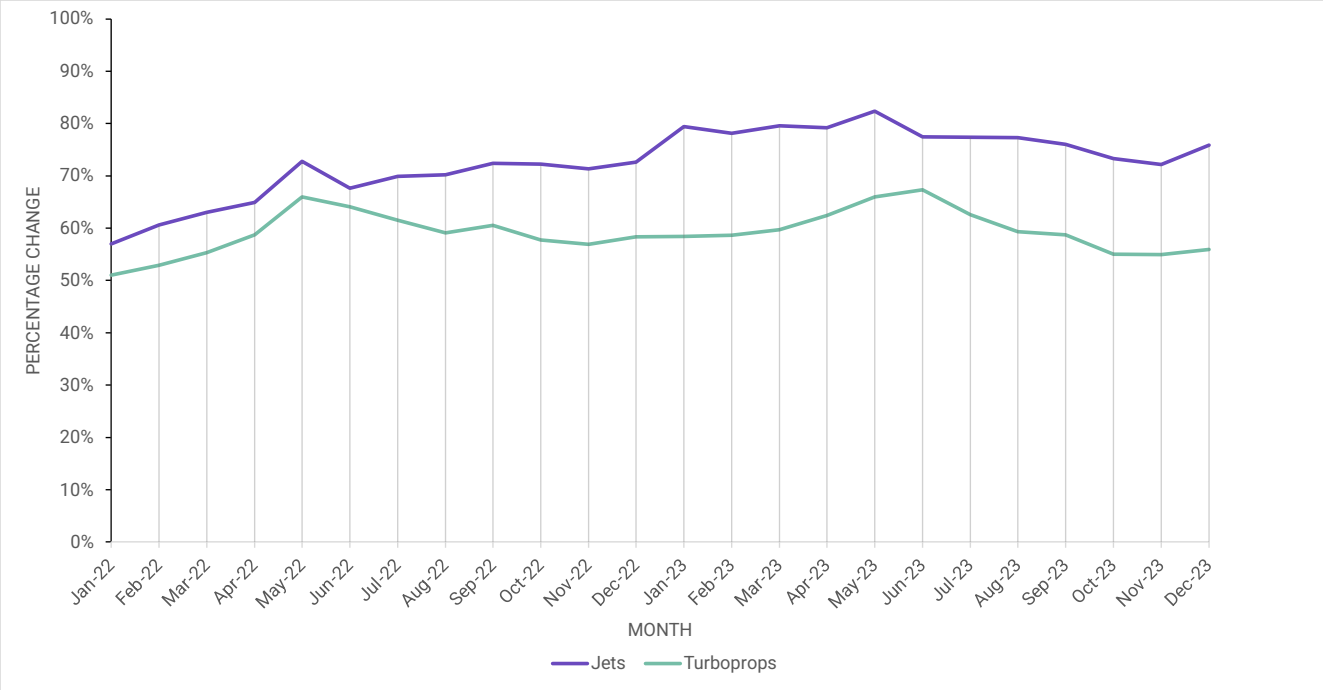
Despite the relatively high share of turboprop flights in Southeast Asia there have not been any commitments from Southeast Asian airlines in converting existing turboprop aircraft to hydrogen or electric propulsion or in acquiring new electric or hybrid electric aircraft. The principal recommendation of this study is for Southeast Asian airlines and governments to consider alternative propulsion options for the super short-haul segment. This could require a mindset change for airlines, airports and governments.

Southeast Asian airlines have been reducing their turboprop fleets in recent years, increasing their reliance on jets even on the shortest routes and resulting in an increase in average aircraft gauge. The number of turboprop flights in Southeast Asia has declined by nearly 40% compared to prior to the pandemic as the number of turboprops operated has been reduced from about 300 aircraft at the beginning of 2020 to about 200 aircraft currently.

This is a concerning trend as turboprops are generally more efficient and emit less carbon dioxide per passenger than jets on very short sectors. The dwindling turboprop fleet in Southeast Asia is also a concern as it provides less opportunities for potential conversions to electric, hybrid electric, hydrogen electric or hydrogen powertrains.

The turboprop and jet recovery rates for super short-haul flights in Southeast Asia were only about 5 percentage points apart at the beginning of 2022 but have since been diverging and are now about 20 percentage points apart. The turboprop recovery rate has plateaued at roughly 60% for the last 18 months due to the 40% cut in the turboprop fleet and will not be able to reach significantly higher levels unless Southeast Asian carriers rebuild their turboprop fleets. The jet recovery rate has continued to increase as the narrowbody fleet was not cut significantly and airlines have been able to gradually add more super short-haul jet flights as more of their narrowbody aircraft have been reactivated. The jet recovery rate is now almost 80% and could reach 100% within the next year. The jet recovery rate includes all types of jets (regional jets, narrowbody and widebody) but narrowbody accounts for about 97% of super short-haul jet flights in Southeast Asia.

Figure 1 - Recovery rate for jet and turboprop super short-haul flights: Jan 2022 to Dec 2023



Note: Recovery rate calculated based on the same month of 2019; there was a jump in the jet recovery rate in January 2023 partially due to the smaller base of January 2019 compared to December 2019 as the number of flights grew during 2019
Source: OAG

The reduced popularity of turboprops – among Southeast Asian airlines and consumers – poses a potential setback in the Southeast Asian aviation sector's decarbonisation and sustainability initiative. Southeast Asian airlines should reconsider turboprops and smaller aircraft generally, including electric aircraft.

Southeast Asian airports and governments should reconsider their policies to facilitate smaller aircraft, including turboprops with conventional powerplants in the short-term and new propulsion technologies in the medium to long-term. Several major airports in Southeast Asia now ban or restrict turboprop operations. Small electric aircraft will also not be able to access these airports unless there are policy changes.

Southeast Asian airports should consider adjusting policies and investing in the necessary infrastructure to support new technology regional aircraft. Policies that encourage jet aircraft and up-gauging from smaller to larger aircraft make it difficult if not impossible for Southeast Asian hub airports to take advantage of new aircraft and propulsion technologies that would improve their green credentials as well as their connectivity.

Southeast Asian governments have been supporting SAF and other aviation sustainability initiatives. However, they have not been that supportive of the new zero emissions fixed wing regional aircraft which have been embraced by governments in other regions through grants and other initiatives.

Southeast Asian governments should relook at their policies and consider promoting zero emissions fixed wing regional aircraft while lifting current impediments. There is particularly an opportunity for governments to encourage zero emissions aircraft at environmentally sensitive but increasingly popular tourist destinations that are now in a delicate position due to earlier environmental neglect. Sustainable tourism is now capturing considerable attention and there is an opportunity to align sustainable tourism strategies with sustainable aviation strategies by pursuing near-term opportunities in decarbonising super short-haul air travel.

Every Southeast Asian government should adopt a green aviation or aviation sustainability strategy that includes a plan for decarbonising super short-haul routes. Developing SAF and hydrogen capabilities and investing in related infrastructure are important. However, a lot more can be achieved in the short-term with decarbonising super short-haul routes.

Southeast Asian governments should start working with each other to ensure there is an enabling environment for decarbonising super short-haul routes, including standardisation of regulations and airport infrastructure. Southeast Asian countries could forge a partnership – perhaps using the example of the Nordic Network for Electric Aviation – to set goals for decarbonising super short-haul flights within the region and providing standard regulations for aircraft using new zero emissions propulsion technologies.

It will be difficult in some areas of Southeast Asia to provide the airport infrastructure required to support electric and hydrogen. However, some Southeast Asian markets are relatively well placed to potentially support new zero emission technologies in the relatively near-term. Some Southeast Asia countries should be able to take a lead by learning from what is already being done in other regions and making the right investments.

While eVTOLs could play an important role in sustainable transportation they are generally not a solution for super short-haul routes between airports given their very small size. eVTOLs have more potential to shuttle individual or small groups of passengers to, from or within congested urban areas, assuming a role that is most similar to helicopters or limousines rather than fixed-wing aircraft. However, they cannot realistically replace land-based aircraft now operating between airports.

Zero emission land-based aircraft – both new and retrofitted – do have the potential to take over super short-haul flights now being operated with conventional aircraft as well to launch new routes between airports that are not currently served. This includes both domestic flights in the eight Southeast Asian countries that have domestic air transport markets as well as international flights connecting neighbouring Southeast Asian countries.

Super short-haul air routes have a critical role in Southeast Asia as the region's geography often limits surface travel options. There is an opportunity to grow the number of super short-haul flights and routes in Southeast Asia without impacting the environment. This would have profound economic benefits while supporting sustainable aviation and sustainable tourism goals. However, a shift in mindset and policy is required to unleash this potential.

Recommendations

Principal Recommendation:

- Southeast Asian airlines and governments should consider alternative propulsion options for the super short-haul segment.

Related Recommendations:

- Airlines should consider acquiring small electric fixed wing aircraft and rebuilding turboprops fleets.
- Governments should start working with each other to set goals for decarbonising super short-haul flights and to provide standard regulations for aircraft using new zero emissions propulsion technologies.
- Governments should consider adopting polices that support rather than inhibit turboprops on short sectors, initially with current powerplant technology and in future with new zero emissions technology.
- Governments should align sustainable tourism strategies with sustainable aviation strategies by pursuing near-term opportunities to decarbonise super short-haul air travel.
- Airports should consider adjusting policies and investing in the necessary infrastructure to facilitate new technology regional aircraft.
- Governments should consider promoting, and in future potentially requiring, zero emissions aircraft for island destinations that are environmentally sensitive, recognizing decarbonisation could help support sustainable tourism.

Country Specific Recommendations:

- Indonesia should reconsider its policy limiting international flights at only 12 airports to facilitate international connectivity with other Southeast Asian countries.
- Malaysia should reconsider its new policy permitting jet operations at Subang Airport and instead promote the continued use of turboprops for super short-haul as well as an enabling environment for new zero emissions aircraft.
- Singapore should consider adjusting policies for small aircraft at Changi Airport, particularly for new zero emissions aircraft, to facilitate sustainable aviation and super short-haul connectivity.

International super short-haul market

Overview of routes and Kuala Lumpur-Singapore case study

There are currently 28 super short-haul international routes in Southeast Asia, including 15 routes which are served at least daily and 13 which are served less than daily. A list of the 28 routes, which cover 13 country pairs, is provided below in Table 1 and Table 2. Several more tables, looking at how the market breaks down in terms of countries, hubs and airlines, are provided in the Appendix.

Table 1 - Top international super short-haul routes in Southeast Asia: 2023

Rank	Route (Airport pair)	Average daily flights 2023	Average daily flights 2019	Route type	Distance (km)
1.	Kuala Lumpur-Singapore (KUL-SIN)	36.4	41.5	Overland	296
2.	Kuala Lumpur-Medan (KUL-KNO)	8.6	8.9	Overwater	330
3.	Medan-Penang (KNO-PEN)	6.8	7.0	Overwater	240
4.	Kuala Lumpur-Singapore (SZB-XSP)	6.0	5.6	Overland	319
5.	Ho Chi Minh-Phnom Penh (SGN-PNH)	3.9	4.8	Overland	212
6.	Ipoh-Singapore (IPH-SIN)	3.4	3.2	Overland	480
7.	Bangkok-Siem Reap (BKK-REP/SAI)	3.2	7.0	Overland	332
8.	Kuala Lumpur-Padang (KUL-PDG)	2.7	3.0	Overwater	426
9.	Kuala Lumpur-Pekanbaru (KUL-PKU)	2.6	2.2	Overwater	254
	Ho Chi Minh-Siem Reap (SGN-REP/SAI)	2.6	4.6	Overland	422
11.	Bangkok-Siem Reap (DMK-REP/SAI)	2.4	3.0	Overland	349
12.	Hanoi-Vientiane (HAN-VTE)	2.0	2.0	Overland	494
13.	Bangkok-Vientiane (DMK-VTE)	1.7	1.0	Overland	499
14.	Hat Yai-Kuala Lumpur (HDY-KUL)	1.0	1.2	Overland	486
	Ho Chi Minh-Sihanoukville (SGN-KOS)	1.0	1.1	Overland	330

Source: OAG and Sobie Aviation
Notes: Ranking based on number of scheduled flights in 2023
Siem Reap calculated using a combination of the old airport (REP) and new airport (SAI), which opened in October 2023 with REP closing
Routes are based on airport pairs and some city pairs are included multiple times as there are two airports for some cities
Land routes include some short water crossings which are connected with bridges

Table 2 - Other (non-daily) international super short-haul routes in Southeast Asia: 2023

Rank	Route (Airport pair)	Average weekly flights 2023	Average weekly flights 2019	Route type	Distance (km)
16.	Batam-Kuala Lumpur (BTH-SZB)	6.4	7.0	Overwater	360
17.	Hanoi-Luang Prabang (HAN-LPQ)	6.2	13.6	Overland	407
18.	Brunei-Kota Kinabalu (BWN-BKI)	5.9	18.9	Overland	167
19.	Penang-Phuket (PEN-HKT)	4.0	7.6	Overland	380
	Pekanbaru-Singapore (PKU-SIN)	4.0	4.0	Overwater	299
	Mandalay-Mangshi (MDL-LUM)	3.5	2.7	Overland	398
21.	Malacca-Pekanbaru (MKZ-PKU)	3.3	7.0	Overwater	219
22.	Chiang Mai-Luang Prabang (CNX-LPQ)	3.2	7.5	Overland	357
23.	Ho Chi Minh-Pakse (SGN-PKZ)	3.0	3.0	Overland	486
25.	Kuantan-Singapore (KUA-SIN)	2.7	4.3	Overland	282
26.	Pakse-Siem Reap (PKZ-REP/SAI)	2.2	4.2	Overland	285
27.	Chiang Mai-Jinghong (CNX-JHG)	2.1	3.8	Overland	401
28.	Chiang Mai-Yangon (CNX-RGN)	1.9	8.7	Overland	362

Source: OAG and Sobie Aviation
Notes: Ranking based on number of scheduled flights in 2023
Siem Reap calculated using a combination of the old airport (REP) and new airport (SAI), which opened in October 2023 with REP closing
Routes are based on airport pairs and some city pairs are included multiple times as there are two airports for some cities
Land routes include some short water crossings which are connected with bridges

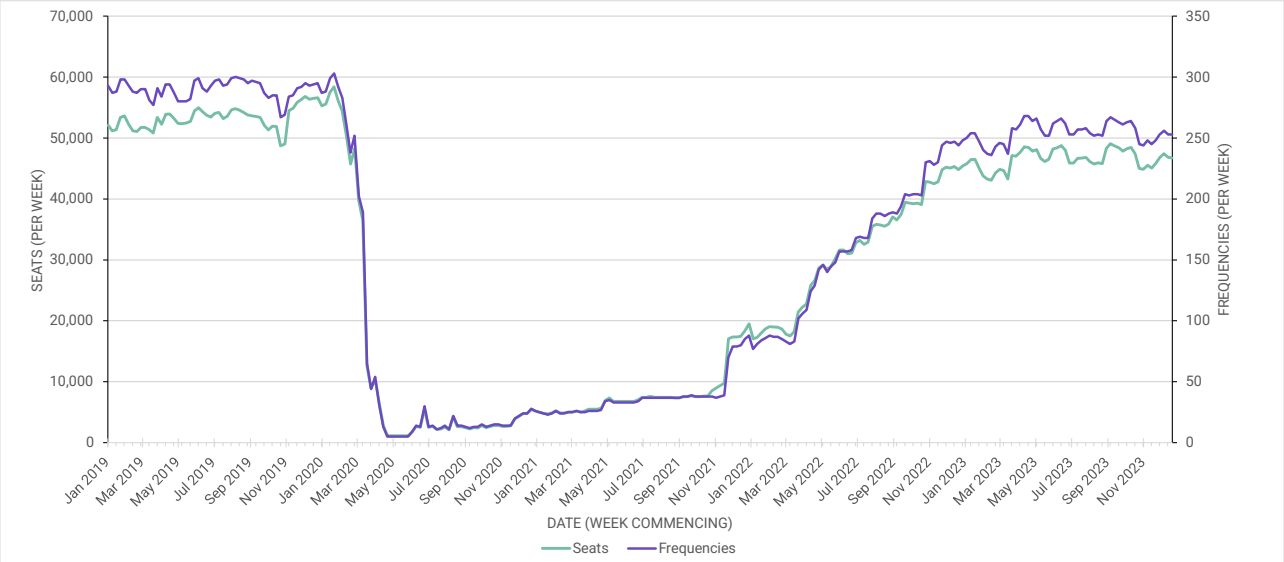
Illustration of Routes listed in Table 1 (White) and Table 2 (Cyan)
Map generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

Kuala Lumpur International-Singapore Changi (KUL-SIN) is by far the biggest route and accounts for nearly half of total scheduled seats in Southeast Asia's super short-haul international market. KUL-SIN is over four times larger than the second largest route, Kuala Lumpur-Medan (KUL-KNO), and over five times larger than the third largest route, Medan-Penang (KNO-PEN).

The fourth largest route is Kuala Lumpur Subang-Singapore Seletar (SZB-XSP). When including both KUL-SIN and SZB-XSP, the Kuala Lumpur-Singapore market has an average of 42 to 43 daily flights (based on OAG schedules data for 2023). This includes a modest six daily flights on SZB-XSP and 36 to 37 daily flights on KUL-SIN.

In 2019, KUL-SIN was served with an average of 41 to 42 flights per day. The route is now over 90% recovered – based on both frequencies and seats – compared to prior to the pandemic, as illustrated in Figure 2, below.

Figure 2 - Singapore Changi - Kuala Lumpur International weekly one-way frequencies and seats: 2019 to 2023



Source: OAG

SZB-XSP flights began in April 2019 with six daily flights, resulting in an average of 47 to 48 daily flights in the Kuala Lumpur-Singapore market over the last eight months of 2019. The SZB-XSP flights replaced SZB-SIN, which were discontinued at the beginning of December 2018. There was subsequently a temporary (nearly five months) reduction in flights in the Kuala Lumpur-Singapore market due to the delayed opening of Seletar Airport to scheduled flights.

KUL-SIN is the biggest international route in the world, based on scheduled seat capacity for both 2019 (prior to the pandemic) and 2023 (after the pandemic). Of the top 20 international routes globally, only one other is in the super short-haul category, Dublin-London Heathrow (DUB-LHR), which is 449 km.

Potential impact of high-speed rail

Unlike Kuala Lumpur-Singapore, Dublin-London includes an overwater crossing and therefore is not an option for high-speed rail. A Kuala Lumpur-Singapore high-speed rail line has been considered many times over the years and in 2013 Malaysia and Singapore agreed to a 350 km high-speed rail line with an initial estimated completion date of 2026. However, Malaysia and Singapore decided in late 2020 to terminate this project, which would have connected Jurong in the western part of Singapore to central Kuala Lumpur in 90 minutes.

The pressure on Malaysia and Singapore to relook at a high-speed rail project will likely mount over the next few years given the increasing importance of sustainability. A high-speed rail line connecting Kuala Lumpur to Singapore would clearly be a gamechanger and result in most – if not all – the traffic flying between Kuala Lumpur and Singapore shifting from air to rail. Even connecting passengers could potentially be served by rail if any new high-speed rail line includes stops at the two main airports (KUL and SIN), which was not part of the earlier proposal but is a possibility for any future proposal.

While it would make sense to replace Southeast Asia's largest super short-haul route with high-speed rail it will take at least a decade before this happens. In the meantime, Malaysia and Singapore should consider other options for reducing the environmental impact of the KUL-SIN air route, including consideration of alternative propulsion technologies. This may require the use of dedicated aircraft for KUL-SIN, which is not ideal from an airline perspective as the aircraft used for KUL-SIN are also used for other much longer routes. However, a dedicated fleet for KUL-SIN and other super short-haul routes could make it feasible to achieve net zero much earlier on the world's largest international route given the range limitations of early generation zero emissions aircraft.

Most of the other main international super short-haul routes in Southeast Asia can also in theory be replaced by high-speed rail. Of the 28 super short-haul international routes (listed in Table 1 and Table 2), only seven involve significant overwater crossings while the other 21 are overland. All the overwater routes connect Malaysia or Singapore with Indonesia. Most of the overland routes involve crossing smaller bodies of water via bridges. While the distances are all short (212 km to 499 km), a lack of highway infrastructure and/or long border crossing times generally makes air travel the most convenient option.

With a few possible exceptions, high-speed rail lines are unlikely in the foreseeable future. Kuala Lumpur-Singapore is unique in that the massive size of the market (that now opt for either surface or air transport) is sufficient to support a high-speed rail line. Most of the other markets are not likely large enough to support high-speed rail although there is still potential to decarbonise by embracing alternative propulsion technologies.

The possible exceptions for high-speed rail include Singapore-Ipoh, Kuala Lumpur-Hat Yai and Bangkok-Vientiane. Ipoh-Singapore could potentially be connected by high-speed rail if a Singapore-Kuala Lumpur high-speed rail line is extended further north to Penang, as Ipoh would be a potential stop between Kuala Lumpur and Penang. Extending a high-speed rail line further north from Penang to the Thailand border and Hat Yai is also possible but less likely.

Bangkok-Vientiane is a possible high-speed rail route as Thailand is already planning to build a high-speed rail line to link Bangkok with the Thailand-Laos border at Nong Khai, which is just across the Mekong River from Vientiane. This new high-speed rail line, which has a targeted completion date of 2028, could significantly impact the Bangkok-Vientiane market. There are currently up to six flight per days in this market although four are from Bangkok Suvarnabhumi, which is 515 km from Vientiane and therefore does not qualify under the

super short-haul criteria used in this study. There are up to two daily flights from Bangkok Don Mueang, which qualifies as it is 499 km from Vientiane.

A high-speed rail line from Bangkok to Vientiane would connect with the new high-speed rail line from Vientiane to Luang Prabang and Kunming, the capital of China's Yunnan Province. Luang Prabang-Kunming and Vientiane-Kunming are not super short-haul routes as they are almost 600 km and 800 km respectively. The new train also has stops in southern Yunnan, a region that previously had flights to Laos.

Currently there are only two super short-haul routes connecting Southeast Asia with China – Mandalay in Myanmar to Mangshi in western Yunnan (MDL-LUM) and Chiang Mai in Thailand Jinghong (CNX-JHG) in southern Yunnan. MDL-LUM and CNX-JGH are the only current super short-haul routes in Southeast Asia that are not between two Southeast Asia countries.

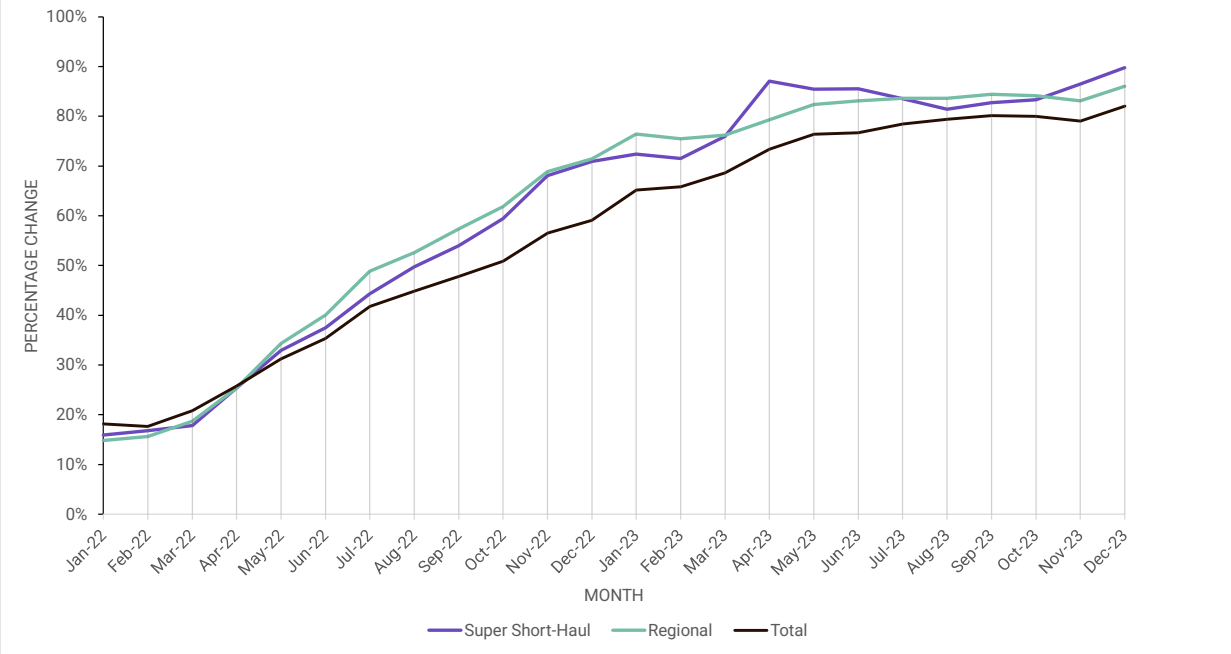
Recovery and un-resumed routes

The super short-haul international segment will likely achieve a full recovery sometime in 2024. Seat capacity in this segment was about 86% recovered in 2023 (compared to 2019) with a 90% recovery rate being reached for the first time in December 2023).

The overall international market in Southeast Asia will also likely achieve a full recovery by the end of 2024 although it has so far been recovering slower than the regional market (flights within Southeast Asia) as well as the super short-haul segment (flights of less than 500 km). Total international seat capacity in Southeast Asia was about 76% recovered in 2023 while the regional market was 82% recovered. The regional market accounts for about 43% of the total market while the super short-haul segment accounts for about 7% of the total market.

The overall international recovery rate has continued to gradually improve, reaching 82% in December 2023. The regional and super short-haul recovery rates are still slightly higher but there is less of a gap compared to earlier in 2023. This is due to the significant increase in recovery rate on North Asia routes over the last eight months, particularly mainland China after the country reopened. The overall recovery rate was higher than the regional recovery rate back in early 2022 as long-haul markets reopened first, but regional including super short-haul has had higher recovery rates since May 2023. The regional market including the super short-haul segment recovered rapidly after the reopening of borders and easing of travel restrictions in Southeast Asia in April 2022.

Figure 3 - Recovery rates for international seat capacity in Southeast Asia: Jan 2022 to Dec 2023



Note: Recovery rate calculated based on the same month of 2019; there was a jump in the jet recovery rate in January 2023 partially due to the smaller base of January 2019 compared to December 2019 as the number of flights grew during 2019
Source: OAG

For the super short-haul segment, the next phase of capacity increases will likely include the resumption of some routes that are not currently operating as well as more capacity on existing routes, particularly routes that are not yet fully recovered. As the earlier tables highlight, of the 29 routes that are currently being operated only seven had more or the same number of flights in 2023 compared to 2019. While several routes were close to a full recovery five were less than 50% recovered.

Routes within the Indochina subregion (consisting of Cambodia, Laos, Myanmar, Thailand and Vietnam) have been particularly slow to recover including BKK-REP, CNX-MDL, CNX-LPQ, HAN-LPQ, PKZ-REP/SAI and SGN-REP/SAI.

Indochina along with intra-Borneo also account for most of the un-resumed routes. Overall, there are 17 un-resumed routes, including seven in Indochina and six in Borneo (the island of Borneo includes Brunei, Indonesia and Malaysia).

Table 3 - Un-resumed international super short-haul routes in Southeast Asia

Rank	Route (airport codes)	Average weekly flights 2019	Route type	Distance (km)	Ave. seats per flight 2019
1.	Kuching-Pontianak (KCH-PNK)	14.0	Overland	208	125
2.	Palembang-Singapore (PLM-SIN)	4.1	Overwater	476	176
3.	Chiang Mai-Mandalay (CNX-MDL)	4.0	Overland	449	*See Notes*
4.	Bangkok-Sihanoukville (BKK-KOS)	3.6	Overland	467	180
5.	Tarakan-Tawau (TRK-TWU)	3.0	Overland	124	68
6.	Chiang Rai-Jinghong (CEI-JHG)	2.9	Overland	241	136
7.	Kuala Lumpur-Silangit (KUL-DTB)	2.6	Overwater	180	306
8.	Hanoi-Nanning (HAN-NNG)	2.4	Overland	288	140
9.	Langkawi-Phuket (LGK-HKT)	2.2	Overwater	249	72
10.	Bangkok-Sihanoukville (DMK-KOS)	2.1	Overland	496	180
11.	Kuala Lumpur-Pekanbaru (SZB-PKU)	1.7	Overwater	296	72
12.	Brunei-Sandakan (BWN-SDK)	1.1	Overland	362	72
13.	Brunei-Sibu (BWN-SBW)	0.8	Overland	360	72
	Brunei-Tawau (BWN-TWU)	0.8	Overland	443	72
15.	Bintulu-Brunei (BTU-BWN)	0.7	Overland	291	72
	Kawthaung-Phuket (KAW-HKT)	0.7	Overwater	216	98
	Luang Prabang-Jinghong (LPQ-JHG)	0.7	Overland	272	70

Source: OAG and Sobie Aviation
Notes: Ranking based on number of scheduled flights in 2019
Chiang Mai-Mandalay was resumed on a very limited basis in March and April 2023 but with only one weekly frequency and was again suspended
Routes are based on airport pairs and some city pairs are included multiple times as there are two airports for some cities
Land routes include some short water crossings which are connected by bridges

One of the un-resumed routes was served daily in 2019 – Kuching-Pontianak (KCH-PNK) – while the other 16 routes were served less than daily. Bangkok-Sihanoukville is counted as two un-resumed routes as Sihanoukville was served in 2019 from both Bangkok airports. Both were launched in 2019, with JC International Airlines serving Sihanoukville from Bangkok Suvarnabhumi and Thai AirAsia serving Sihanoukville from Bangkok Don Mueang.

Four of the six un-resumed intra-Borneo routes also launched in 2019 as part of a new turboprop operation by Royal Brunei Airlines (RBA) that was branded RB Link. The RB Link operation commenced in July 2019 using ATR 72-600s that were wet leased from Batik Air Malaysia (formerly known as Malindo Air). RB Link initially launched services from Bandar Seri Begawan hub to Kuching and Kota Kinabalu, supplementing flights which RBA operates on these routes using A320s. In October and November 2019 RB Link launched flights from Bandar Seri Begawan to four other cities in the Malaysian states of Sabah and Sarawak, which did not previously have any service – Bintulu, Sandakan, Sibu and Tawau.

Illustration of Routes listed in Table 3
Map generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

While Bintulu, Sandakan, Sibu and Tawau were all served with five or six weekly flights the average number of flights for the year (as indicated in Table 3 above) was only about one as the flights only began in the fourth quarter of 2019. It is unlikely these routes will be resumed in the foreseeable future as RBA has no plans to relaunch RB Link. Without RB Link there will also likely be less capacity on the Brunei to Kuching and Kota Kinabalu routes although RBA continues to have a smaller number of frequencies on these routes using A320s. (The Brunei-Kuching route is not considered super short-haul as it is 636 km).

KCH-PNK is a much larger and more established intra-Borneo route that was served prior to the pandemic with a daily flight from both AirAsia and Indonesia's Wings Air. Tarakan-Tawau (TRK-TWU) was a smaller but also a well-established intra-Borneo route that was served prior to the pandemic with three weekly flights from MASwings.

Regulatory challenges in Indonesia

Prior to the pandemic there were 23 airports in Indonesia with scheduled international services. During the height of the pandemic all but three of the airports were closed for international services. In 2022, Indonesia began gradually approving the resumption of airports to handle scheduled international flights. However, a new policy was adopted capping at 15 the number of airports that are permitted to have scheduled international flights (religious pilgrimage charter flights to Saudi Arabia are excluded from this policy).

Palembang and Silangit in Sumatra did not make this list along with Pontianak and Tarakan in Borneo. The KCH-PNK, TRK-TWU, PLM-SIN and KUL-DTB routes therefore cannot be resumed.

In Sumatra only Banda Aceh, Medan, Padang, Pekanbaru are now able to handle scheduled international flights. These are all in the northern half of the island, limiting the accessibility of southern Sumatra, which spans several hundred kilometres.

On the Indonesian side of Borneo only Balikpapan on the eastern side of the island is permitted to handle international flights. This limits the accessibility of the western side of Borneo, which also spans several hundred kilometres.

Illustration of a selection of airports mentioned in this section
Green = Airports that continue to accept International Scheduled services
Red = Airports that can no longer accept International Scheduled services

Indonesia is trying to build up hub traffic by consolidating international traffic at larger airports. However, the new policy has unfortunately led to a reduction in connectivity, particularly short-haul regional connectivity from secondary airports to neighbouring countries.

The current policy makes it difficult to travel short distances from remote parts of Indonesia to neighbouring countries which often is not possible via land transport due to rugged terrain or bodies of water. Longer flights are now required to hub airports followed by domestic flights, resulting in circuitous journeys that require significant backtracking. Such journeys have a detrimental impact on the environment and are more expensive. They also impact local economies as fewer people travel, resulting in remote destinations receiving fewer visitors for both leisure and business.

For example, to travel from Kuching to Pontianak now requires a flight from Kuching to Jakarta followed by a domestic flight from Jakarta to Pontianak. This is a journey of 1,667 km (938 km for Kuching-Jakarta and 729 km for Jakarta-Pontianak) compared to a direct journey of only 208 km. Kuching-Jakarta-Pontianak only became an option in June 2023 when Indonesia AirAsia launched Kuching-Jakarta but as Indonesia AirAsia does not serve the Jakarta-Pontianak route a self-connection is required in Jakarta. The only other option is to take three flights – for example from Kuching to Johor Bahru, Kuala Lumpur or Singapore, then Johor Bahru, Kuala Lumpur or Singapore to Jakarta or Surabaya and finally Jakarta or Surabaya to Pontianak.

Illustration of Routing Options between Kuching (Malaysia) and Pontianak (Indonesia) | Yellow = Previous Route | Cyan = New Shortest Routes
Maps generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

From Tawau to Tarakan three flights are now the only option due to the absence of the direct flight. Tawau-Tarakan passengers now need to fly from Tawau to Johor Bahru or Kuala Lumpur and then from Johor Bahru or Kuala Lumpur to Jakarta or Surabaya and finally Jakarta or Surabaya to Tarakan.

Illustration of Routing Options between Tawau (Malaysia) and Tarakan (Indonesia) | Yellow = Previous Route | Cyan = New Shortest Routes

From Palembang to Singapore a domestic flight to Jakarta or Surabaya is now required followed by a flight to Singapore as a direct flight is no longer an option due to Palembang no longer being open for scheduled international flights. From Palembang to Kuala Lumpur a similar journey via Jakarta or Surabaya is now required. Palembang-Kuala Lumpur, which was operated with 10 weekly AirAsia flights prior to the pandemic does not meet the super short-haul criteria as it is 707 km while Palembang-Singapore, which was operated with up to five weekly Scoot flights, is 476 km.

In 2019 AirAsia also operated up to four weekly flights from Kuala Lumpur to Silangit, which is the closest airport to Lake Toba, a popular tourist destination in Sumatra which is about six hours by surface transport from Medan. Singapore-Silangit was served briefly in 2017 by Garuda but did not have any service prior to the pandemic. Both Kuala Lumpur-Silangit and Singapore-Silangit meet the criteria of super short-haul.

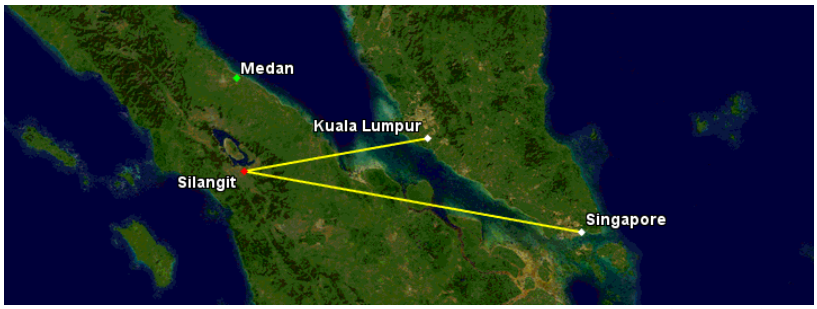


Illustration of Previous Routes between Silangit Airport, Siborong-Borong (Indonesia) and both Kuala Lumpur (Malaysia) and Singapore
Maps generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

The current Indonesia policy does not only preclude the resumption of several short-haul international routes it also makes it impossible to launch several possible new routes, including routes that in future could potentially be viable using small electric aircraft. Kuala Lumpur and Singapore are the closest international hubs to regions of western Indonesia that now suffer from a lack of connectivity. These regions – which include Sumatra, the Riau Islands and the Bangka Belitung Islands – could be within range of future electric aircraft based in Singapore and Kuala Lumpur. In the meantime, there are several potential routes connecting these regions of Indonesia with Malaysia or Singapore using existing aircraft. However, it is impossible for any of these routes to be launched – and to improve Indonesia's connectivity with Malaysia or Singapore – unless Indonesia changes its policy and again permits scheduled international services at all secondary airports.

- Recommendation: Indonesia should reconsider its policy limiting international flights at only 12 airports to facilitate international connectivity with other Southeast Asian countries.

New route opportunities in Indonesia (with Malaysia and Singapore)

There are over 20 airports in Sumatra with commercial services, including eight with at least 1 million annual passengers. There are also nearly 10 airports in the Riau Islands, an Indonesian province consisting of many smaller islands east of Sumatra, with commercial services.

In Sumatra, there are eight provinces, all of which could potentially support services to Kuala Lumpur and Singapore. However, only four of the provinces have airports that are now open for scheduled international

services. The provincial capital airports that are currently closed for international services are Bandar Lampung, Bengkulu, Jambi and Palembang.

Palembang is the largest of these airports, handling over 5 million annual passengers prior to the pandemic, making it the second largest airport in Sumatra after Medan and slightly ahead of Padang and Pekanbaru. Bandar Lampung handled over 2 million annual passengers prior to the pandemic, Jambi almost 2 million and Bengkulu slightly less than 1 million.

Silangit Airport, which is in in the province of North Sumatra (the same province of Medan), handled over 400,000 passengers per annum prior to the pandemic. Two other airports in North Sumatra, at Gunungsitoli and Sibolga, handled about 300,000 and 200,000 passengers per annum prior to the pandemic. All of these airports could in future support flights to Kuala Lumpur or Singapore, particularly with smaller aircraft, although some of the routes are slightly longer than 500 km.

In the Riau Islands, only Batam (BTH) currently is allowed to handle international flights. It is by far the largest airport in the province with 5 million annual passengers prior to the pandemic. BTH is a domestic hub and prior to the pandemic had less than 100,000 international passengers per annum.

Tanjung Pinang (TNJ), which is the main city on the island of Bintan, is the second largest airport in the Riau Islands with 300,000 to 400,000 annual passengers prior to the pandemic. It had about 10,000 international passengers per year prior to the pandemic and limited services to China. It is not currently allowed to handle international flights.

Smaller airports in the Riau Islands include Dabo (SIQ), Letung (LMU), Matak (MWK), Ranai Kota (NTX), Tambelan (TBX) and Tanjung Balai (TJB). All these airports are within 500 km of Singapore and can only be served with small aircraft.

Batam and Bintan are the closest Indonesian islands to Singapore and have ferry services to Singapore. The other islands in Riau Islands province are further from Singapore and are more remote but could potentially be linked in the future to Singapore with small aircraft. Flights to Kuala Lumpur from the smaller islands are also possible. Kuala Lumpur is already served from BTH.

There are also potential routes from Kuala Lumpur and Singapore to the Bangka Belitung Islands, another Indonesian province which is located to the south of Riau Islands and to the east of southern Sumatra near Palembang. None of the airports in this province are now permitted to handle scheduled international flights although prior to the pandemic Tanjung Pandan (TJQ) on the island of Belitung was open for international flights.

TJQ had a service to Kuala Lumpur operated by Indonesia AirAsia until the start of the pandemic. TJQ also was briefly had a service to Singapore by Garuda in late 2018 and early 2019. However, both the TJQ-KUL and TJQ-SIN routes are longer than 500 km.

There is also an airport at Pangkal Pinang (PGK) on the island of Bangka that could potentially support international services. PGK handled over 2 million annual passengers (all domestic) prior to the pandemic while TJQ handled over 1 million (predominately but not entirely domestic). While PGK is bigger, TJQ has more international potential as Belitung is an emerging tourist destination. In 2019 the government of Indonesian included Belitung on its list of “10 new Balis” as part of a tourism development plan. Lake Toba is also on this list, but as highlighted earlier in this section, its closest airport, Silangit (DTB), is similarly no longer open for scheduled international flights.

There are currently eight routes connecting Malaysia with Sumatra, the Riau Islands or Bangka Belitung Islands with six less than 500 km. In 2019, there were 16 routes including 12 of less than 500 km. From Singapore to Sumatra, the Riau Islands or Bangka Belitung Islands there are currently only two routes including one that is less than 500 km. In 2019, there were four routes including two less than 500 km.

Illustration of the airports mentioned in this section
Orange = Kuala Lumpur and Singapore are shown for reference | Red = Airports that can no longer accept International Scheduled services | Grey = Airports that continue to accept only Domestic Scheduled services | Green = Airports that continue to accept International Scheduled services | Maps generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

Services with electric or hybrid electric aircraft (discussed in a later section of this paper) could become an ideal solution for improving the connectivity from western Indonesia to Singapore and Malaysia. It could also help improve the connectivity in Borneo by facilitating super short-haul flights connecting the Indonesian, Malaysian and Bruneian parts of the island. There are also opportunities in eastern Indonesia to improve connectivity by facilitating super short-haul flights to Timor-Leste and Papua New Guinea.

However, improving the connectivity between Indonesia and any of its neighbouring countries is not possible unless Indonesia reopens or opens more airports for scheduled international services. A reconsideration of the current policy that restricts scheduled international flights to only 15 airports in the vast country would be sensible for Indonesia as it would improve connectivity for several remote provinces and support local economies.

A change in this policy is also important for both Kuala Lumpur and Singapore as both serve as hubs for Indonesia. Singapore is particularly well positioned to become a hub for the Riau Islands with a combination of ferries and potential super short flights connecting to Changi's massive network of international destinations. However, a policy change in Singapore would also be needed lifting the current restrictions on small aircraft at Changi.

- Recommendation: Singapore should consider adjusting policies for small aircraft at Changi Airport, particularly for new zero emissions aircraft, to facilitate sustainable aviation and super short-haul connectivity.

Other new route opportunities in the region

There are also potential new routes connecting peninsular Malaysia and Singapore although some are slightly longer than 500 km. Possible new Malaysia-Singapore routes that would qualify as super short-haul include Singapore to Kuala Terengganu, Kerteh, Malacca, Pangkor and Tioman. Potential new routes between peninsular Malaysia and Singapore which are slightly longer than 500 km include Alor Setar, Kota Bahru and Redang.

Kuala Terengganu and Tioman previously had service to Singapore until 2014. The Tioman service, which used turboprop aircraft, was operated for several years by Berjaya Air while the Kuala Terengganu route was served briefly by AirAsia. Berjaya several years ago also had scheduled services from Singapore to Redang (in 2022 and 2023 it operated a small number of charter flights from Seletar to Redang). Small electric or hybrid electric aircraft could significantly improve the potential viability of these routes.

There are currently 10 scheduled routes between Malaysia and Singapore but four of these are routes to east Malaysia (the Malaysian part of Borneo). Of the six to peninsular Malaysia four are less than 500 km (KUL-SIN, SZB-SIN, IPH-SIN and KUA-SIN). The other two are Penang-Singapore Changi (600 km) and Langkawi-Singapore Changi (727 km).

Illustration of the airports in Malaysia mentioned in this section | Singapore is shown for reference in orange
Map generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

Penang-Singapore Changi (PEN-SIN) is the second largest Malaysia-Singapore route after KUL-SIN with an average of 13 daily flights in 2023. High-speed rail is possible between Penang and Singapore if a high-speed rail line is built from Kuala Lumpur to Singapore (as discussed in the section on the '*Potential impact of high-speed*' – from page 16, above). This is because the line could be extended to Penang from Kuala Lumpur or Malacca, which was a proposed stop on the previously planned Kuala Lumpur-Singapore line. High-speed rail is not a possibility for Langkawi as it is an island that is much further from the mainland and therefore can only be connected by ferry.

One Malaysia-Singapore route, Kota Bahru-Singapore Changi (KBR-SIN), was operated prior to the pandemic but has not yet resumed. This route was 566 km. Kota Bahru as well Kerteh, Kuala Terengganu and Kuantan are on the east coast of peninsular Malaysia, which is not likely to have a high-speed rail line in future as it is more remote and less populated than the west coast of peninsular Malaysia.

Redang and Tioman are islands off the east coast while Pangkor is an island off the west coast. All three islands have short runways but could potentially be served with small electric aircraft (discussed in a later section of this paper).

There are also many potential new super short-haul routes in the Indochina subregion (Cambodia, Laos, Myanmar, Thailand and Vietnam). Secondary cities in this subregion of Southeast Asia have been growing rapidly but are generally not well connected to each other.

New international short-haul routes connecting smaller but increasingly popular secondary Indochina destinations would boost tourism and economic ties. Such routes are particularly important for facilitating multi-country itineraries in Southeast Asia as currently it can be hard for visitors to travel between destinations in neighbouring countries despite short distances.

Potential new super short-haul routes connecting neighbouring countries in Indochina include:

- Bangkok-Koh Kong (Thailand-Cambodia)
- Bokeo-Chiang Mai (Laos-Thailand)
- Can Tho-Phnom Penh (Vietnam-Cambodia)
- Can Tho-Siem Reap (Vietnam-Cambodia)
- Chiang Mai-Bagan (Thailand-Myanmar)

- Chiang Mai-Naypyidaw (Thailand-Myanmar)
- Da Lat-Phnom Penh (Vietnam-Cambodia)
- Da Nang-Pakse (Vietnam-Laos)
- Da Nang-Savannakhet (Vietnam-Laos)
- Da Nang-Ubon Ratchathani (Vietnam-Thailand)
- Ho Chi Minh-Koh Kong (Vietnam-Cambodia)
- Mae Sot-Yangon (Thailand-Myanmar)
- Phnom Penh-Phu Quoc (Cambodia-Vietnam)
- Phnom Penh-Trat (Cambodia-Thailand)
- Phnom Penh-Ubon Ratchathani (Cambodia-Thailand)
- Phu Quoc-Siem Reap (Vietnam-Cambodia)
- Phu Quoc-Sihanoukville (Vietnam-Cambodia)
- Udon Thani-Vinh (Thailand-Vietnam)
- Vientiane-Vinh (Laos-Vietnam)

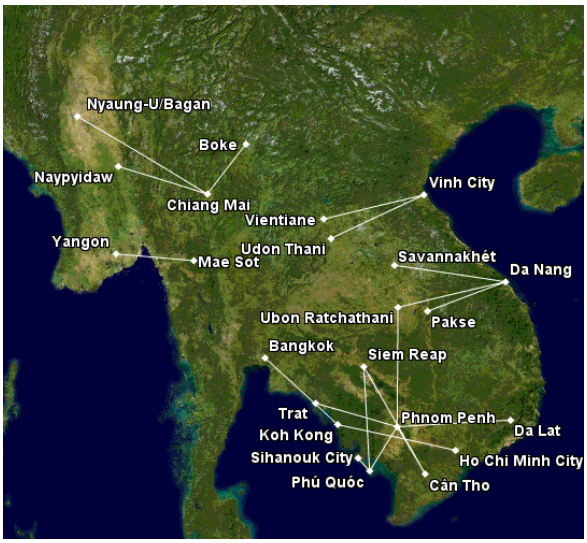


Illustration of the airports and routes mentioned in this section
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Several of these routes have been served previously but not in recent years. For example, Da Nang-Paske was served in 2012 and 2013, Phu Quoc-Siem Reap in 2015, Phu Quoc-Sihanoukville in 2016, Vientiane-Vinh in 2017 and Mae Sot-Yangon in 2017 and 2018.

Road transport options are available for most of these potential routes (Phu Quoc is an exception although ferries are available). However, air travel is generally much more convenient as roads in this region are generally slow. The distance by road in many cases is also much longer due to mountains.

Regulatory issues are not an obstacle in Indochina and the number of international airports has been expanding, resulting in more potential options. For example, the number of airports with scheduled international services has expanded in Vietnam over the last decade from four to ten. Can Tho, Da Lat, Hai Phong, Phu Quoc, Van Don and Vinh have all been upgraded for international operations (although scheduled international flights at Van Don and Vinh have not yet resumed following the pandemic). In 2013 there were only scheduled international services at Da Nang, Hanoi, Ho Chi Minh and Nha Trang. Vietnam is planning to upgrade more airports for scheduled international operations over the next few years (a few of these airports such as Hue already have international charter services.)

In Laos, Bokeo International Airport opened in 2023, becoming the country's fifth international airport after Luang Prabang, Pakse, Savannakhet and Vientiane. Bokeo is a province in northeast Laos near the Myanmar and Thailand borders. (There have not been any scheduled international services at Savannakhet since 2017 and Bokeo so far has only had domestic flights.)

In Cambodia, a new international airport in Koh Kong province near the Gulf of Thailand is slated to soon open. Dara Sakor International Airport will become the fourth international airport in Cambodia after Phnom Penh, Siem Reap and Sihanoukville (a replacement airport opened in Siem Reap in October 2023 and a new airport for Phnom Penh is now under construction). Dara Sakor International Airport is intended to help Koh Kong, particularly the Dara Sakor Resort, attract international tourists. While the airport will be capable of handling widebody long-haul flights, short regional flights to hubs such as Bangkok and Ho Chi Minh are more likely given the small size of the market.

Myanmar has the potential of short-haul international flights from several additional airports should the political situation stabilize. Currently there are only international flights from Myanmar and Yangon. Prior to the pandemic there were also several international routes from the capital Nay Pyi Taw and a limited number of short international flights to Thailand from Kawthaung and Mawlamyine. Other airports in Myanmar such as

Bagan also could potentially attract international flights if they are able to secure an international designation in future.

Thailand already has several airports which are capable of handling international services but do not currently have any international flights. Thailand had scheduled international flights at nine airports in 2023 compared to 11 airports in 2019. There are also several airports which can support international flights but did not have any scheduled services in 2019.

Malaysia is similarly ready to have more airports handling international flights. In 2019 there were 16 airports in Malaysia with scheduled international flights. There were also a few more airports that did not have international flights but did have the handling capability for them. Malaysia currently has only 12 airports with scheduled international flights.

The number of airports capable of handling international flights is not an issue in Brunei, Singapore and Timor-Leste given the small size of these countries. Finally, for the Philippines this is not an issue for the super short-haul international market as it is separated geographically from the rest of Southeast Asia.

Further details on countries and hubs can be found in the Appendix.

Aircraft fleet challenges (International Market)

The biggest potential challenge impeding growth in the number of international super short-haul routes is the lack of suitable aircraft. New super short-haul routes – and most of the thinner existing routes – are generally best served with turboprop aircraft. However, the number of turboprops operating in several Southeast Asian countries has been declining the last few years and is expected to further decline over the next few years, making it difficult to achieve growth in this segment.

While jets are also an option, turboprops are easier to fill with passengers as they have fewer seats, making them more commercially viable option for testing out new smaller routes. Large turboprops are also more efficient than jets on very short routes, generally emitting fewer emissions and burning less fuel per passenger than jets.

Airlines in Southeast Asia are currently operating less than 200 turboprops in passenger configuration compared to about 300 prior to the pandemic. This excludes turboprops operated by airlines in cargo configuration or turboprops flown by military, government or business aviation operators. ATR 72s (seating up to 78 passengers) are the backbone of Southeast Asia's passenger airline turboprop fleet and has shrunk to about 130 aircraft currently compared to nearly 230 aircraft prior to the pandemic. The rest of the passenger airline turboprop fleet in Southeast Asia includes about 10 ATR 42s (seating up to 48 passengers) and about 10 Dash 8 Q400s (seating up to 86 passengers) with the remaining turboprops consisting of several different aircraft types seating 30 passengers or less.

The ATR 72 is the only turboprop currently used on international routes in Southeast Asia as the other types of turboprops operating in Southeast Asia are only used for domestic services. As the ATR 72 fleet has shrunk the number of super short-haul international flights operated with ATR 72s has declined, resulting in a higher portion of super short-haul flights being operated with jets despite the efficiency and environmental benefits of ATR 72s on sectors of less than 500 km.

In 2019, ATR 72s accounted for 24% of frequencies and 11% of seats on super short-haul international routes in Southeast Asia. As shown in Table 4 below, this declined to just 18% of frequencies and 8% of seats in 2023. The narrowbody jet portion of frequencies increased from 71% to 78% with the portion of seats increasing from 79% to 85%. Widebody jets accounted for 5% of frequencies in 2019 and 4% in 2023.

There are no regional or small jets currently operating super short-haul international flights in Southeast Asia although there was a small number of such flights prior to the pandemic using Embraer E-Jets. Passenger airlines in Southeast Asia currently only operate about ten regional jets compared to about 20 regional jets prior to the pandemic.

There will likely again be a small number of super short-haul regional jet international flights later this year (in 2024) as two Southeast Asian airlines are planning to add E-Jets to their fleets. However, the number of small or regional jets will remain modest and the portion of super short-haul flights operated with small jets is not about to become significant in the near-term. Small jets are easier to fill than narrowbody aircraft, making them a potentially attractive option on thinner routes that are not served with turboprops. However, they are generally less efficient or economical and less environmentally friendly than turboprops on sectors of less than 500 km.

The most common aircraft type in Southeast Asia is the A320. The A320 family currently accounts for nearly half of the passenger aircraft operated by Southeast Asian carriers and accounts for over half of super short-haul international flights.

Table 4 - International super short-haul flights in Southeast Asia by aircraft type: 2023

Aircraft type	% of frequencies 2023	% of seats 2023	% of frequencies 2019	% of seats 2019
ATR 72	18%	8%	24%	11%
Airbus A320	53%	59%	51%	59%
Boeing 737	24%	25%	19%	20%
Embraer E170/E190	0%	0%	<1%	<1%
Airbus A330	0%	0%	3%	5%
Airbus A350	3%	4%	1%	2%
Boeing 777	<1%	1%	<1%	1%
Boeing 787	1%	2%	<1%	1%
Turboprops	18%	8%	24%	11%
Narrowbody jets	78%	85%	71%	79%
Widebody jets	4%	8%	5%	10%
Regional jets	0%	0%	<1%	<1%

Source: OAG and Sobie Aviation
Note. Sum of percentages may not total 100 due to rounding.

When excluding KUL and SIN, the turboprop share of the market is higher. But it also declined from 42% of frequencies and 22% of seats in 2019 to 35% of frequencies and 17% of seats in 2023. This highlights how turboprop operations have declined significantly in the airports they operate.

KUL and SIN do not permit turboprop operations but are the largest two hubs, accounting for a combined 53% of super short-haul international frequencies in Southeast Asia and 61% of seats in 2023. While SZB and XSP permit turboprops they are relatively small airports, accounting for a combined 7% of frequencies and 3% of seats.

SZB and XSP do not currently allow jets although the Malaysian government has announced that SZB will permit jets, including regional jets and narrowbody aircraft, starting later this year (an exact date in 2024 has not yet been announced). There are no plans for permitting jets at XSP although there is interest from airlines for XSP to open to more turboprop operators and more routes. So far Singapore has only approved scheduled services at XSP from one airline (Firefly) on one route (SZB).

The average gauge of a super short-haul flight from both KUL and SIN is about 180 seats while it is 72 seats from both SZB and XSP. Overall, the average gauge of a super short-haul international flight in Southeast Asia in the 2023 was 163 seats. This compares to an average gauge of 155 seats in 2019. The higher average gauge is another indication of the decline in turboprop operations. A route-by-route analysis of the drop in average gauge is shown in Table 5, below.

Of the 28 super short-haul international routes that were operated in 2023, 16 were only operated with jets. Eight of these routes involve KUL and/or SIN and therefore only jets are permitted while on the other eight routes turboprops are permitted but are not currently used.

Eight of the 28 routes were only operated with turboprops (entirely with ATR 72s) and only four were operated with a mix of turboprops and jets.

Table 5 - International super short-haul routes in Southeast Asia ranked by gauge: 2023

Route (airport pair)	Ave. seats per flight 2023	Ave. seats per flight 2019	Aircraft type 2023	Distance (km)
Penang-Phuket (PEN-HKT)	189	123	jet only	380
Medan-Penang (KNO-PEN)	185	186	jet only	240
Kuala Lumpur-Singapore (KUL-SIN)	183	184	jet only	296
Pekanbaru-Singapore (PKU-SIN)	182	180	jet only	299
Kuantan-Singapore (KUA-SIN)	181	137	jet only	282
Kuala Lumpur-Padang (KUL-PDG)	181	180	jet only	426
Ipoh-Singapore (IPH-SIN)	180	166	jet only	480
Bangkok-Siem Reap (DMK-REP/SAI)	180	180	jet only	349
Bangkok-Vientiane (DMK-VTE)	180	180	jet only	499
Hat Yai-Kuala Lumpur (HDY-KUL)	180	180	jet only	486
Kuala Lumpur-Pekanbaru (KUL-PKU)	179	180	jet only	254
Hanoi-Vientiane (HAN-VTE)	178	173	jet only	494
Kuala Lumpur-Medan (KUL-KNO)	175	176	jet only	330
Ho Chi Minh-Siem Reap (SGN-REP/SAI)	171	144	jet and prop	422
Mangshi-Mandalay (LUM-MDL)	154	139	jet only	398
Brunei-Kota Kinabalu (BWN-BKI)	150	132	jet only	167
Chiang Mai-Jinghong (CNX-JHG)	141	137	jet only	401
Ho Chi Minh-Phnom Penh (SGN-PNH)	129	160	jet and prop	212
Hanoi-Luang Prabang (HAN-LPQ)	115	116	jet and prop	407
Bangkok-Siem Reap (BKK-REP/SAI)	83	119	jet and prop	332
Batam-Kuala Lumpur (BTH-SZB)	72	72	prop only	360
Kuala Lumpur-Singapore (SZB-XSP)	72	72	prop only	319
Malacca-Pekanbaru (MKZ-PKU)	72	72	prop only	219
Chiang Mai-Yangon (CNX-RGN)	72	73	prop only	362
Chiang Mai-Luang Prabang (CNX-LPQ)	70	70	prop only	357
Ho Chi Minh-Pakse (SGN-PKZ)	70	70	prop only	486
Pakse-Siem Reap (PKZ-REP/SAI)	70	70	prop only	285
Ho Chi Minh-Sihanoukville (SGN-KOS)	70	70	prop only	330

Source: OAG and Sobie Aviation
Note: Ranking based on number of scheduled flights in 2023
Siem Reap calculated using a combination of the old airport (REP) and new airport (SAI), which opened in October 2023 with REP closing

Illustration of the routes mentioned in Table 5 | White = Jet-Only | Red = Jet and Prop | Cyan = Prop Only
Map generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

Of the 16 jet-only routes, nine had an increase in average gauge, three had the same average gauge and four had a slight decrease. The biggest increase, on PEN-HKT, was driven by Firefly adding a jet operation. Firefly currently serves PEN-HKT with four weekly 737-800 flights compared with four weekly ATR 72-500 flights in 2019. Firefly is currently the only operator of this route although AirAsia also served it for most of 2019 with A320s, which impacted the average gauge for 2019.

Turboprop operation to shrink further driven by Malaysia policy change

Firefly is currently operating 737-800s on nine routes from Penang, including five international routes (Banda Aceh, Bangkok, Medan, Phuket and Singapore) and four domestic (Kuching, Kota Kinabalu, Johor Bahru and Langkawi). Three of these routes Firefly previously served with ATR 72s (Langkawi, Johor Bahru and Phuket). Banda Aceh, Medan and Singapore are also short routes which are easily within range of ATR 72s.

Only Langkawi, Medan and Phuket are considered super short-haul; Banda Aceh, Johor Bahru and Singapore are slightly longer at 536 km, 554 km and 600 km respectively. Firefly is also currently operating 737-800s on five domestic routes within East Malaysia; all of these are within turboprop range although only three are considered super short-haul.

Firefly no longer has an ATR base at Penang and now only has a turboprop base at Kuala Lumpur Subang, which has been cut with further reductions planned once jet operations begin at Subang. Batik Air Malaysia also has cut its ATR 72 fleet over the last few years and is now considering phasing out turboprops entirely once jet operations begin at Subang.

Malaysia's new policy for Subang will result in even fewer turboprop flights for Malaysia in both the domestic and international super short-haul segments. While Batik Air Malaysia and Firefly would prefer to continue operating turboprops on super short-haul routes from Subang, they believe they will need to start using jets to compete with other airlines that are planning to enter the Subang market once jet operations are permitted.

Airlines are often compelled to replace turboprops with jets on super short-haul routes when competitors start using jets as passengers prefer a jet product although turboprops are generally more efficient and better for the environment. Malaysia should reconsider its new policy for Subang and promote the continued use of turboprops for super short-haul as well as an enabling environment for new zero emissions aircraft.

- Recommendation: Malaysia should reconsider its new policy permitting jet operations at Subang Airport and instead promote the continued use of turboprops for super short-haul as well as an enabling environment for new zero emissions aircraft.

Opportunities to build connectivity with new technologies

The ATR fleet is also expected to further shrink in other Southeast Asian countries. For example, Vietnam Airlines plans to entirely phase out its ATR 72 fleet and become an all-jet operator over the next few years. This will result in a further reduction in the portion of super short-haul flights (both domestic and international) that are operated with turboprops in Vietnam and a further increase in average gauge for super short-haul flights.

In addition to impacting several existing routes, the expected further reduction in Southeast Asia's ATR 72 fleet will make it more difficult to launch new super short-haul routes. There are essentially no other turboprop options for super short-haul flights as the ATR 72 is the only type of turboprop operating international super short-haul flights in Southeast Asia.

While electric aircraft could eventually be used in this segment it will be at least a few years for Southeast Asian airlines to acquire and begin operating electric or hybrid electric aircraft. (The challenges and potential timelines of electric and hybrid electric aircraft are discussed in a subsequent section.)

In the meantime, only if there is a reversal in the current trend and Southeast Asian airlines start to acquire more turboprops will the portion of super short-haul international flights that are operated with turboprops increase

back to pre-pandemic levels and closer to international norms. This would facilitate a nearer term improvement in connectivity driven by the launch or relaunch of thinner international super short-haul routes.

Even pre-pandemic, the turboprop portion of super short-haul international flights in Southeast Asia was low compared to most other regions. Globally 29% of super short-haul international flights were operated with turboprops in 2019 and turboprops accounted for 14% of super short-haul international seat capacity.

Southeast Asia should reconsider policies that make it difficult or impossible for airlines to operate turboprops on short sectors connecting neighbouring countries. If anything, there should be policies and programs promoting and incentivizing the use of turboprops. This is an important interim step as a larger turboprop fleet could facilitate improvements in super short-haul international connectivity until new propulsion technologies and related airport infrastructure are available.

It is also important to start adopting policies and programs that incentivize the use of small aircraft with electric, hybrid electric, hydrogen electric and hydrogen powertrains when the technology becomes available. Such policies would make sense for sustainability and further help facilitate regional connectivity in ASEAN, resulting in economic benefits.

- Recommendation: Airlines should consider acquiring small electric fixed wing aircraft and rebuilding turboprops fleets.
- Recommendation: Governments should consider adopting polices that support rather than inhibit turboprops on short sectors, initially with current powerplant technology and in future with new zero emissions technology.

Domestic super short-haul markets

Overview of routes

There are currently about 300 super short-haul domestic routes in Southeast Asia, including about 200 which were served daily in 2023. The routes range from as short as 31 km to 499 km. Most of the routes under 100 km connect remote communities in eastern Malaysia, some of which do not have road access, and are operated with 19 seat turboprops.

It is not possible to list all domestic routes in this paper as the list is very long. The integrity of domestic airline schedule data in Southeast Asia can also be spotty, particularly on smaller routes.

The top 20 domestic super short-haul routes, based on weekly frequencies in 2023, are included in the Table 6 below. The shortest of these routes is 190 km.

Table 6 - Top domestic super short-haul routes in Southeast Asia: 2023

Rank	Route (Airport pair)	Average daily flights 2023	Average daily flights 2019	Route type	Aircraft type 2023	Distance (km)
1.	Caticlan-Manila (MPH-MNL)	26	13	Overwater	Mixed	304
2.	Bangkok-Samui (BKK-USM)	22	22	Overwater	Mixed	465
3.	Ho Chi Minh-Phu Quoc (SGN-PQC)	19	17	Overwater	Jet only	299
4.	Jakarta-Yogyakarta (CGK-YIA*)	17	26	Overland	Jet only	425
	Kuala Lumpur-Penang (KUL-PEN)	17	25	Overland	Jet only	323
6.	Con Dao-Ho Chi Minh (VCS-SGN)	16	9	Overwater	Mixed	233
	Kuala Lumpur-Langkawi (KUL-LGK)	16	19	Overwater	Jet only	455
	Iloilo-Manila (ILO-MNL)	16	16	Overwater	Mixed	452
9.	Jakarta-Palembang (CGK-PLM)	15	21	Overwater	Jet only	418
10.	Bacolod-Manila (BCD-MNL)	14	12	Overwater	Mixed	467
	Con Dao-Ho Chi Minh (VCS-SGN)	14	9	Overwater	Mixed	233
12.	Bali-Surabaya (DPS-SUB)	12	15	Overwater	Jet only	303
	Jakarta-Semarang (CGK-SRG)	12	22	Overland	Jet only	420
14.	Jakarta-Pangkal Pinang (CGK-PGK)	11	8	Overwater	Jet only	444
15.	Kota Bahru-Kuala Lumpur (KBR-KUL)	10	11	Overland	Jet only	386
16.	Ho Chi Minh-Nha Trang (SGN-CXR)	10	14	Overland	Jet only	307
	Kuala Lumpur-Penang (SZB-PEN)	10	19	Overland	Prop only	278
	Bangkok-Udan Thani (DMK-UTH)	10	5	Overland	Jet only	451
19.	Cebu-Davao (CEB-DVO)	9	9	Overwater	Mixed	398
20.	Jakarta-Bandar Lampung (CGK-TKG)	8	17	Overwater	Jet only	190

Source: OAG and Sobie Aviation
*Notes: *The new Yogyakarta International Airport (YIA) opened in 2020; the 2019 data is based on flights to the original Yogyakarta Airport (JOG)*
Ranking based on number of scheduled flights in the second quarter of 2023
Routes are based on airport pairs and some city pairs are included multiple times as there are two airports for some cities
Land routes include some short water crossings which are connected by bridges

Caticlan-Manila (MPH-MNL) has become the largest route with an average of 26 daily flights in 2023 compared to 13 daily flights in 2019. The number of flights has roughly doubled since prior to the pandemic as Boracay island has re-emerged as a very popular destination. In 2019, MPH-MNL was only the 14th largest super short-haul domestic route in Southeast Asia. Boracay was reopened in late October 2018 following a six-month closure due to a massive environmental clean up effort.

There are three other Philippines routes among the top 20, all of which are overwater. There are also six Indonesia routes among the top 20 (four of which are overwater) and four Malaysia routes (only one of which is overwater). There are four Vietnam routes (three of which are overwater), and two Thailand routes (one of

which is overwater). Therefore, there are a total of seven overland routes in the top 20, which is a much smaller portion compared to the top international super short-haul routes.

Illustrations of the routes mentioned in Table 6 | White = Jet-Only | Red = Jet and Prop | Cyan = Prop Only
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Short flights to popular holiday islands are particularly common and account for several of the top 20 routes. This includes Bali in Indonesia, Boracay in the Philippines (which is a 10 to 15 minutes ferry from Caticlan); Con Dao and Phu Quoc in Vietnam; Langkawi in Malaysia; and Samui in Thailand. These islands are all environmentally sensitive, sparking concerns from international groups about over-tourism. They would benefit from aviation decarbonisation.

Reducing and eventually eliminating aircraft emissions is particularly important for these markets because high-speed rail will never be an option. A shift in how these and other environmentally sensitive holiday islands throughout Southeast Asia are served from their main domestic hubs may be required to reduce the impact on the environment and meet sustainable tourism goals. Operating smaller aircraft with more frequent flights could be an option as zero emissions technology for small short-range aircraft will be available much sooner. (The development of zero emissions aircraft, including potential timelines, is discussed in the subsequent section '*Zero Emission Aircraft and Propulsion Options*', from page 44, below).

Island hops generally dominate the domestic super short-haul market in Southeast Asia, particularly in Indonesia and the Philippines. Smaller islands or islands with less tourism are generally served with turboprops – in many cases the runways are too short for jets but in some cases the market is too thin to support larger aircraft. Eliminating aircraft emissions at these types of airports should be easier to achieve than larger island markets as existing turboprops can potentially be modified with electric or hydrogen powertrains. In the near-term zero emissions aircraft will also only be available in small sizes, potentially providing sufficient capacity in smaller island markets.

- Recommendation: Governments should consider promoting, and in future potentially requiring, zero emissions aircraft for island destinations that are environmentally sensitive, recognising decarbonisation could help support sustainable tourism.

Philippines

Almost two-thirds of all domestic routes in the Philippines are under 500 km. Most domestic routes in the Philippines, including most super short-haul routes, connect islands. However, there are some exceptions including routes within the island of Luzon.

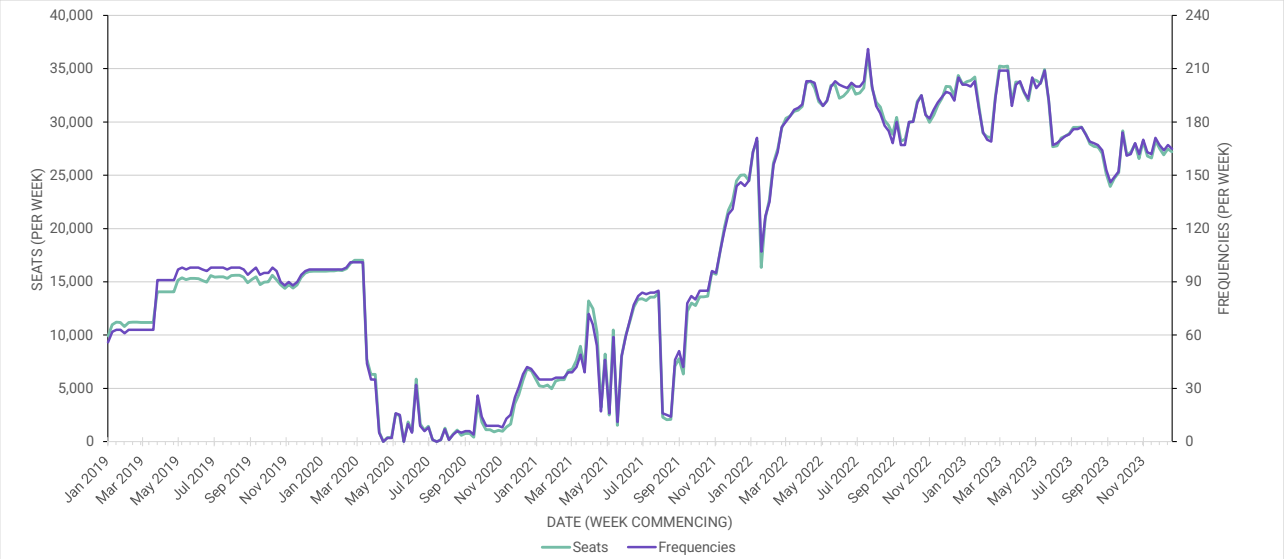
The longest route within Luzon is Manila to Laoag and Bicol, which are at the opposite ends of Luzon while Manila is roughly in the middle. Manila-Laoag (MNL-LAO) is an overland route of 410 km and is served with only an average of two daily flight while Manila-Bicol (MNL-DRP) is a route of 325 km and is currently served with an average of seven daily flights.

It takes about nine hours to drive from Manila to Laoag, which is in the far north of Luzon, while it takes about 11 hours to drive from Manila to Bicol or Legazpi. Bicol is a region of southern Luzon and DRP is 10 km outside of Legazpi City, which had its own airport until DRP opened in 2021. While high-speed rail is a possibility for Luzon it is unlikely in the foreseeable future and the focus has recently been more on improving rail connections

within the Manila area, including a new rail line from Manila to Clark Airport, covering a distance of about 100 km.

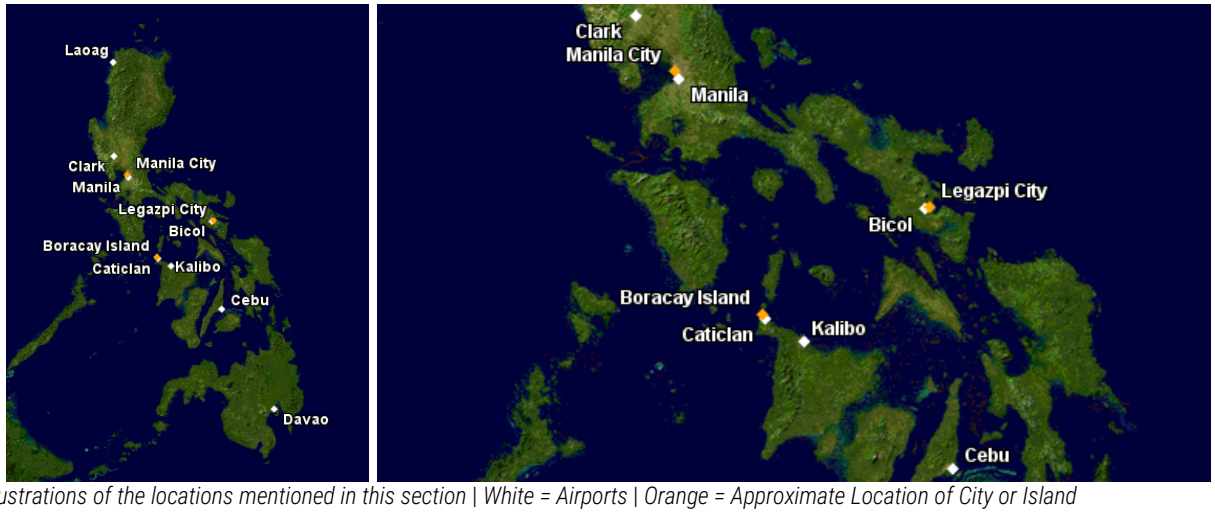
Several super short-haul routes in the Philippines have experienced an increase in capacity as overall super short-haul domestic capacity in the Philippines is now higher than 2019 levels. However, MPH-MNL stands out for its staggering growth rate. As outlined in the prior section and as depicted in Figure 4 (below) MPH-MNL flights have roughly doubled compared to pre-COVID levels.

Figure 4 - Manila Ninoy Aquino (MNL)-Caticlan (MPH) weekly one-way frequencies and seats: 2019 to 2023



Source: OAG

MPH is the closest airport to Boracay island. Kalibo Airport (KLO) also serves as a gateway to Boracay but is much further away. It takes about two and a half hours to travel (by road and ferry combination) from KLO to Boracay compared to about a half hour from MPH (by ferry).



Illustrations of the locations mentioned in this section | White = Airports | Orange = Approximate Location of City or Island
Maps generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

KLO has experienced a large reduction in traffic that has enabled MPH to significantly increase traffic without resulting in an increase in visitor numbers to Boracay. This is due to Boracay having had a cap on the number of visitors since reopening in October 2018 following a six-month closure for environmental rehabilitation. The cap is based on the number of visitors entering the island; there is no cap on passengers at either MPH or KLO. However, the visitor cap at Boracay essentially results in a cap on the number of flights MPH and KLO combined can handle given an overwhelming majority of passengers arriving at both these airports are tourists heading to Boracay.

Kalibo-Manila (KLO-MNL) is currently served with five daily flights, which is the same as 2019. However, Kalibo has experienced a significant reduction in international flights and Boracay has experienced a significant reduction in international visitors which has enabled it to accept more domestic tourists without increasing the cap. Kalibo had an average of only three to four international flights per day in 2023 compared to 15 in 2019.

Cebu Pacific now has up to 16 MPH-MNL flights per day during the peak season (13 with A320s and three with ATR 72s) compared to only eight (five with A320s and three with ATR 72s) in 2019. Philippine Airlines has increased its MPH-MNL schedule to up to seven daily flights during the peak season (an average of four with A320s and three with Dash 8s) compared to only two in 2019 (both with A320s). Philippines AirAsia also now has up to eight daily MPH-MNL flights during the peak season compared to four in 2019 (all with A320s). Two much smaller carriers, Royal Air and AirSwift, also serve MPH-MNL but with limited flights (an average of less than one flight per day).

Many of the smaller domestic routes in the Philippines are served entirely with turboprops. The Philippines is the only Southeast Asian country that has not experienced a significant reduction in the turboprop fleet. Turboprops are particularly important at secondary hubs such as Cebu, Clark and Davao as Manila is primarily served with jets due to slot constraints.

There are over 20 turboprop domestic routes from Cebu, which accounts for about one third of all domestic turboprop routes, while there are about ten routes each from Clark, Davao and Manila. Turboprops are also used on about 12 point-to-point routes – typically short hops between neighbouring islands.

Indonesia

Indonesia has a similar archipelago geography as the Philippines. However, several of Indonesia's largest cities are concentrated on the main island of Java while in the Philippines most major cities are located on different islands. Some of Indonesia's largest super short-haul routes are overland routes within Java and could potentially be replaced by high-speed rail.

Prior to the pandemic, Jakarta Soekarno Hatta-Yogyakarta (CGK-JOG) was the largest super short-haul domestic route in Southeast Asia with an average of 26 daily flights. A new airport in Yogyakarta (YIA) opened in August 2020, which has reduced the attractiveness of flying between the two cities as the new airport is much further from the city centre. The old downtown airport in Yogyakarta (JOG) now only handles limited turboprop flights, including three daily ATR 72 flights to Jakarta's secondary airport Halim (HLP).

The Jakarta-Yogyakarta market currently has an average of about 24 daily flights, including 17 on CGK-YIA, four on HLP-YIA and three on HLP-JOG. In 2019 the Jakarta-Yogyakarta market had an average of 37 daily flights, including 26 on CGK-JOG and 11 on HLP-JOG. HLP-JOG, which was served with jets prior to the opening of YIA, was also a top 20 super short-haul route in 2019.

It takes at least six hours to drive from Jakarta to Yogyakarta (more during peak periods due to traffic) and there is also a train service that takes at least six hours (more depending on the train). However, the Indonesian government has announced plans to extend the high-speed rail line that now connects Jakarta and Bandung with both Yogyakarta and Surabaya.

The 142 km long Jakarta-Bandung high-speed rail line opened in October 2023, becoming Indonesia's first high-speed rail service and reducing Jakarta-Bandung train travel time from over three hours to about 40 minutes. An extension of this high-speed rail line could connect Yogyakarta with Jakarta in about two hours and Surabaya in about three hours. The current short distance (142 km) of the Jakarta-Bandung line means it will not have a direct impact on any air route unless it is extended.

Illustrations of the locations and routes mentioned in this section | White = Airports | Orange = Approximate Location of City
Map generated by the Great Circle Mapper (www.gcmap.com) - copyright © Karl L. Swartz

Jakarta-Surabaya does not qualify as a super short-haul route as it is 690 km long. However, the potential impact of high-speed rail for the Jakarta-Surabaya market is massive as Jakarta Soekarno Hatta-Surabaya (CGK-SUB) is the fourth largest domestic route in Indonesia with an average of 36 flights per day in 2023. There is also an average of about 11 daily flights on the Jakarta Halim-Surabaya (HLP-SUB) route.

CGK-YIA is currently the tenth largest domestic route in Indonesia, down from the fifth spot (for CGK-JOG) in 2019. CGK-YIA and CGK-SUB are the only current top 10 domestic routes in Indonesia that are overland. Jakarta-Semarang (CGK-SRG) and HLP-SUB are the only other overland routes in the top 20.

Jakarta and Surabaya are Indonesia's two largest cities and are on opposite sides of Java, Indonesia's most populated island. High-speed rail is only an option for replacing flights within Java, but the potential is massive given Java's population is about 150 million, which accounts for slightly over half of Indonesia's total population.

CGK-YIA and CKG-SRG are two of six Indonesia routes among the top 20 super short-haul domestic routes within Southeast Asia. The other four are overwater routes from Jakarta to southern Sumatra or Bangka Island, which is located off the southeast coast of Sumatra.

Malaysia

While there are four overland Malaysia routes in the top 20 there are only three city pairs. The Kuala Lumpur-Penang city pair had an average of 27 daily flights in 2023, including 17 from Kuala Lumpur International Airport (KUL) and ten from Kuala Lumpur Subang (SZB). Both KUL-PEN and SZB-PEN are top 20 routes.

In 2019, Kuala Lumpur-Penang was the largest super short-haul domestic market in Southeast Asia based on frequencies with an average of 44 per day, including 25 on KUL-PEN and 19 on KUL-SZB. However, it was second largest behind Jakarta-Yogyakarta in terms of seat capacity.

The Kuala Lumpur-Kota Bahru market had an average of 18 daily flights in 2023, including ten from KUL and eight from SZB. In 2019 the Kuala Lumpur-Kota Bahru market had 24 daily flights, including 11 from KUL and 13 from SZB. Both were top 20 super short-haul routes in 2019 but SZB-KBR did not make the top 20 in 2023.

The Kuala Lumpur-Langkawi market has an average of 19 daily flights in 2023, including 16 from KUL and three from SZB. The Kuala Lumpur-Langkawi market had an average of 24 daily flights in 2019, including 19 from KUL and five from SZB.

High-speed rail from Kuala Lumpur to Penang is a future long-term possibility (not for at least 10 years given the typical time it takes to plan and construct a new high-speed rail line). This could be an independent line or an extension to the Kuala Lumpur-Singapore high-speed rail line if this project is reconsidered, as discussed in the section on the international super short-haul market.

A high-speed rail line from Kuala Lumpur to Kota Bahru is less likely as the east coast of peninsular Malaysia is less populated and remote than the west coast.

More likely is a high-speed rail from Kuala Lumpur to Johor Bahru, which is located next to Singapore. Kuala Lumpur and Johor Bahru would be connected as part of the possible Kuala Lumpur-Singapore high-speed rail, and it is also possible that Malaysia pursues a purely domestic high-speed rail from Kuala Lumpur to Johor Bahru without the line crossing into Singapore. Kuala Lumpur International (KUL)-Johor Bahru (JHB) is not currently a top 20 route but was in 2019 when it had an average of 14 daily flights.

The overall Kuala Lumpur-Johor Bahru market is still significant with an average of 12 daily flights in 2023, including seven from KUL and five from SZB. This is down from an average of 27 daily flights in 2019, including 14 from KUL and 13 from SZB.

Kuala Lumpur and Johor are less than 300 km apart and connected with a highway that takes as little as three hours (without traffic) to drive. It is hard to imagine this market returning to 27 daily flights given the increasing focus on environmental sustainability. However, electric aircraft and other new technology options could become a solution. Electric or hydrogen powered aircraft could support even significantly higher frequencies if a high-speed rail line is not built.

Kuala Lumpur to Penang is only slightly more than 300 km and similarly connected with a highway that takes less than four hours to drive. The drive from Kuala Lumpur to Kota Bahru is much longer, at over six hours, and more difficult as it traverses a remote mountainous region of peninsular Malaysia. This is essentially the longest drive from Kuala Lumpur to any city in peninsular Malaysia.

KUL and/or SZB are currently connected with nine destinations in peninsular Malaysia, all of which qualify as super short-haul, with a tenth destination (Kerteh) that was served prior to the pandemic but has not yet resumed. Seven of the ten destinations are overland with viable road transport options (Alor Setar, Kota Bahru, Johor Bahru, Kerteh, Kuantan, Penang and Kuala Terengganu) while three are overwater and are only otherwise connected via a combination of road transport and ferries (Langkawi, Redang and Tioman).

Of the three overwater destinations, only Langkawi is a significant market.

Redang and Tioman are very small islands and have limited turboprop services from SZB. Another island destination, Pangkor, also previously had limited turboprop services from SZB. The highway-ferry combo journey from Kuala Lumpur to Pangkor is only about four hours while it is at least seven hours to travel via surface transport from Kuala Lumpur to Langkawi, Redang or Tioman.

Illustration of the locations mentioned in this section White = Airports | Orange = Approximate Location of City Maps generated by the Great Circle Mapper - copyright © Karl L. Swartz

Indochina (Cambodia, Laos, Myanmar, Thailand and Vietnam)

Most of Southeast Asia's other large overland domestic super short-haul routes are in Thailand and Vietnam. There are high-speed rail possibilities in both countries, including the planned high-speed rail line from Bangkok to Udon Thani and the border with Laos.

Bangkok Don Mueang-Udon Thani (DMK-UTH) is one of the top 20 super short-haul domestic routes with an average of ten daily flights in 2023. The overall Bangkok-Udon Thani market had an average of 15 daily flights in 2023, including nine from DMK and six from Bangkok Suvarnabhumi (BKK).

The only other top 20 domestic super short-haul route in Thailand is Bangkok Suvarnabhumi-Samui (BKK-USM), which is the second largest super short-haul domestic route in Southeast Asia with an average of 22 daily flights in 2023. There are no flights to Samui, a popular tourist destination, from Bangkok Don Mueang as Samui Airport is owned by Bangkok Airways, which has its hub at BKK.

Samui is not the most visited island destination in Thailand as Phuket is bigger. However, Phuket is more than 500 km from Bangkok and therefore does not meet the super short-haul criteria.

The third largest domestic super short-haul route in Southeast Asia is also an overwater route to a popular island, Phu Quoc in Vietnam. There was an average of 19 daily flights between Ho Chi Minh and Phu Quoc in 2023.

The route connecting Ho Chi Minh with another popular but smaller island in Vietnam, Con Dao, was the sixth largest domestic super short-haul route in 2023 with 16 daily flights. The Con Dao market has grown rapidly the last few years, growing from only nine daily flights to Ho Chi Minh in 2019, and is expected to experience more rapid growth following a planned expansion of the Con Dao Airport. The expansion, which includes a runway extension that will permit narrowbody jet operations, is expected to be completed in 2024. Currently the airport can only handle turboprops and regional jets.

The only overland Vietnam route that makes the top 20 is Ho Chi Minh to Nha Trang, which had an average of ten daily flights in 2023. There are many smaller overland routes in Vietnam that are also under 500 km but most of the main domestic trunk routes in Vietnam do not meet the super short-haul criteria.

Vietnam is a very long country from north to south, and the cities where most of the wealth is concentrated are spread out, making high-speed rail difficult to justify. However, the government has talked about the possibility of a high-speed rail line which would stretch the 1,500 km between the two main Vietnamese cities Ho Chi Minh and Hanoi with stops in several secondary cities. If pursued, high-speed rail would be a gamechanger in Vietnam's domestic air transport market and significantly reduce demand. Vietnam has been one of the fastest growing domestic air transport markets in the world both pre- and post-COVID.

The other three domestic markets in the Indochina subregion (Cambodia, Laos and Myanmar) are very small although most domestic routes in these countries qualify as super short-haul.

Southeast Asia's first high-speed rail line opened in Laos in late 2021, connecting the capital Vientiane and the popular tourist town of Luang Prabang in only two hours compared to six prior to the pandemic. However, some passengers still fly the 214 km route between Vientiane and Luang Prabang as seats on the new train can be difficult to secure (due to infrequent trains and an antiquated sales system). There are currently an average of two daily flights between Vientiane and Luang Prabang.

Vientiane-Luang Prabang has never been that big of a market, but this high-speed rail line was developed as part of a broader China-based plan to improve connectivity between China and Laos. The train continues from Luang Prabang, which is in the north of Laos and is a popular UNESCO heritage site, across the China border to Kunming. An extension from Vientiane to Bangkok is now planned which, if completed, will result in the high-speed rail option for the Bangkok-Udon Thani route.

Illustration of the locations and routes mentioned
White = Airports | Orange = Approximate Location of City
Maps generated by the Great Circle Mapper - copyright © Karl L. Swartz

While the new train line in Laos is referred to as high-speed rail, it is in reality closer to medium speed as it travels at a relatively modest 160 km/hr. By comparison, the new high-speed rail line from Jakarta to Bandung travels of speeds up to speeds of up 350 km per hour, making it in many respects the first high-speed rail for Southeast Asia.

There are still several domestic routes in Laos that do not have a high-speed rail option. For example, surface travel from Vientiane to Pakse, which is the second largest city in Laos and is in the south of the country, takes about 10 hours on mountainous roads. There are currently an average of two daily flights from Vientiane to Pakse, which is an air route of 467 km.

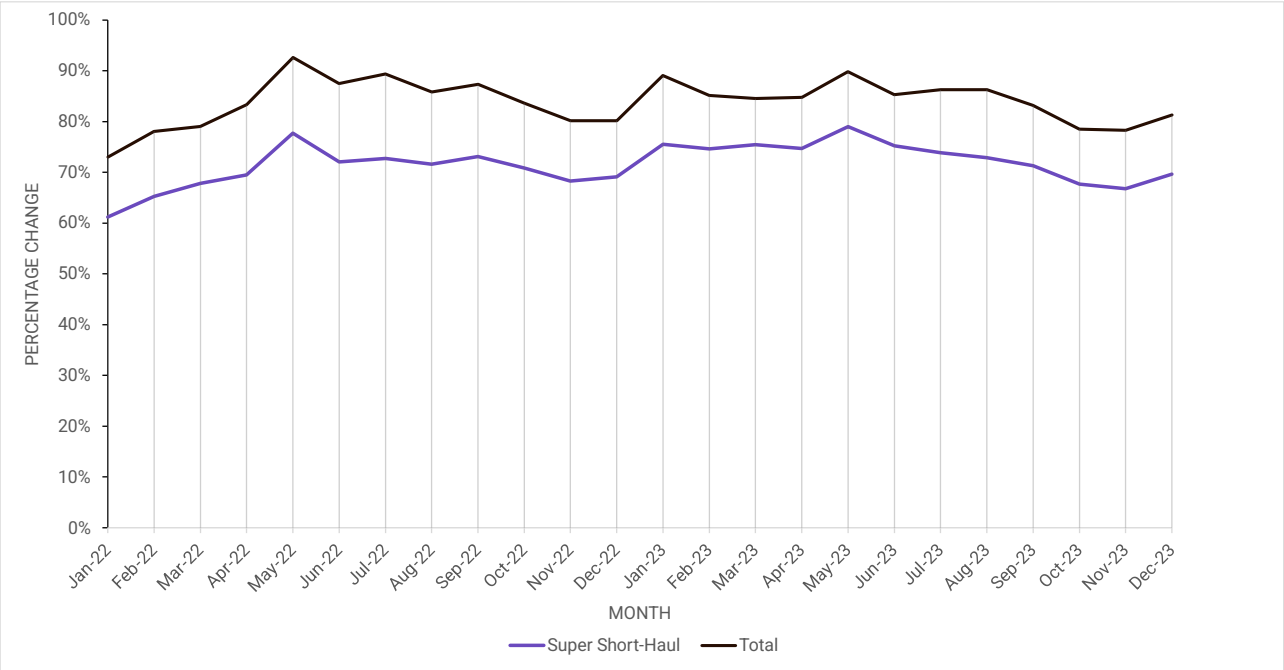
There are about another ten smaller domestic routes in Laos. While most of these routes are served daily none have more than two daily frequencies.

Recovery and un-resumed routes

The domestic super short-haul segment has recovered much slower than the overall domestic market. In 2023, Southeast Asia's domestic short-haul segment was only 68% recovered in terms of flights and 72% recovered in terms of seat capacity (based on OAG schedules data for 2023 vs 2019). This compares to a recovery rate of 79% in terms of flights and 84% for seats in the overall domestic market.

In December 2023, the gap was about 11 percentage points with seat capacity in the domestic super short-haul market about 70% recovered compared to 81% for the overall domestic market.

Figure 5 - Recovery rates for domestic seat capacity in Southeast Asia: Jan 2022 to Dec 2023



Note: Recovery rate calculated based on the same month of 2019; there was a jump in the recovery rates in January 2023 partially due to the smaller base of January 2019 compared to December 2019 as the number of flights grew during 2019
Source: OAG

The super short-haul portion of domestic capacity has declined or been flat in all the domestic markets except the Philippines, which has experienced growth in both the super short-haul segment and the overall domestic market. Overall, the super short-haul portion has declined from 46% of flights and 37% of seats in 2019 to 39% of flights and 32% of seat capacity in 2023.

The average aircraft gauge for super short-haul flights has increased in all six of Southeast Asia's main domestic markets with the biggest increases taking place in Indonesia and Thailand. Overall, the average gauge (average number of seats per super short-haul domestic flight) increased from about 123 seats in 2019 to about 131 seats in 2023. A summary can be found in Table 7, below.

Table 7 - Super short-haul portion of total domestic market by country: 2023

Rank	Country	Portion of flights 2023	Portion of flights 2019	Portion of seats 2023	Portion of seats 2019	Average gauge 2023	Average gauge 2019
1.	Indonesia	34%	43%	27%	35%	131	123
2.	Malaysia	61%	66%	52%	57%	119	117
3.	Philippines	53%	51%	45%	42%	131	128
4.	Thailand	31%	34%	28%	28%	150	140
5.	Vietnam	24%	24%	20%	21%	171	168
6.	Myanmar	72%	83%	68%	81%	74	71
7.	Laos	98%	98%	99%	97%	64	68
8.	Cambodia	100%	100%	100%	100%	83	134
	Total	*39%*	*46%*	*32%*	*37%*	*131*	*123*

Source: OAG and Sobie Aviation
Note: Ranking based on number of scheduled flights in 2023

The slower recovery in the super short-haul segment compared to the overall domestic market and the reduction in average gauge is due to the reduction in the size of the turboprop fleet. The number of turboprop domestic super short-haul flights was only 60% recovered in 2023 while the number of jet flights was 76% recovered. The 40% reduction is roughly in line with the 40% reduction in the number of turboprops that are operating in Southeast Asia.

The reduction in the turboprop fleet has resulted in a significant decline in the number of super short-haul routes as many smaller routes have not yet resumed. It also has led to capacity reductions due to frequency reductions on many of the resumed routes.

The number of super short-haul daily routes has declined by about one-third, from approximately 300 in 2019 to about 200 currently. The total number of routes has declined by about one-quarter as about 100 low frequency routes have not yet been resumed. Many of these were turboprop routes.

Aircraft fleet challenges (Domestic Market)

While the reduction in the turboprop fleet also has impacted the international super short-haul segment, as highlighted earlier in this paper, it has had a more significant impact in the domestic market as the region's turboprop fleet is predominately used for domestic services. Several of Southeast Asia's turboprop operators do not have any international services and others have limited international services.

The portion of super short-haul flights that are flown by turboprop aircraft declined from 49% in 2019 to 43% in 2023. The portion of scheduled domestic seats in the super short-haul segment declined from 27% to 43%. As indicated in Table 8, every major market except the Philippines has recorded a decline in these metrics.

Table 8 - Turboprop portion of the super short-haul segment by country: 2023

Rank	Country	Portion of flights 2023	Portion of flights 2019	Portion of seats 2023	Portion of seats 2019
1.	Indonesia	43%	47%	23%	27%
2.	Malaysia	48%	51%	23%	27%
3.	Philippines	50%	49%	30%	29%
4.	Thailand	22%	35%	10%	19%
5.	Vietnam	16%	23%	7%	9%
6.	Myanmar	84%	95%	79%	91%
7.	Laos	92%	93%	81%	85%
8.	Cambodia	87%	37%	71%	18%
	Total	*43%*	*49%*	*23%*	*27%*

Source: OAG and Sobie Aviation
Note: Ranking based on number of scheduled flights in 2023

The narrowbody jet portion has increased as the turboprop portion has declined. In 2023 narrowbody jets accounted for 56% of frequencies and 77% of seats in the domestic super short-haul segment compared to 50% and 72% in 2019.

This does not mean narrowbody jets have taken over turboprop routes. While there are a few examples of this, for the most part the routes which were only operated by turboprops prior to the pandemic have not resumed entirely or have experienced reductions in capacity.

This also does not mean narrowbody flights have fully recovered. But the narrowbody recovery rate in the domestic super short-haul segment has been tracking about 20 percentage points above the turboprop recovery rate.

In 2023, the average domestic super short-haul turboprop flight in Southeast Asia had 69 seats while the average narrowbody flight had 180 seats. The average gauge of the latter has increased from 176 seats in 2019, which is in line with an overall up-gauging trend in Southeast Asia as airlines gradually transition their narrowbody fleets to larger aircraft such as A321neos. This partly explains the increase in average gauge for domestic super short-haul flights although the decline in the turboprop portion is also a big driver.

Several airlines in Southeast Asia are opting for larger gauge narrowbody aircraft (or up-gauging) to improve efficiency (operating economics) and reduce unit costs as well as to maximize slots at congested airports. While this makes sense from a financial and competitive perspective it does make it harder to maintain thinner routes, resulting in a reduction in connectivity in some Southeast Asian markets.

The reduction in the turboprop fleet makes it even harder to maintain the shorter thinner routes as turboprops are not available to replace smaller gauge narrowbody aircraft on flights or routes that are too thin to support larger gauge narrowbody aircraft. The reduction in the turboprop fleet is generally not driven by financial issues but by policy and passenger perception issues. As the turboprop fleet declines it makes it harder for some of the remaining operators from a competitive perspective, as passengers generally prefer jets. Even if turboprops make more sense from a route profitability and environmental perspective, the turboprop fleet may continue to decline due to the other factors mentioned, resulting in further reductions in super short-haul domestic connectivity.

There are several types of widebody aircraft that operate super short-haul domestic services in Southeast Asia. However, the number of widebody flights is very small and their overall portion of domestic short-haul flights is well under 1%.

Regional jets are also not that common and account for only 1% of the overall market. E190s are the only type of regional or small jet currently operating in Southeast Asia's domestic market. In 2019 there were a few other types of regional or small jets operating in this segment but all with a limited number of flights.

Table 9 - Domestic super short-haul flights in Southeast Asia by aircraft type: 2023

Aircraft type	% of frequencies 2023	% of seats 2023	% of frequencies 2019	% of seats 2019
ATR 42/72	36%	19%	41%	24%
Dash 8	4%	2%	5%	3%
Twin Otter	3%	<1%	2%	<1%
MA60	<1%	<1%	<1%	<1%
Turboprops	43%	22%	48%	27%
Airbus A320	39%	54%	30%	44%
Boeing 737	16%	22%	20%	28%
Narrowbody jets	56%	77%	50%	72%
Regional jets	1%	1%	1%	1%
Widebody jets	<1%	<1%	<1%	<1%

Source: OAG and Sobie Aviation

As Table 9 above indicates, the Airbus A320 family of aircraft dominates the narrowbody segment. It accounts for more than twice as many domestic super short-haul flights in Southeast Asia than the rival Boeing 737.

ATR dominates the turboprop segment. ATR turboprops accounted for 36% of all super short-haul scheduled domestic frequencies and 19% of seats in 2023, down from 41% and 24% in 2019. Almost all the ATR fleet in Southeast Asia consists of ATR 72s, which seats 70 to 78 passengers, but there are also a few smaller ATR 42s operating on domestic routes.

The rest of the turboprop portion of domestic super short-haul flights are operated with Bombardier Dash 8s (a mix of variants seating about 30 to 80 passengers), Xian MA60s (seating about 60 passengers) and de Havilland Twin Otters (seating 19 passenger). This study only includes turboprops with at least 19 seats.

There are several operators of small turboprops (less than 19 seats) in Southeast Asia, but these generally operate under a different set of regulations and are considered air taxi companies rather than scheduled airlines. Most operators of small turboprops (the Cessna Grand Caravan is the most common type) do not operate scheduled services and those that do have some scheduled flights generally do not file their schedules, which makes it difficult to track and include in any analysis. However, the Caravan and other small aircraft with less than 19 seats currently account for a very small share of the overall market.

There are opportunities to grow the under-19 seat sector, particularly as aircraft in this category are the first to have zero emission solutions. The potential introduction of electric aircraft could lead to a significant increase in the number of flights in Southeast Asia's super short-haul domestic segment. Small electric aircraft could be a game changer for improving domestic connectivity in remote areas as they will provide a more efficient option than small conventional aircraft and their environmental credentials should result in more favourable policies for regional aviation. However, the impact on overall seat capacity may not be that significant given their small size.

There could be a bigger impact on seat capacity over the next decade if airlines rebuild their large turboprop fleets, potentially as reduced emission or zero emission powertrain options become available.

Implications of further reductions in the turboprop fleet

The recent trend in the reduction in the number of large turboprops operating in Southeast Asia is expected to continue as several ATR 72 operators are planning to further reduce their fleets. This could drive further declines in super short-haul flights and the number of routes in the short to medium-term.

For example, the Vietnam Airlines Group is planning to phase out its ATR fleet entirely over the next few years. The group currently has only six ATR 72s remaining, which are operated mainly by its VASCO subsidiary. The only other commercial turboprop operator in Vietnam, Hai Au Aviation, operates three 12-seat Cessna Grand Caravan seaplanes, offering limited schedule services as well as charter and sightseeing flights.

In Malaysia, Batik Air Malaysia and Firefly are both expecting to further reduce their ATR 72 fleets due to a change of policy at Subang, which currently only permits commercial flights with turboprops but is planning to start permitting jet flights later this year. Batik Air Malaysia and Firefly both now base all their ATR 72s at Subang, where they are used for mainly domestic and some regional international services. Both had previously also based ATR 72s at Penang.

Batik Air Malaysia currently has only three turboprop routes compared to 16 in 2019. All three of Batik Air Malaysia's turboprop routes are now from Subang, two of which are in the domestic market. In 2019, Batik Air Malaysia operated nine turboprop routes from Subang (including seven domestic) and seven point-to-point turboprop routes (including five domestic).

Firefly currently has eight turboprop routes compared to 12 in 2019. Seven of its current turboprop routes are from Subang (six domestic) and one is point-to-point. In 2019, Firefly operated the same seven routes from Subang but also had six routes from Penang (four domestic including Subang and two international). The reduction in turboprop routes at Batik Air Malaysia and Firefly is concerning as it contradicts sustainable aviation objectives in Malaysia.

There are currently 23 ATR 72s operating in Malaysia across four operators compared to 35 aircraft prior to the pandemic. The other two ATR operators in Malaysia are MASwings and charter carrier Berjaya Air. Berjaya

currently only has charter services while MASwings has 14 ATR routes within east Malaysia which are subsidized under the Malaysian government's Rural Air Services (RAS) program.

The only other turboprops operating scheduled services in Malaysia are De Havilland Twin Otters. MASwings operates six Twin Otters on 25 very thin routes connecting small communities in east Malaysia. These are also RAS-subsidized routes to short take-off and landing (STOL) airfields that cannot be accessed by larger aircraft. SKS Airways has two Twin Otters which were used in 2023 to serve two small island airports in peninsular Malaysia (these services are currently suspended). The SKS routes are operated on a commercial basis while the MASwings routes are all operated on a subsidized basis and are not likely to be cut as the government continues to fund the RAS program due to its essential role.

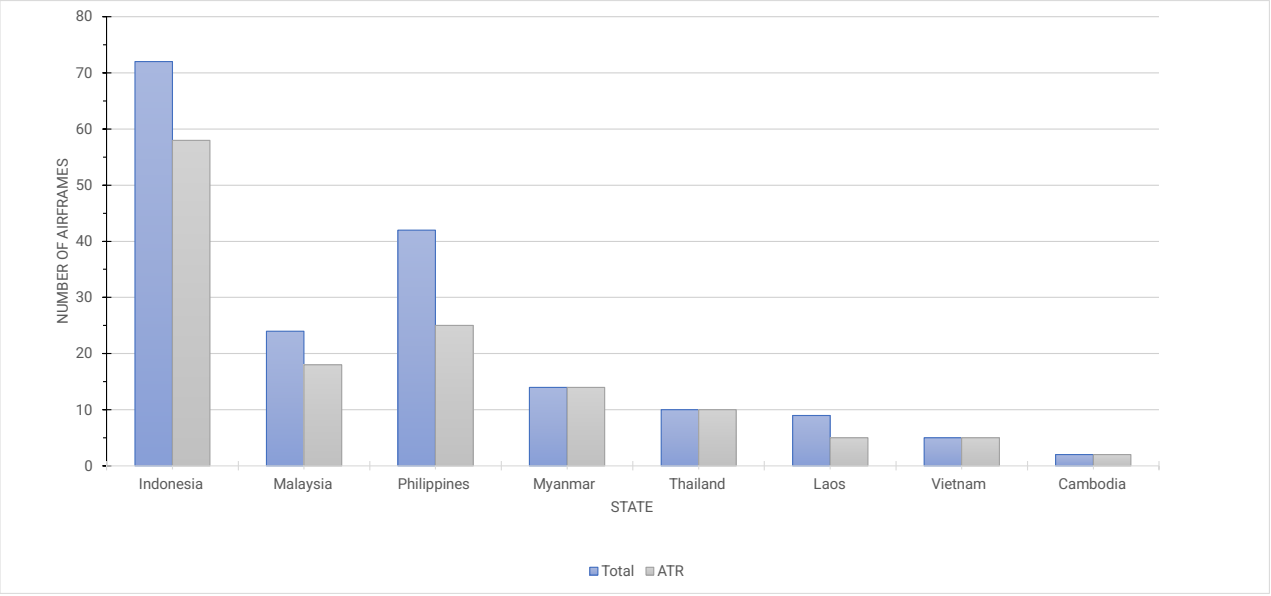
In Thailand, the ATR 72 fleet has declined from 13 aircraft prior to the pandemic to ten aircraft currently and the overall commercial turboprop fleet has dropped from 21 to ten aircraft. Bangkok Airways has reduced its ATR 72 fleet while Nok Air has phased out all its Bombardier Dash 8s and is now an all-jet operator. Bangkok Airways is the only remaining scheduled turboprop operator as other smaller regional carriers ceased operations several years ago.

In Myanmar, the ATR fleet has shrunk from about 30 active aircraft prior to the pandemic to only 13 aircraft currently. The number of operators has shrunk as there has been consolidation in the Myanmar's airline sector and most of the remaining operators have also reduced their fleets.

In Indonesia, the largest Southeast Asian market, Indonesia, the ATR passenger fleet has shrunk from about 110 active aircraft prior to the pandemic to slightly over 70. Wings Air is still the largest ATR operator in the world and has only shrunk its fleet slightly, but three other Indonesian airlines are no longer operating ATRs (Garuda Indonesia, Nam Air and TransNusa). While Wings Air now accounts for about three quarters of the ATR fleet in Indonesia, Citilink and several small airlines still operate ATRs. The smaller airlines also operate turboprops although most do not have scheduled services. The overall turboprop fleet in Indonesia has declined from about 160 prior to the pandemic to about 110 aircraft currently.

The turboprop fleets in Cambodia, Laos and the Philippines are roughly the same size as before the pandemic. However, the number of aircraft operating in Cambodia and Laos is very small, as illustrated in Figure 6, below.

Figure 6 - Active commercial turboprop passenger fleet: as of end of 2023



Note: Excludes military or government aircraft and freighters
Source: CH Aviation

Overall small aircraft (less than 100 seats) may eventually be able to regain the market share they have lost in recent years and grow their share of the domestic super short-haul segment. As sustainability becomes more important in Southeast Asia it is inevitable there will be shifts in the domestic super short-haul segment.

A combination of new propulsion options for existing turboprop aircraft (including the ATR 72 and Twin Otter) and the development of new zero emissions aircraft will provide airlines in Southeast Asia an opportunity to relook at small aircraft. Decarbonisation and sustainability could drive a shift towards smaller aircraft in the domestic super short-haul segment given the superior environmental credentials of smaller aircraft, particularly in the near to medium-term as it could take a couple of decades to develop larger zero emissions aircraft.

The development of zero emissions aircraft and new propulsion options for existing aircraft is discussed in the next section of this paper. As highlighted in the background and scope of study section at the beginning of this paper, SAF is not covered here as it is not a solution for zero emissions. The increased use of SAF and larger new generation narrowbody aircraft will only generate incremental improvements.

Zero Emission Aircraft and Propulsion Options

Overview of airline commitments globally

Several companies are now selling small all-electric aircraft with sufficient range for most super short-haul flights. Hybrid electric aircraft are also now being sold, offering sufficient range to cover super short-haul flights and with slightly more seating capacity than all-electric aircraft. Hydrogen conversion kits are now being sold for large turboprop aircraft, including the ATR 72, while electric or hybrid electric conversion kits are available for smaller aircraft.

There are not yet any options for aircraft with over 100 seats and it could take at least several years for zero emissions technology to be mature enough to support large aircraft. However, in the meantime, airlines and governments in many regions have embraced the near-term opportunities with smaller aircraft. Over 30 airlines have so far announced orders for electric or hybrid electric aircraft as well as hydrogen or electric conversion kits. However, none of these airlines are from Southeast Asia.

Below is a partial list of airlines from other regions which have committed to electric or other alternative propulsion fixed wing aircraft (both new aircraft and retrofits). This paper only briefly summarizes global developments and is not meant to outline all zero emission fixed wing options that are now available, nor detail all airline commitments. The objective of this section of the paper is to provide a snapshot and highlight how this is a rapidly developing segment of the industry in other regions but not in Southeast Asia.

Examples of airline commitments:

- Aerus (Mexico, startup-up airline)
- Air Cahana (United States, start-up airline)
- Air Canada (Canada, existing all-jet operator*)
- Air New Zealand (New Zealand, existing jet and turboprop operator)
- Air Nostrum (Spain, existing jet and turboprop operator)
- Amelia (France, existing jet and turboprop operator)
- Azul (Brazil, existing jet and turboprop operator)
- Braathens Regional Airlines (Norway, existing all-turboprop operator)
- Cape Air (United States, existing turboprop operator)
- Connect Airlines (United States, start-up airline)
- Ecojet (United Kingdom, start-up airline)
- Evia Aero (Germany, start-up airline)
- Flybig (India, existing turboprop operator)
- FlyWithLucy (Netherlands, start-up airline)
- GlobalX Airlines (United States, existing jet operator)
- Harbour Air (Canada, existing turboprop operator)
- Hawaiian Airlines (United States, existing all-jet operator)
- Icelandair (Iceland, existing jet and turboprop operator)
- JSX (United States, existing jet operator)
- Mehair (India, existing turboprop operator)
- Mokulele Airlines (United States, existing turboprop operator)
- Ravn Alaska (United States, existing turboprop operator)
- Rex Airlines (Australia, existing jet and turboprop operator)
- SAS (Sweden, existing all-jet operator*)
- Sevenair (Portugal, existing all-turboprop operator)
- Southern Airways Express (United States, existing turboprop operator)

- Sounds Air (New Zealand, existing all-turboprop operator)
- Surcar Airlines (Spain, start-up airline)
- Territory Air Services (Australia, existing all-turboprop operator)
- United Airlines (United States, existing all-jet operator)

*Note: *Air Canada and SAS have turboprop flights that are operated by independent airlines under capacity purchase agreements*

Most of the interest so far has been from airlines in Australasia, Europe and North America although there are also commitments in some emerging markets such as Brazil and India.

In India, Flybig announced in November 2022 a partnership with leasing company MONTE to provide financing and leasing solutions to support the conversion of De Havilland DHC-6 Twin Otters and, potentially in future, ATR 72s to zero emission propulsion technologies. MONTE, a new leasing company focusing entirely on zero emissions and low emissions regional aircraft, plans to lease Flybig two 19-seat Twin Otters which are expected to be converted. MONTE is acquiring up to 100 ZeroAvia ZA600 powertrains for conversion on Twin Otters as well as other similarly sized turboprops such as Cessna Caravans and Dornier 228s.

Flybig took delivery of its first Twin Otter at the end of June 2023 and currently operates three ATR 72s and currently has two Twin Otters in its fleet. Flybig previously had three ATR 72s which were used in 2023 to operate 11 scheduled routes including nine that were under 500 km (based on OAG data), but it stopped operating ATRs in November 2023.

Also in India, Mehair ordered in July 2023 up to 50 Jekta PHA-ZE 100 19-seat electric seaplanes. Mehair plans to use the PHA-ZE 100 to connect coastal communities and islands from 2029. Mehair currently operates conventional seaplanes on very short scheduled flights within the Andaman and Nicobar Islands as well as charter services.

In Brazil, Azul ordered in January 2023 six Eco Caravan upgrades from Ampaire, which provides a new hybrid electric conversion option for the Cessna Grand Caravan. Azul also announced in November 2023 a collaboration with Surf Air, which is developing an electrified powertrain for the Grand Caravan that is expected to be certified in 2026. Azul's regional subsidiary Azul Conecta operates about 30 nine-seat Grand Caravans to over 50 small cities or communities in remote areas of Brazil, including the Amazon. Azul also operates about 40 ATR 72s but has not yet announced commitments to zero or low emission conversion kits for its ATR fleet. The ATR fleet is used for about 70 regularly scheduled domestic routes including about 40 routes which are less than 500 km (according to OAG data).

In Asia-Pacific so far most of the interest has been from airlines in Australia and New Zealand (Australasia). China and Japan have zero emissions aircraft and powertrain development projects but, there have been very few commitments from airlines anywhere in Asia to zero emissions fixed wing aircraft. The two commitments in India are exceptions as are agreements that Japan Airlines announced in November 2023 with Universal Hydrogen and ZeroAvia. Japan Airlines has not yet committed to acquiring zero emissions aircraft or retrofits. However, under the recent MOUs with Universal Hydrogen and ZeroAvia Japan Airlines is exploring the development of hydrogen and hydrogen electric engines to retrofit existing turboprops. The Japan Airlines (JAL) Group currently has a fleet of 11 ATR 42-600s, two ATR 72-600s and five De Havilland Dash 8-400s.

This section of the study briefly outlines some of the commitments from airlines in Australasia, Europe and North America. A few aircraft leasing companies also have announced commitments to zero emissions fixed wing aircraft including Aerolease and MONTE. While Southeast Asian airlines have not yet leased any zero emission fixed wing aircraft, leveraging the orders already placed by leasing companies (similar to Flybig's agreement with MONTE) offers a potential quick option for airlines from Southeast Asia to enter this segment.

Commitments in Australasia

Air New Zealand and the New Zealand government have been a leader pursuing new aircraft propulsion technology as well as other sustainable aviation initiatives aimed at meeting net zero objectives. In December 2022, Air New Zealand announced an initial list of four partners (Beta Technologies, Cranfield Aerospace,

Eviation and VoltAero) to develop zero emission domestic demonstrator flights by 2026 using electric, green hydrogen and hybrid technologies. In February 2023 it added another five partners to its zero emissions next generation aircraft program (Airbus, ATR, Embraer, Heart Aerospace and Universal Hydrogen).

Air New Zealand plans to acquire electric or alternative propulsion aircraft, with the objective of replacing its fleet of Bombardier Dash 8 Q300 turboprop fleet. A selection of one or more manufacturers is. Air New Zealand also launched in August 2023 a competition to select two airports to support domestic demonstration flights starting in 2026.

While it is also working towards a longer-term objective to decarbonise its jet fleet, Air New Zealand recognises the near-term opportunities with its domestic turboprop fleet. Air New Zealand currently operates 23 Q300s configured with 50 seats and 29 ATR 72-600s configured with 68 seats, giving it fleet of 52 turboprops alongside 53 jets.

Air New Zealand currently operates 41 domestic routes, including 28 routes which are under 500 km (according to OAG data). The turboprop fleet are used on 34 domestic routes, including 27 which are less than 500 km. Turboprops account for about 85% of Air New Zealand's super short-haul flights, making electric, hydrogen or hybrid conversion kits for its existing turboprop fleet a potentially attractive solution for reducing emissions and eventually meeting zero emissions targets. New zero emissions small aircraft could also be part of the solution on some existing routes as well as potentially support the launch of new routes, some of which Air New Zealand served before it phased out its fleet of 19-seat turboprops in 2016.

To further support its initial foray into electric aviation, Air New Zealand announced in December 2023 the acquisition of one ALIA fixed wing electric aircraft from Beta Technologies. Air New Zealand plans to initially use the ALIA from 2026 to carry cargo on routes of about 100 km. Air New Zealand is considering acquiring ALIA passenger aircraft although the size is very small, carrying only five passengers. Beta Technologies is developing both conventional take-off and landing (CTOL) and vertical take-off and landing (VTOL) variants of the ALIA with Air New Zealand committing to the former.

While Air New Zealand does not currently operate any aircraft with less than 50 seats, there are small turboprops in the domestic New Zealand market operated by independent regional airlines. Some of these smaller operators are actively pursuing zero emission options.

For example, Sounds Air, has acquired up to three 30-seat Heart Aerospace ES-30 electric aircraft as part of the first phase in a plan to transition to an all-electric fleet. Sounds Air initially announced in 2021 the acquisition of at least three 19-seat Heart Aerospace ES-19s and changed this order in 2022 to the larger ES-30 after Heart Aerospace dropped plans to develop the ES-19 in favour of the ES-30, which is slated to enter service in 2028.

Sounds Air currently operates 13 domestic routes, all of which qualify as super short-haul as they range from only 71 km to 306 km (according to OAG data). Most of Sound Air's routes cross the Cook Strait, the body of water separating New Zealand's north and south islands that takes about three hours to cross by ferry. Sounds Air operates four 12-seat Cessna Caravans and six 9-seat Pilatus PC-12s. It has already started talking to airports it serves with its existing fleet, including Blenheim and Wellington, to prepare the infrastructure required to support commercial electric flights.

A small charter operator, Air Napier, signed a purchase agreement in June 2023, with Dutch start-up Maeve Aerospace to acquire 35 44-seat Maeve 01 electric aircraft. The all-electric Maeve 01, which was initially launched in 2022 as the Echelon 01 when Maeve Aerospace was known as Venturi Aviation, is expected to enter service in 2029 with a range of up to 460 km. Maeve is also developing a hybrid electric aircraft with 80 seats, which was announced in December 2023 and is slated to enter service in 2031 with a range of almost 1500 km.

The Maeve 01 would be a major step up for Air Napier as it currently operates aircraft with up to ten seats (small turboprops as well as small business jets) and does not have any scheduled services. Air Napier has signed up as a launch customer for the Maeve 01 and, if delivered, would likely use electric aircraft to launch scheduled services.

In Australia, some of the regional carriers also have committed to electric aircraft and the government has provided a grant to Dovetail Electric Aviation to support the development of zero emissions aircraft. Dovetail is

developing battery-powered electric propulsion systems that could be installed on existing small turboprop aircraft.

Rex Airlines forged a partnership with Dovetail in July 2022 and in June 2023 acquired a 20% stake in the company. Rex has a fleet of about 60 Saab 340 turboprops, making it the largest Saab 340 operator in the world, and is planning to provide a Saab 340 to Dovetail as a test bed. Dovetail also plans to convert other turboprops such as the Cessna Grand Caravan and De Havilland Twin Otter to electric propulsion.

Once retrofitted the Saab 340 is expected to have an all-electric range of about 500 km. Rex currently uses the Saab 340 on about 60 domestic routes, including about 45 routes that are under 500 km (according to OAG data). Rex has 30 to 36 seats on its Saab 340s; it also has a fleet of ten Boeing 737-800s which it uses on domestic trunk routes.

In late 2022, Territories Air Services ordered from Eviation 20 electric aircraft known as Alice, which is slated to enter service in 2027 with a range of nearly 500 km and seating up to nine passengers. Territories Air Services operates scheduled flights on several short domestic routes in Australia's Northern Territories and northern Queensland that are subsidized by the government (not in OAG schedules data). It also operates charter and scenic flights. Its current fleet includes a variety of very small aircraft with up to seven seats.

There are several small regional airlines in Australia operating government subsidized scheduled services to remote areas and offering a wide mix of general aviation types of services. Several of these companies are ideal candidates for small electric aircraft, particularly given the decarbonisation initiatives by the Australian government.

Southeast Asian carriers and governments should closely monitor developments in Australia and New Zealand as they could provide some relevant lessons. Some Southeast Asian countries have similar geography to New Zealand and similarly rely on short flights for domestic connectivity given the limited surface transport options. Southeast Asian airports could also learn from New Zealand airports, some of which are taking a lead role in supporting electric and hydrogen aircraft.

Commitments in Europe

There are several airlines in Europe that have announced commitments to zero emissions aircraft, particularly existing or new regional airlines which believe there is an opportunity to leverage the technology becoming available in the near-term for short flights. While high speed rail is the most common transport mode in Europe for sectors of less than 500 km there are several markets in Europe that rely on air connectivity for even very short distances due to geography.

Electric aviation has particularly generated interest from airlines in the Nordic region. Icelandair, Sweden-based Braathen Regional Airlines (BRA) and Scandinavian Airlines (SAS) have all placed orders for the Heart Aerospace 30-seat ES-30 electric aircraft.

In June 2023, SAS even sold seats on its inaugural ES-30 flights in Denmark, Norway and Sweden, which are expected in 2028. All 90 seats (30 on each inaugural flight) sold out within a few hours. SAS currently has 40 super short-haul routes, seven of which are entirely operated with ATR 72 turboprops with another eight using a mix of turboprops and jets (according to OAG data).

BRA has 11 super short-haul routes all of which also use the ATR 72. BRA also has forged a partnership with ZeroAvia to demonstrate hydrogen electric powertrains, which could potentially be used on BRA's ATR 72 fleet.

Icelandair has only three super short-haul routes, which are short domestic hops using Bombardier Dash 8 turboprops. It also has several longer Dash 8 routes, mainly to Greenland.

In March 2023, the Government of Åland, a group of islands in the Baltic Sea, also signed a collaboration agreement with Heart Aerospace to explore use of the HS-30. Åland is an autonomous part of Finland and its capital Mariehamn is now connected with Helsinki and Turku in Finland as well as Stockholm in Sweden using turboprops. Mariehamn is 121 km from Stockholm, 137 km from Turku and 280 km from Helsinki. Finnair

serves the Mariehamn-Helsinki route using ATR 72s while Ampola Flyg serves Mariehamn-Stockholm and Mariehamn-Turku using Fokker 50s. Finnair initially signed letters of intent for 20 ES-19 electric aircraft but it opted not to commit to the ES-30 when Heart Aerospace scrapped the 19-seat ES 19 for the larger ES 30.

Elsewhere in Europe, Portuguese carrier Sevenair signed a letter of intent in October 2022 for three ES-30s plus options for another three. Sevenair currently operates four domestic routes in Portugal, all of which are under 300 km, using Dornier 228 turboprops.

Spanish carriers Air Nostrum and Volotea announced in December 2022 a partnership with Dovetail Electric Aviation and sister company Dante Aeronautical. Air Nostrum announced in November the purchase of ten electric propulsion kits from Dovetail. Air Nostrum has not yet specified which aircraft they will use the kits for but it could potentially convert its ATR 72 fleet if Dovetail is able to develop a product for large turboprops. Dovetail is currently testing electric batteries on small turboprops, but Dovetail and Dante are interested in providing solutions for larger aircraft in future with electric or hydrogen-powered propulsion options. Volotea only operates narrowbody jets, but it focuses on serving small cities in Europe that could be connected in future with electric aircraft.

The French airline Amelia signed in early 2022 a letter of intent with Universal Hydrogen to convert three ATR 72-600s to hydrogen fuel cell powerplants. Amelia is a charter and wet lease carrier operating ATR 42s, ATR 72s as well as regional jets and small narrowbody aircraft. After being retrofitted the ATR 72s could be used to operate scheduled domestic services in France.

Several planned new start-up airlines in Europe also have embraced electric or hydrogen aviation, including Ecojet, Evia Aero and FlyWithLucy and Surcar Airlines.

Spain-based Surcar has ordered ZA600 hydrogen electric engines for its planned fleet of De Havilland DHC-6 Twin Otters. Surcar plans to start with conventionally powered aircraft and switch to hydrogen electric aircraft, which will be used on short island-hopping flights in the Canary Islands.

Netherlands-based FlyWithLucy (also known as Lucy) plans to begin air taxi operations in 2025 initially with 5-seat electric aircraft. It plans to later offer scheduled flights using the 44-seat Maeve 01 electric aircraft, which is expected to enter service in 2029. Lucy aims to take over routes from airlines by 2030 and has secured investment from Air France-KLM subsidiary Transavia.

UK-based Ecojet plans to initially launch services in 2024 using 19-seat aircraft with kerosene-based fuel. After about a year it plans to retrofit the aircraft with engines that convert green hydrogen into electricity. Ecojet expects to operate flights of up to 500 km starting with a service between Southampton and Edinburgh. It aims to introduce larger 70 seat zero emissions aircraft as part of a later phase. In November 2023 Ecojet and ZeroAvia announced a deal for 70 ZA600 hydrogen electric engines, which are being developed to power aircraft with nine to 19 seats by 2025.

Germany-based Evia Aero has signed a letter of intent to purchase 25 nine-seat Alice electric aircraft from Eviation. Evia Aero has also signed a letter of intent with Cranfield Aerospace Solutions (CAes) for ten hydrogen fuel cell-propelled conversion kits for the nine-seat Britten-Norman Islander. CAes plans to certify the kits in 2025 which could ultimately be used by several Islander operators. Britten-Norman has been working since 2021 with several small British companies and academics to transform nine to 19 seat aircraft with zero carbon solutions.

The world's shortest flight – a 3 km hop from Westray to Papa Westray in the Orkney Islands off Scotland – is operated with nine-seat Britten-Norman Islanders. However, the airline operating this service, Loganair, has not yet committed to electric aircraft or any electric conversions. Loganair also has larger turboprops with 19, 34, 48 and 72 seats, which are used to operate 40 regularly scheduled routes, including 33 routes of less than 500 km and seven routes which are slightly longer (according to the OAG database, which does not list Loganair's Islander routes).

Loganair and several airlines in Europe have stated it believes hydrogen aviation is more likely to mature quicker than electric aviation due to the space required for the batteries needed to support electric aircraft. Even for the

3 km flight from Westray to Papa Westray Loganair believes electric aircraft would be difficult to operate as it is required to carry sufficient fuel reserves for a 50-minute diversion to the Orkney capital of Kirkwall.

There could be similar issues in Southeast Asia, particularly remote areas where it may be difficult to provide the airport infrastructure needed to support electric aviation and diversion requirements result in range requirements that are beyond the capability of electric aircraft. However, some markets in Southeast Asia should be able to support electric aviation and will soon be able to learn from the experiences of airlines and airports in Europe as well as other regions.

Hydrogen also can potentially be used in Southeast Asian markets that cannot support electric aviation and it could become a better solution overall for regional aircraft in Southeast Asia. In addition to offering turboprop operators conversion kits, Universal Hydrogen is now offering hydrogen fuel services to airports that use existing freight networks and does not require any special infrastructure.

Universal Hydrogen has completed trials that demonstrate that standard air freight containers can be used to transport hydrogen in capsules from the hydrogen production site to the airport and returned to the production site for refuelling. It plans to have this service ready in 2025 when conversion kits for the ATR 72 will also be available, providing a potentially attractive near-term solution for turboprop operators in Southeast Asia as well as other regions.

Commitments in North America

In North America, Air Canada, Mesa Air Group and United Airlines have invested in Heart Aerospace and placed orders for a total of 230 ES-30s 30-seat electric aircraft. Mesa and United initially each ordered 100 19-seat ES 19s in 2021. In September 2022, these orders were updated for the ES 30 as the new larger variant was launched and at the same time Air Canada also placed orders for 30 of the aircraft.

While the ES-19 was initially being designed as purely an electric aircraft with an expected range of 400 km, the ES-30 will be a hybrid aircraft. It is expected to have a fully electric range of 200 km and a range of up to 400 km with 30 passengers or up to 800 km with 25 passengers in reserve-hybrid configuration, which includes two turbo generators powered by SAF. While the ES-19 was initially slated to enter service in 2025 the ES-30 is expected to enter service in 2028.

Air Canada does not operate any turboprops but has a capacity purchase agreement with Jazz, an independent Canadian regional carrier. Jazz currently operates 39 Q400s for Air Canada on 51 routes, 22 of which are less than 500 km (according to OAG data). The shortest routes are only 51 km and 63 km – from Vancouver to Nanaimo and Victoria, both of which are located on Vancouver Island, which is connected with Vancouver via ferries that take at least 90 minutes. Air Canada also has 19 super short-haul routes that are operated with jets (some of these routes have a mix of turboprop and jet services).

United has not had any turboprop flights in its network since January 2018, when Dash 8s were phased out. However, it uses Mesa and other regional carriers to operate regional jets. United currently has about 110 regularly scheduled super short-haul routes (according to OAG data). Mesa could potentially use the ES-30 to operate some of these routes on behalf of United Express. As the ES-30 is significantly smaller than any of the existing aircraft in the United Express fleet, it would also be used to launch new routes or routes which United previously served but were suspended as United phased out smaller aircraft.

Independent regional airline JSX also announced an order in December 2023 for 50 ES-30s. At the same time it also announced 50 orders for Aura Aero ERA, a nine-seat hybrid electric aircraft with a range of up to 1600 km that was unveiled earlier in 2023. JSX currently operates Embraer in a low density 30 seat configuration, connecting about 25 destinations in North America under a public charter model.

Small aircraft (both turboprops and small regional jets) have been on the decline generally in the US domestic market as they are uneconomical and often not liked by passengers. However, electric aircraft could provide an opportunity for some US carriers to again offer flights with small aircraft, resulting in improved connectivity for smaller communities, as they are more efficient and could be more appreciated by passengers given their green credentials.

Hawaiian Airlines announced in 2022 an investment in Regent, which is developing electric sea gliders. Regent aims to have a 100-seat sea glider in service by 2028, offering a range of up to 290 km with current battery technology and potentially up to 800 km with next generation batteries. A sea glider takes off and lands from water but cruises like an aircraft with speeds of up to 180 mph.

Hawaiian Airlines currently uses a fleet of 19 Boeing 717s with 123 to 128 seats on inter-island routes. It currently operates eight inter-island routes covering distances of 134 km to 422 km (according to OAG data). While Hawaiian Airlines has been exploring electric sea gliders and other zero emission solutions it is also looking at new generation conventional aircraft such as Airbus A220s and Embraer E195-E2s to replace its 717s. Hawaiian Airlines recognises it could take several years for new zero emissions technology to mature to sufficiently support 100-seat aircraft even on very short routes.

Hawaiian Airways only operates thick inter-island routes and competes on some of these with Southwest Airlines. A much smaller Hawaii-based regional carrier, Mokulele Airlines, operates thinner inter-island routes to smaller communities using a fleet of 9-seat Grand Caravans and 30-seat Saab 340 turboprops. Mokulele announced in June 2022 plans to operate 12-seat electric sea gliders that are being developed by Regent and is expected to enter service in 2025.

Mokulele also has a partnership Ampaire, which in December 2020 demonstrated on a Mokulele route a six-seat Cessna 337 with a hybrid electric powertrain. This demonstration marked the first time a hybrid electric aircraft was used to conduct test flights on a commercial airline route.

Ampaire is now testing a hybrid electric powertrain on a Cessna Caravan which is expected to be approved in 2024 and provide a 50% to 70% reduction of fuel burn depending on the length of flight. Mokulele's Caravan fleet – and possibly in future its Saab fleet, which Mokulele began adding in 2022 – could be electrified. However, a commitment or timeline for upgrades have not yet been announced.

Mokulele was acquired in 2019 by Southern Airways, which is the largest Caravan operator in the US and serves about 40 US cities. In August 2023, Southern Airways was acquired by Surf Air Mobility, which initially partnered with Southern Airways in 2022. Surf Air Mobility expects its acquisition of Southern Airways, along with an initial public offering which was completed at the same time, will accelerate green flying as it pursues hybrid electric and fully electric powertrain technology to upgrade Southern Airways' Caravan fleet. Southern Airways and Surf Air, a much smaller airline which offers charter services, combined flew 450,000 passengers in 2022. Surf Air Mobility announced in September 2023 an order from Textron of 100 Cessna Grand Caravan Aircraft which Surf Air Mobility will upgrade using its electric or hybrid electric powertrain technology.

Another large US-based operator of small aircraft, Cape Air, signed a letter of intent in 2022 with Eviation for 75 Alice nine-seat all-electric aircraft. Cape Air operates about 100 small turboprop aircraft, offering scheduled services connecting small cities in the Caribbean and continental US. Most of Cape Air's fleet consists of Cessna 402s but it also operates Britten-Norman Islanders and Tecnam P2012 Travellers.

GlobalX Airlines (Global Crossing Airlines) also ordered 50 Alice electric aircraft in 2022. GlobalX currently does not operate any scheduled services but operates as a charter and wet lease carrier in the US and Caribbean with A320 family aircraft.

A Mexican start-up airline, Aerus, announced in January 2023 a letter of intent with Eviation for 30 Alice electric aircraft. Aerus launched services in April 2023 using nine-seat Cessna Grand Caravans with conventional powerplants that operate scheduled services to underserved or unserved communities in northern Mexico. Aerus also plans to acquire 19-seat Cessna 408 SkyCouriers. The SkyCourier is a new conventional turboprop aircraft that entered service as a freighter in May 2022 with a 19-seat passenger variant that entered service in May 2023.

A small Canadian carrier, Harbour Air, completed an all-electric test flight in 2022 with a De Havilland DHC-2 Beaver converted to an all-electric motor. Harbour Air operates single engine-aircraft on very short hops around British Colombia, including to Vancouver Island, using aircraft with six to 19 seats. It has been partnered with electric propulsion company MagniX since 2019 and aims to transition its entire fleet of over 40 aircraft to zero emissions.

A planned new US-based regional carrier, Connect Airlines, placed orders in June 2022 for 75 Universal Hydrogen conversion kits for ATR 72-600s for delivery from 2025. Connect Airlines aims to initially launch services using ATR 72-600s with conventional powerplants, before converting its ATR 72-600s to hydrogen powertrains as part of an objective of becoming the "world's first true zero emissions airline".

American Airlines and JetBlue have also announced investments in Universal Hydrogen but have not yet announced any commitments to operate turboprop aircraft. Universal Hydrogen, which is also developing a conversion for the Dash 8 turboprop, has announced it has received aircraft conversion orders from 16 customers for 247 aircraft. So far only Connect Airlines and Amelia have been disclosed as customers.

American Airlines and United Airlines have also invested in ZeroAvia, which is developing hydrogen electric powertrain for several types of regional aircraft. As part of its investment, American has an option to order up to 100 engines that are being developed under ZeroAvia's hydrogen electric zero emissions powertrain development program for potential use on regional jets.

De Havilland initially teamed up with ZeroAvia in 2021 to offer a hydrogen electric option for the Dash 8 Q400. In May 2023 Alaska Airlines handed over to Zero Avia a Q400 that will be used for test flights. ZeroAvia aims to certify the ZA2000 powertrain on the Q400 by 2027, providing an all-electric range of up to 500 km.

In 2022, Alaska-based RavnAir ordered 30 ZA2000 hydrogen electric engines for its Dash 8 fleet and in June 2023 California-based start-up airline Air Cahana ordered 250 ZA2000 engines. RavnAir uses Dash 8 100s and 300s to serve rural communities in Alaska. Air Cahana plans to initially launch flights using SAF on conventional aircraft before adopting zero emissions propulsion systems.

ZeroAvia's smaller ZA600 powertrain is expected to initially enter service with nine to 19 seat aircraft in 2025. Test flights using a 19-seat Dornier 228 turboprop began in January 2023.

The developments in North America highlight the near-term opportunities for small electric aircraft as well for converting to zero emission powertrain turboprops of all sizes. Turboprop conversions are particularly relevant for Southeast Asia as the region has a sizeable turboprop fleet.

Ramifications for Southeast Asia

While the ATR 72 is by far the most common turboprop operated in Southeast Asia, there are also several operators of aircraft with less than 19 seats with the Caravan particularly common.

There over 100 Caravans operating in Southeast Asia, excluding government aircraft. This includes about 80 aircraft operating in Indonesia. Although these aircraft are generally not operating as scheduled airline services it would be prudent for governments and operators in Southeast Asia to start considering the zero carbon options which are already being embraced by Caravan operators in North America and other regions. With the right policies and infrastructure, the number of aircraft with less than 19 seats in Southeast Asia could expand significantly without impacting the environment. This would improve connectivity in the region by offering scheduled services on routes that are currently not served or have limited services.

While a lot of the attention so far has been on zero emissions small aircraft, there are several programs underway at the major aircraft manufacturers to develop zero emission technologies that could eventually be used for larger aircraft. Airbus, ATR, Boeing, Embraer and GE Aerospace all have electric and/or hydrogen development programs.

For example, ATR is developing the ATR EVO, which is expected to enter service in 2030 featuring a new powerplant with hybrid electric capabilities. Embraer has been working for several years on developing a hybrid electric aircraft with 19 and 30 seats that is expected to enter service in 2030 with a range of nearly 1000 km in hybrid mode.

While none of the major manufacturers have started selling aircraft with electric, hybrid electric, hydrogen electric or hydrogen powertrains, it is worthwhile for Southeast Asian airlines to closely monitor these programs as well as the several programs now well underway at new companies specializing in electric or hydrogen

aviation sector. Several airlines and governments in other regions have been very proactive in supporting and even investing in these programs, which give them a front row seat as zero emissions technology matures. Southeast Asian airlines and governments should consider following their counterparts in other regions as otherwise they risk missing out on near-term opportunities to decarbonise super short-haul routes.

- Recommendation: Southeast Asian airlines and governments should consider alternative propulsion options for the super short-haul segment.

Appendix

International super short-haul: overview of countries

Malaysia has more international super short-haul flights and routes than any other Southeast Asian country. KUL is the largest airport in Southeast Asia for international short-haul flights and there are six other airports in Malaysia with these flights. Malaysia accounts for seven of the 28 airports in Southeast Asia with international short-haul services.

Singapore is the second largest market with SIN the second largest airport, while Indonesia is the third largest market with KNO the third largest airport. The massive size of the KUL-SIN route is a major factor in this ranking, but Indonesia also has sizeable market. Cambodia, Thailand, Vietnam, Laos, Brunei and Myanmar have much smaller markets as can be seen in Table 10.

Table 10 - International super short-haul flights in Southeast Asia by country: 2023

Rank	Country	Share of flights 2023	Share of seats 2023	Ave. seats per flight 2023	# of airports 2023	Share of flights 2019	Share of seats 2019
1.	Malaysia	39%	41%	171	7	37%	38%
2.	Singapore	26%	26%	168	2	23%	25%
3.	Indonesia	12%	13%	173	4	12%	12%
4.	Cambodia	7%	6%	130	3	9%	8%
5.	Thailand	6%	5%	149	5	7%	6%
	Vietnam	6%	5%	139	2	6%	6%
7.	Laos	3%	3%	147	3	3%	3%
8.	Brunei	>1%	>1%	150	1	1%	1%
9.	Myanmar	>1%	>1%	125	1	>1%	>1%

Source: OAG and Sobie Aviation
Note: Ranking based on number of scheduled flights in 2023
Siem Reap calculated using a combination of the old airport (REP) and new airport (SAI), which opened in October 2023 with REP closing

The only Southeast Asian countries without any super short-haul international flights are Philippines and Timor-Leste.

Timor-Leste is a very small market with only three scheduled international routes overall although one, Dili-Darwin, is quite short at 724 km. The other current routes from Dili are Bali (1,136 km) and Singapore (2,626 km). Dili briefly had a super short-haul route in 2020, to Kupang (272 km) in the Indonesian province of East Nusa Tenggara, but this service only operated for a month prior to the pandemic with three weekly flights and has not resumed.

The Philippines is separated geographically from the rest of Asia. The shortest international route from the Philippines is currently Manila-Kaohsiung (MNL-KHH), which is 898 km. The shortest current international route from the Philippines to another Southeast Asian country is Manila-Kota Kinabalu (MNL-BKI), which is 1,094 km.

The only possible super short-haul international route from the Philippines is a crossing of the Sulu Sea from the Zamboanga peninsula in the northeast corner of Borneo, which is part of the Malaysian state of Sabah. Several years ago, a flight of about 450 km connected Zamboanga to Sandakan. Philippines Airlines has been planning (both before and after the pandemic) to commence a new route from Zamboanga to Kota Kinabalu, which is the capital of Sabah, but this route is nearly 700 km, and a launch date has not yet been set.

International super short-haul: overview of hubs

KUL and SIN combined accounted for 50% of international short-haul flights in Southeast Asia in 2023. The Kuala Lumpur and Singapore markets overall accounted for 58% when including SZB and XSP. SZB is the sixth

largest Southeast Asian airport for international super short-haul flights while XSP is ninth largest although neither make the top 10 based on scheduled seats.

KNO is the third largest based on both number of flights and seats while PEN is fourth largest. REP/SAI, SGN, DMK and PKU are also in the top 10 based on number of flights. Table 11 provides further details.

Table 11 - Top 10 airports for international super short-haul flights in Southeast Asia: 2023

Rank	Airport	Share of flights 2023	Share of seats 2023	Ave. seats per flight 2023	Share of flights 2019	Share of seats 2019
1.	Kuala Lumpur International (KUL)	28%	31%	181	24%	28%
2.	Singapore Changi (SIN)	22%	25%	183	20%	23%
3.	Medan Kualanamu (KNO)	8%	9%	180	7%	8%
4.	Penang International (PEN)	5%	4%	184	3%	4%
	Siem Reap (REP/SAI)	5%	4%	137	6%	6%
6.	Ho Chi Minh City (SGN)	4%	4%	132	5%	4%
	Kuala Lumpur Subang (SZB)	4%	2%	72	4%	2%
8.	Bangkok Don Mueang (DMK)	3%	3%	180	2%	2%
9.	Singapore Seletar (XSP)	3%	2%	72	2%	1%
	Vientiane (VTE)	2%	2%	179	1%	1%

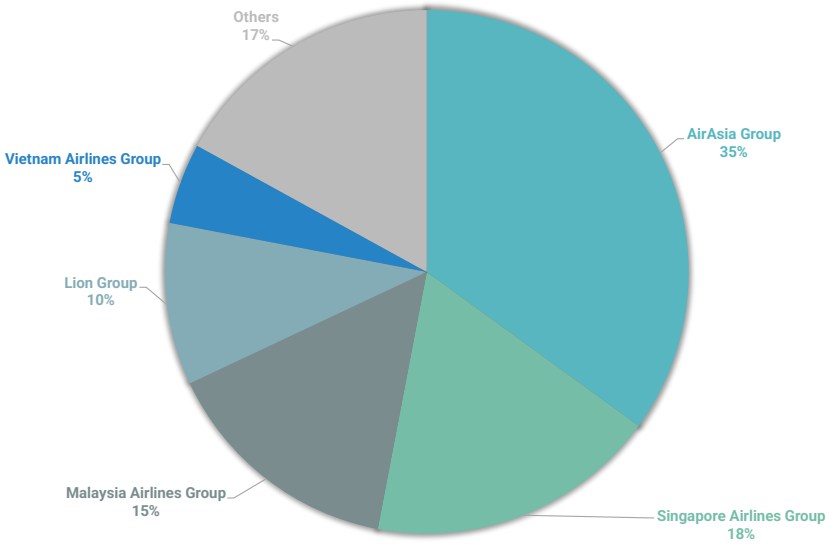
Source: OAG and Sobie Aviation
Note: Ranking based on number of scheduled flights in 2023
Siem Reap calculated using a combination of the old airport (REP) and new airport (SAI), which opened in October 2023 with REP closing

International super short-haul: overview of airlines

Malaysia also accounts for the three largest carriers in Southeast Asia's super short-haul international market. AirAsia is by far the largest airline, boosted by its market leading position on the two largest routes (KUL-SIN and KUL-KNO). AirAsia Group is also the market leader on the third largest route (PEN-KNO) when including the flights operated by both its Malaysian subsidiary and Indonesian affiliate.

There are currently about 20 Southeast Asian airlines operating international super short-haul flights, but four main groups account for about 80% of the market. AirAsia Group accounted for 32% of frequencies and 35% of seats in 2023 while Malaysia Airlines Group accounted for 19% of frequencies and 15% of seats. Singapore Airlines Group accounted for 15% of frequencies and 18% of seats while Lion Group accounted for 10% of both frequencies and seats.

Figure 7 - Top 5 Southeast Asian airline groups based on international super short-haul seat capacity: 2023



Source: OAG and Sobie Aviation

There is also currently three non-Southeast Asian airlines operating super short-haul flights to Southeast Asia. This includes Ethiopian Airlines, Qatar Airways and China's Ruili Airlines. Ethiopian Airlines serves KUL-SIN with fifth freedom rights, while Qatar Airways serves PNH-SGN with fifth freedom rights. There were more fifth freedom competitors on KUL-SIN and other routes in 2019. All the non-Southeast Asian carriers are included under the other column in Table 12 below.

Table 12 - Southeast Asian airlines with international super short-haul flights: 2023

Rank	Airline (IATA airline code)	Country	Share of frequencies 2023	Share of seats 2023	Share of frequencies 2019	Share of seats 2019
1.	AirAsia (AK)	Malaysia	21%	24%	19%	22%
2.	Malaysia Airlines (MH)	Malaysia	11%	11%	10%	10%
3.	Firefly	Malaysia	8%	5%	8%	4%
	Singapore Airlines (SQ)	Singapore	8%	9%	8%*	9%*
5.	Scoot (TR)	Singapore	7%	9%	5%	7%
6.	Thai AirAsia (FD)	Thailand	6%	6%	5%	5%
	Batik Air Malaysia (OD)	Indonesia	6%	5%	6%	5%
	Cambodia Angkor Air (K6)	Cambodia	6%	4%	6%	3%
9.	Indonesia AirAsia (QZ)	Indonesia	4%	5%	6%	7%
	Vietnam Airlines (VN)	Vietnam	4%	5%	4%	5%
11.	Bangkok Airways (PG)	Thailand	3%	1%	6%	4%
	Jetstar Asia (3K)	Singapore	3%	4%	4%	4%
	Lao Airlines (QV)	Laos	3%	2%	4%	2%
14.	Citilink (QG)	Indonesia	2%	2%	<1%	<1%
	Lion Air (JT)	Indonesia	2%	3%	1%	1%
	Batik Air (ID)	Indonesia	2%	2%	1%	1%
17.	Royal Brunei (BI)	Brunei	1%	1%	2%	2%
18.	Cambodia Airways (KR)	Cambodia	<1%	<1%	N/A	N/A
	Super Air Jet (IU)	Indonesia	<1%	<1%	N/A	N/A
	Thai Smile (WE)	Thailand	<1%	<1%	2%	2%
	Wings Air (IW)	Indonesia	<1%	<1%	<1%	<1%
N/A	Sriwijaya Air (SJ)	Indonesia	N/A	N/A	1%	1%
	AirAsia X (D7)	Malaysia	N/A	N/A	<1%	1%
	JC International (QD)	Cambodia	N/A	N/A	<1%	<1%
	MASwings (MY)	Malaysia	N/A	N/A	<1%	<1%
	*Others^*		*1%*	*2%*	*3%*	*5%*

Source: OAG and Sobie Aviation
Notes: ^Others are airlines that are not based in Southeast Asia
**SilkAir is included in Singapore Airlines 2019 frequency and seat share; SilkAir merged into Singapore Airlines in 2021*
Thai Smile merged into Thai Airways in 2023
Batik Air Malaysia was formerly known as Malindo Air

Malaysia AirAsia currently has a higher share of the market compared to prior to the pandemic as it has fully restored its capacity on all its super short-haul international routes while the overall market is not yet fully restored. AirAsia currently operates up to 11 daily flights on KUL-SIN, up to four daily flights on KUL-KNO, up to three daily flights on KUL-PDG, up to 18 weekly flights on KUL-PKU and up to ten weekly flights on PEN-KNO. Indonesia AirAsia supplements KUL-KNO with up to 21 weekly flights and PEN-KNO with up to 18 weekly flights.

Thai AirAsia also has a higher market share than prior to the pandemic as it has fully restored its super short-haul international capacity. Thai AirAsia currently operates up to three daily flights on DMK-SAI and up to two daily flights on DMK-VTE. It now has more capacity on DMK-VTE than prior to the pandemic and about the same amount of DMK-REP/SIA capacity while its competitors have reduced capacity on BKK-VTE and BKK-REP/SAI. Thai AirAsia has not yet resumed a third super short-haul route, DMK-KOS, although this was only launched in July 2019 with four weekly flights. Its third Bangkok-Cambodia route, DMK-PNH, is slightly more than 500 km so does not qualify as super short-haul.

AirAsia Group's overall share has only increased slightly as Indonesia AirAsia has contracted and AirAsia X, which operated two daily KUL-SIN flights before the pandemic with high density A330 widebody aircraft, has not yet resumed Singapore flights. AirAsia X is one of five Southeast Asian carriers that operated super short-haul international flights in 2019 but did not in 2023. The other four are JC International, MASwings, SilkAir and Sriwijaya Air.

SilkAir was merged into Singapore Airlines in 2021. JC International also has ceased operations. Sriwijaya is a much smaller airline than prior to the pandemic. MASwings no longer operates international services.

Domestic super short-haul: overview of countries and hubs

Indonesia is by far the largest domestic market in Southeast Asia and accounted for 37% of total domestic passenger traffic in Southeast Asia in 2019. It is also the largest super short-haul domestic market in Southeast Asia, with nearly 150 routes in 2019.

Thailand and Vietnam are the second largest domestic markets overall, each accounting for about 17% of total domestic traffic in Southeast Asia in 2019. Philippines is fourth largest with a 14% share followed by Malaysia with a 13% share. Myanmar is sixth largest but is much smaller, accounting for only a 1% share. Cambodia is the smallest domestic market in Southeast Asia, behind even Laos, and has only three domestic routes. Brunei, Singapore and Timor-Leste do not have any domestic services.

However, Malaysia is the second largest domestic super short-haul market as it has a higher share of super short-haul routes. In addition to several relatively thick routes within peninsular Malaysia, there are numerous thin routes within east Malaysia (Sabah and Sarawak). Most of these are government subsidized routes connecting small remote communities with small 19-seat turboprop aircraft.

The Philippines has the third largest super short-haul domestic market followed by Thailand, Vietnam and Myanmar. Cambodia and Laos have by far the smallest super short-haul domestic market. All domestic flights in Cambodia and almost all domestic flights in Laos are less than 500 km but their domestic markets are very small.

Table 13 - Domestic super short-haul flights in Southeast Asia by country: 2023

Rank	Country	Share of flights 2023	Share of seats 2023	# of daily routes 2023	Share of flights 2019	Share of seats 2019	# of daily routes 2019
1.	Indonesia	34%	34%	71	41%	41%	145
2.	Malaysia	20%	18%	39	20%	19%	41
3.	Philippines	20%	20%	37	14%	14%	40
4.	Thailand	11%	12%	20	10%	12%	23
5.	Vietnam	10%	13%	13	6%	9%	17
6.	Myanmar	3%	2%	10	6%	3%	20
7.	Laos	2%	1%	6	2%	1%	8
8.	Cambodia	<1%	<1%	1	1%	1%	3

Source: OAG and Sobie Aviation
Note: Ranking based on number of scheduled flights in the second quarter of 2023

As indicated above in Table 13, all the countries have seen a reduction in the number of daily domestic super short-haul routes. Indonesia has experienced the most significant reduction in the number of routes. There are approximately 70 fewer daily domestic super short-haul routes than prior to the pandemic and about 80 routes have not yet resumed. However, the un-resumed routes are predominately small point to point routes and very few airports have lost commercial services entirely. The number of Indonesian airports with scheduled services has dropped only slightly, from about 120 prior to the pandemic to about 110 currently.

Almost half of all domestic routes in Indonesia are less than 500 km although the portion of super short-haul routes at the main hubs are much smaller. For example, slightly less than one third of domestic routes from Jakarta Soekarno-Hatta are super short-haul.

While Indonesia and Malaysia are larger markets than the Philippines, Manila Ninoy Aquino (MNL) is the largest domestic super short-haul hub and accounted for about 6% of all domestic super short-haul flights in Southeast Asia in 2023. MNL was the third largest hub in 2019 behind Jakarta Soekarno-Hatta (CGK) and Kuala Lumpur (KUL). MNL has risen in the rankings as the Philippines domestic market has already fully recovered while the Indonesia and Malaysia domestic markets are still well below pre-pandemic levels.

The Philippines now accounts for three of the top 10 airports. Malaysia, Indonesia and Thailand each account for two top 10 airports while Vietnam accounts for one. A summary of the top 10 airports can be seen below in Table 14.

Table 14 - Top 10 airports for domestic super short-haul flights in Southeast Asia: 2023

Rank	Airport	Share of flights 2023	Share of seats 2023	Ave. seats per flight 2023	Share of flights 2019	Share of seats 2019
1.	Manila Ninoy Aquino (MNL)	5.8%	6.8%	154	3.2%	3.9%
2.	Jakarta Soekarno-Hatta (CGK)	4.5%	5.9%	174	4.7%	6.6%
3.	Ho Chi Minh (SGN)	4.2%	5.4%	170	2.6%	3.7%
4.	Cebu (CEB)	3.7%	2.7%	97	2.6%	2.3%
5.	Kuala Lumpur International (KUL)	3.6%	4.7%	175	3.5%	4.9%
6.	Bangkok Suvarnabhumi (BKK)	2.5%	2.6%	138	1.6%	1.8%
7.	Bangkok Don Mueang (DMK)	2.2%	3.1%	180	2.8%	3.6%
8.	Caticlan (MPH)	2.0%	2.4%	160	0.9%	1.1%
9.	Penang (PEN)	1.8%	2.0%	138	2.1%	2.2%
10.	Palembang (PLM)	1.6%	2.1%	174	1.7%	2.1%

Source: OAG and Sobie Aviation
Note: Ranking based on number of scheduled flights in 2023

Caticlan (MPH) is not a hub airport but makes the list of top 10 airports given the massive size and rapid growth of the MNL-MPH route. MPH also has three much smaller domestic routes which also qualify for super short-haul but MNH-MPH accounts for about 75% of all flights at MPH.

Domestic super short-haul: overview of airlines

There are currently more than 40 airlines operating domestic super short-haul services in Southeast Asia. The top 20 airlines account for over 80% of flights and over 85% of the total seat capacity. An overview based on seat capacity can be found in Figure 8, below, and a full ranking can be found in Table 15, below.

Indonesia-based Wings Air, a subsidiary of Lion Group that only operates turboprop aircraft, is the largest airline in Southeast Asia's domestic super short-haul market based on frequencies. Sister airline Lion Air is the largest airline in this segment based on seat capacity. (AirAsia Malaysia is slightly smaller).

Indonesian carriers account for six of the top 20 airlines. This includes two ot\her airlines that are affiliated with Lion (Batik Air and Super Air Jet) and two which are part of Garuda Group (Garuda Indonesia and Citilink).

Malaysia accounts for five of the top 20 airlines, including three which are part of Malaysia Airlines Group (Malaysia Airlines, Firefly and MASwings). There are also four airlines in the top 20 from the Philippines, including two which are part of the Cebu Pacific Group (Cebu Pacific and Cebgo).

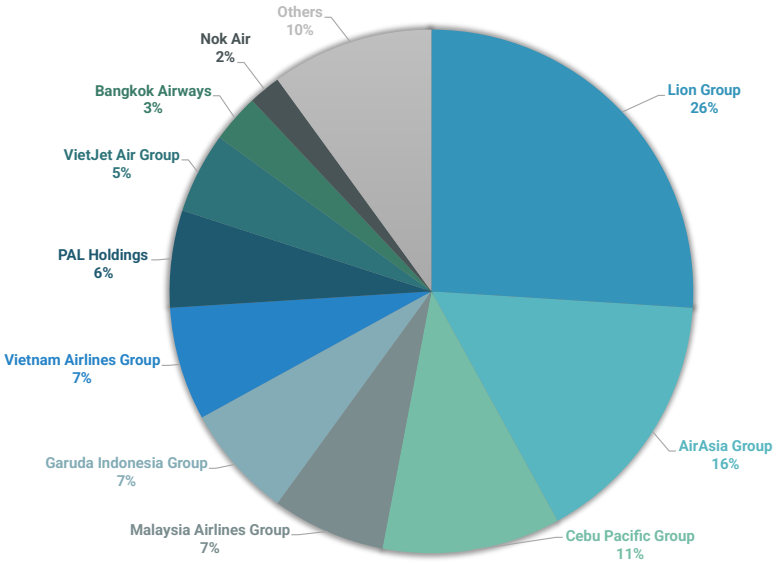
Table 15 - Top 20 domestic super short-haul airlines in Southeast Asia: 2023

Rank	Airline (IATA airline code)	Country	Share of frequencies 2023	Share of seats 2023	Share of frequencies 2019	Share of seats 2019
1.	Wings Air (IW)	Indonesia	12%	7%	13%	7%
2.	AirAsia (AK)	Malaysia	6%	9%	7%	10%
	Lion Air (JT)	Indonesia	6%	9%	5%	8%
	PAL Express (2P)	Philippines	6%	6%	4%	4%
	Cebgo (DG)	Philippines	6%	3%	3%	2%
6.	MASwings (MY)	Malaysia	5%	2%	4%	2%
	Cebu Pacific (5J)	Philippines	5%	7%	4%	5%
8.	Citilink (QG)	Indonesia	4%	5%	4%	6%
	Bangkok Airways (PG)	Thailand	4%	3%	3%	3%
	Batik Air (ID)	Indonesia	4%	5%	2%	3%
	Firefly (FY)	Malaysia	4%	2%	3%	2%
12.	Vietnam Airlines (VN)	Vietnam	3%	5%	2%	3%
	Thai AirAsia (FD)	Thailand	3%	3%	2%	3%
14.	VietJet Air (VJ)	Vietnam	2%	4%	2%	3%
	Malaysia Airlines (MH)	Malaysia	2%	3%	2%	3%
	Philippines AirAsia (Z2)	Philippines	2%	3%	1%	2%
	Garuda (GA)	Indonesia	2%	3%	5%	6%
	Super Air Jet (IU)	Indonesia	2%	3%	N/A	N/A
	Batik Air Malaysia (OD)	Malaysia	2%	1%	4%	3%
	Nok Air (DD)	Thailand	2%	2%	3%	3%

Source: OAG and Sobie Aviation
Notes: Ranking based on number of scheduled flights in 2023
Philippine Airlines (PH) uses PAL Express (2P) to operate almost all its super short-haul domestic flights, but the flight numbers are under PH | Vietnam Airlines excludes turboprop subsidiary VASCO and low-cost subsidiary Pacific Airlines | Batik Air Malaysia was formerly known as Malindo Air | Super Air Jet launched in 2021

The Lion family of airlines, which also includes Batik Air Malaysia and Thai Lion Air, accounted for 26% of total super short-haul domestic frequencies and 26% of seats in 2023. This makes Lion by far the largest player in Southeast Asia's super short-haul domestic market. (Super Air Jet is technically not part of the Lion Group but has the same owners and uses Lion Group to provide many services including aircraft maintenance).

Figure 8 - Top 10 Southeast Asian airline groups based on domestic super short-haul seat capacity: 2023



Source: OAG and Sobie Aviation

The AirAsia, Cebu Pacific and Malaysia Airlines groups have similar shares of Southeast Asia's domestic super short-haul market based on number of flights, but AirAsia is larger in terms of seats. The AirAsia Group accounted for 12% of domestic super short-haul frequencies and 16% of seats in 2023.

The Cebu Pacific Group accounted for 11% of frequencies and 11% of its seats. Unlike AirAsia, Cebu Pacific has a turboprop fleet (operated by the Cebgo subsidiary) and therefore has a smaller share of seats than AirAsia.

The Malaysia Airlines Group (MAG) also accounted for 11% of frequencies but only 7% of seats. Most of MAG's super short-haul flights are operated with turboprops.

Garuda Indonesia Group and Vietnam Airlines Group are the next largest airline groups in Southeast Asia, both with a 6% share of frequencies and a 7% share of seats. The Vietnam Airlines Group includes turboprop subsidiary VASCO, which is not in the top 20 as it a very small airline with only a 1% share of flights.

The Philippines Airlines Group, also known as PAL Holdings, is the seventh largest airline group in Southeast Asia's super short-haul market with a 6% share of both frequencies and seats. All of PAL's super short-haul flights are operated by PAL Express, which operates a fleet of Dash 8 turboprops and all economy A320s.

PAL Express is the largest full-service airline in Southeast Asia's super short-haul domestic market, based on number of flights. The four larger airlines (Wings Air, AirAsia, Lion Air and Cebgo) are all low-cost carriers.

VietJet Air Group has a 3% share of flights and 5% share of seats when also including the 1% share for Thai VietJet, which does not make the top 20. VietJet has an all-jet fleet.

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