NOTE

SUBJECT	Review of assumed airline responses at Schiphol Airport due to tariff differentiation
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INTRODUCTION

The Dutch government wants to reduce noise pollution around Schiphol Airport. To this end, noise targets have been defined for November 2025. In early September 2024 - as part of the Balanced Approach procedure - a package of measures was notified to the European Commission. One of those measures concerns the stronger differentiation of airport charges based on aircraft noise categories. Increasing the charges for noisy aircraft and decreasing them for quieter aircraft creates a (greater) financial incentive for airlines to replace noisy aircraft with quieter types.

The noise impact of a stronger differentiation of airport charges depends on the extent to which airlines can and will replace aircraft. The Ministry of Infrastructure and Water Management (I&W) and Schiphol have estimated their responses separately. Schiphol expects stronger airline responses than I&W, which translates into a larger (positive) noise effect. An indirect consequence is that the number of flights may need to be reduced less to meet noise targets.

Beelining was asked to assess the airline responses assumed by I&W and Schiphol based on the underlying assumptions. This note first describes the new tariff system for the period 2025-2027. It then discusses the possible airline responses. This is followed by an assessment of the responses assumed by I&W and Schiphol. The note ends with the main conclusions and some final remarks.

TARIFF SCHEME FOR 2025-2027

The charges at Schiphol Airport are set for a 3-year period. Within that period, charges may vary from year to year. The charges consist of a rate per passenger and a rate per tonne MTOW for each take-off and landing. The differentiations based on aircraft noise category relate to the latter.

On 31 October 2024, Schiphol published the charges for the period 2025-2027. The first round of new charges will in principle take effect from 1 April 2025.[1] A base tariff applies to take-offs and landings during the day with an aircraft in noise category S3. For noisier aircraft (noise categories S1 and S2) and for night flights, a malus is applied to the base tariff. For quieter aircraft (categories S4-S7), a bonus applies.[2] Furthermore, lower charges apply for passenger aircraft that are handled disconnected and for cargo flights (due to the lower costs associated with such flights). Finally, take-offs and landings are still subject to a charge based on their NO_x emissions.

Under the new tariff scheme, the base tariff will increase in steps from €5.94 in 2024 to €9.73 in 2025 (+64%) and €11.16 in 2026 (+15%). In 2027, the base tariff is again reduced to €9.35 (-16%). In addition, the rates are differentiated more strongly each year, both by noise category and time of day. The differentiations and the absolute tariffs per tonne MTOW (for passenger flights with connected handling) are shown in Table 1 and Table 2. The charges for passenger flights handled disconnected and for cargo flights are reduced by the same percentages as before (20% and 48% respectively). The NO_x charge also remains unchanged at €4 per kg.

TABLE 1 TARIFF DIFFERENTIATIONS (BASE TARIFF = 100%)

Type	2024			2025			2026			2027		
	Day	Night		Day	Night		Day	Night		Day	Night	
		Land.	T/O		Land.	T/O		Land.	T/O		Land.	T/O
S1	200%	500%	600%	250%	1000%	1200%	300%	1500%	1800%	400%	2500%	3000%
S2	145%	225%	250%	170%	350%	375%	200%	450%	500%	250%	675%	750%
S3	**100%**	140%	165%	**100%**	210%	250%	**100%**	280%	330%	**100%**	420%	495%
S4	80%	120%	145%	80%	190%	220%	80%	240%	290%	75%	360%	435%
S5	65%	100%	120%	65%	150%	180%	60%	200%	240%	55%	300%	360%
S6	50%	80%	95%	50%	100%	120%	45%	120%	145%	40%	160%	190%
S7	40%	65%	75%	35%	80%	95%	30%	100%	120%	25%	130%	150%

Source: Beelining based on Royal Schiphol Group (2023, 2024)

The new tariff scheme thus not only includes a stronger differentiation of the charges by noise category (as originally assumed in the Balanced Approach procedure), but also a stronger differentiation by time of day as well as an increase in the base tariff. This may lead to additional airline responses. For instance, a stronger differentiation by time of

1 Airlines can object to the Authority Consumer and Market (ACM) until four weeks after the publication of the new tariffs. If the ACM assesses that the tariffs or conditions violate the Aviation Act, entry into force may be suspended.

2 The total revenue from the airport charges may not exceed the related costs plus a reasonable return on invested capital. This means that the total malus must be offset by equally large bonus on other flights.

day makes it more attractive to shift night flights to the daytime. And the higher base tariff makes the differentiations more effective and may reduce market demand.

TABLE 2 TARIFFS PER START/LANDING (€ PER TON MTOW)

Type	2024			2025			2026			2027		
	Day	Night		Day	Night		Day	Night		Day	Night	
		Land.	T/O		Land.	T/O		Land.	T/O		Land.	T/O
S1	11.88	29.70	35.64	24.33	97.30	116.76	33.48	167.40	200.88	37.40	233.75	280.50
S2	8.61	13.37	14.85	16.54	34.06	36.49	22.32	50.22	55.80	23.38	63.11	70.13
S3	**5.94**	8.32	9.80	**9.73**	20.43	24.33	**11.16**	31.25	36.83	**9.35**	39.27	46.28
S4	4.75	7.13	8.61	7.78	18.49	21.41	8.93	26.78	32.36	7.01	33.66	40.67
S5	3.86	5.94	7.13	6.32	14.60	17.51	6.70	22.32	26.78	5.14	28.05	33.66
S6	2.97	4.75	5.64	4.87	9.73	11.68	5.02	13.39	16.18	3.74	14.96	17.77
S7	2.38	3.86	4.46	3.41	7.78	9.24	3.35	11.16	13.39	2.34	12.16	14.03

Source: Beelining based on Royal Schiphol Group (2023, 2024)

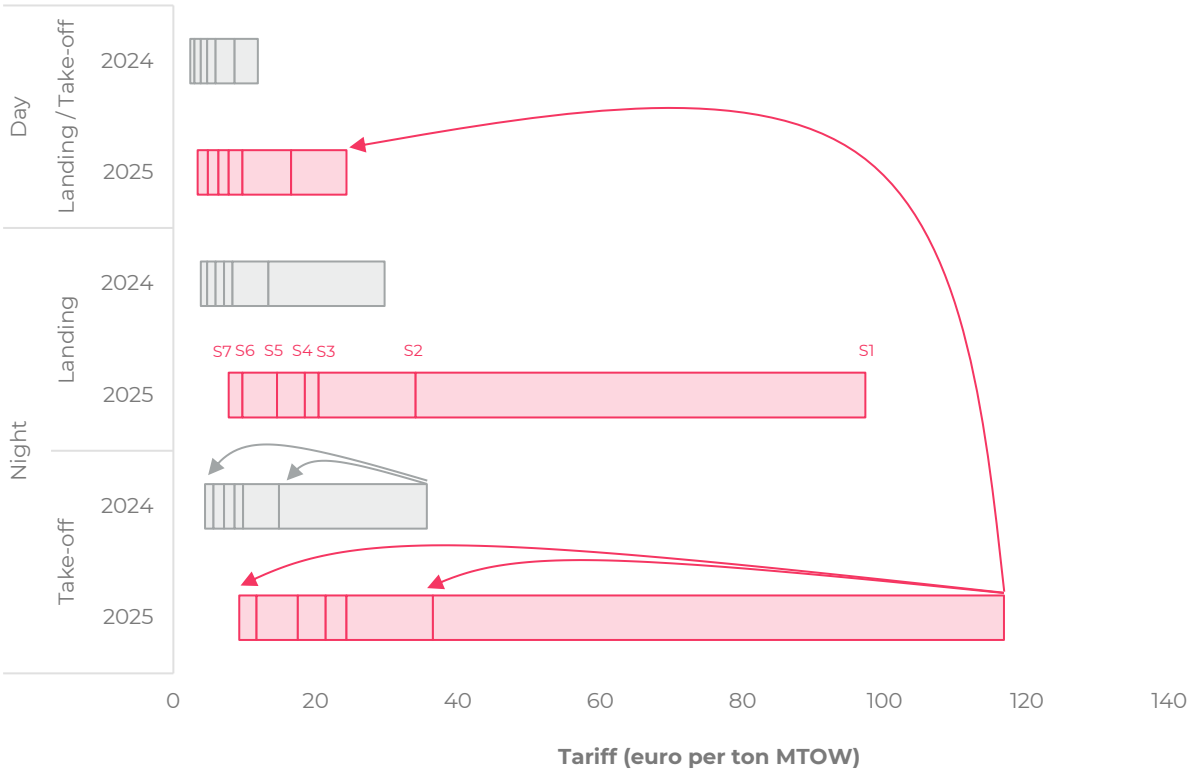
The noise target in the Balanced Approach procedure is defined for November 2025. The extent to which the new tariff scheme contributes to the noise targets should therefore be based on the tariff changes and airline responses up to November 2025 Over the longer-term stronger responses are expected. The final section briefly considers the longer-term effects of the new tariff system.

Although the charges for all aircraft types and noise categories increase under the new scheme, the increases are largest for the noisiest aircraft types (categories S1 and S2), especially at night (see Figure 1). The incentive to replace those aircraft with quieter types is therefore greatest. The incentive to replace quieter aircraft is much lower.

To illustrate, in 2024 replacing an S1 aircraft with a departure at night by a quieter type yielded savings of €20 - 30 per tonne MTOW; in 2025, these savings will increase to around €80 - €110 per tonne MTOW. For daytime departures the savings increase substantially less: in 2024 the savings were €3 - €10 per tonne of MTOW, and in 2025 they increase to €8 - €21.

In addition, the new tariff scheme offers an incentive to move noisy aircraft from night to day. Figure 1 shows, for example, that moving a departure with an S1 aircraft from night to day saves about €90 per tonne MTOW. The potential to move noisy aircraft from night to day is especially large among S2 aircraft, due to the relatively high share of such aircraft in the night. Currently, the share of S2 aircraft at night is about twice the average share of S2 aircraft at Schiphol.

FIGURE 1 TARIFF RANGES FOR CONNECTED PASSENGER AIRCRAFT (€ PER TON MTOW)



Source: Beelining based on Royal Schiphol Group (2023, 2024)

POTENTIAL AIRLINE RESPONSES

Airlines will react differently to the new tariff scheme, depending on their ability to adjust their operations and the financial consequences this has. The potential responses can be roughly classified into the following categories:

1. **Do nothing:** Keep operating the existing aircraft at the set times. This option is interesting to airlines that already operate relatively quiet aircraft at Schiphol. They have little to gain financially from replacing those aircraft with even quieter types (when available);
2. **Replace noisy aircraft with quieter types:** Replacing noisy aircraft with quieter aircraft in the fleet.[3] This is especially interesting to airlines that currently operate relatively noisy aircraft at Schiphol and have quieter types available in their fleets. Home-based airlines that only fly to and from Schiphol do not have this option.[4] Airlines with both a base at Schiphol and other airports may be able to source quieter aircraft from those other bases;

[3] This could also mean replacing cargo flights by passenger flights.
[4] Airlines are unlikely to be able to obtain new (quieter) aircraft from the aircraft manufacturers in the short-term - by November 2025 at the latest – due to the large order books.

3. **Move noisy aircraft from night to day:** This could either consist of a retiming of existing flights or moving a flight with a noisy aircraft to the day and another flight with a quieter aircraft to the night. This is an attractive option for airlines that currently operate in the night, but are not necessarily bound to nightly arrivals and departures and have no or limited opportunities to deploy quieter aircraft at Schiphol;
4. **Reduce flight operations:** Rationalization or termination of flights at Schiphol due to higher tariffs. This applies especially to airlines that currently fly relatively noisy aircraft with no options to replace them with quieter types or shift them to other times of the day.

Airlines shall identify the options available to them and choose the one that is financially most attractive. Thereby, they not only consider the change in airport charges at Schiphol, but the total change in costs and revenues. After all, replacing a noisy aircraft with a quieter type at Schiphol may inflate other costs, such as crew costs, fuel costs, capital costs, landing charges at other airports. The replacement itself also involves administrative costs (switching costs). In addition, moving an aircraft to another time of day or reducing flight operations will have an impact on revenues.

The total financial benefit that airlines can achieve by adjusting their operation is at most equal to the savings on airport charges that can be achieved at Schiphol. After all, if there were additional savings to be made, they would have already adjusted their operation. The actual financial benefit shall likely be lower than the savings on airport charges at Schiphol as other costs may increase and/or revenues decrease. When the savings on airport charges at Schiphol do not outweigh the increase in other costs and/or loss of revenue, an airline shall not adjust its behavior. This explains why some airlines currently operate noisy aircraft at Schiphol, while they have quieter aircraft available in their fleet. Apparently, the current tariff differentiation is not (yet) large enough for them to deploy these quieter aircraft at Schiphol.

REVIEW OF ASSUMED AIRLINE RESPONSES

The airline responses assumed by I&W and Schiphol are limited to (1) doing nothing and (2) replacing noisy aircraft by quieter types. For airlines that cannot replace their noisy aircraft – either because they only fly to and from Schiphol or because they do not have quieter aircraft available in their fleet - it is assumed that they do nothing. For airlines that do have the ability to replace noisy aircraft (in categories S1-S4) with quieter types, it is assumed that they replace part of the aircraft in question.

How airlines shall react to the new tariff system depends on the changes in costs and revenues across their networks (see above). These changes depend on many factors and

are therefore difficult to quantify.[5] I&W has therefore estimated the airline responses based on expert judgement of consultants and researchers. Schiphol also uses expert judgement supplemented by developments at other airports, analysis of flight schedules and contacts with airlines. These contacts showed that many airlines consider replacing noisy aircraft with quieter types as a result of the new regime. However, it is not yet exactly clear which airlines will actually deploy quieter aircraft at Schiphol in 2025.

REPLACEMENT OF NOISY AIRCRAFT BY QUIETER TYPES

I&W and Schiphol use different assumptions regarding the extent to which airlines replace noisy aircraft by quieter types available in their fleets. The assumed replacement shares for the different noise categories are depicted in Table 3. I&W assumes different replacement shares for various carrier types, which are smaller than the generic replacement shares assumed by Schiphol. The replacement shares shall be discussed successively below:

TABLE 3 ASSUMED REPLACEMENT SHARES FOR FLIGHTS WITH S1-S5 AIRCRAFT

TYPE BEING REPLACED	I&W				SCHIPHOL
	Legacy	Low cost	Freight	easyJet	
S1	100%	100%	100%	100%	100%
S2	25%	12.5%	12.5%	25%	50%
S3	12.5%	6.25%	6.25%	12.5%	20%
S4	6.25%	3.125%	3.125%	6.25%	10%
S5	0%	0%	0%	0%	0%

Source: I&W and Schiphol

S1

I&W and Schiphol both assume that the new tariff scheme provides a sufficient financial incentive to replace all S1 aircraft by quieter types (if available).

Although the incentive to replace S1 aircraft is by far the greatest, there are arguments why not all S1 aircraft might be replaced by quieter types in the summer of 2025. First, it may be difficult for airlines to make adjustments to the flight schedule for summer 2025. Second, the financial incentive to replace S1 aircraft during the day may not be sufficient for all airlines to actually do so. Thirdly, airlines operating S1 aircraft at night can largely avoid the tariff increase by shifting the aircraft to the daytime.

[5] A quantitative estimation requires detailed information on operating costs and revenues by type of aircraft and market, or information on previous responses to tariff differentiations.

The assumption that all S1 aircraft will be replaced by quieter types in 2025 due to the new tariff scheme seems somewhat optimistic. This may lead to an overestimation of the noise impact. However, this overestimation will be limited in size, because it is still likely that a significant part of the S1 aircraft shall be replaced and because it concerns a relatively small number of flights.

S2 – S4

I&W assumes that a smaller share of flights operated by S2 to S4 aircraft is replaced by quieter types than Schiphol (see Table 3). As indicated above, it is difficult to quantify exactly how airlines shall react to the new tariff scheme; this is therefore outside the scope of this review. However, a judgement can be made on the total number of replaced flights and on how the replacement rates for the various noise categories relate to one another.

Total number of flights to be replaced

An analysis of Schiphol shows that in 2023 around 75k noisy flights (in categories S2-S4) were operated at the airport by airlines which also had quieter aircraft (in categories S6 and S7) available in their fleets. Some of those flights have since been replaced by a quieter type or will be replaced in the near future as a result of autonomous fleet renewal.[6] This reduces the number of flights potentially eligible for replacement. When we assume that around 10% of the aforementioned 75k noisy flights is replaced each year as a result of autonomous fleet renewal, then around 65k noisy flights (in categories S2-S4) remain in 2025 that are still eligible for replacement by airlines that have the option.

Only part of the 65k noisy flights that could potentially be replaced by quieter types in 2025 will actually be replaced. First, it may be difficult for airlines to make adjustments to the flight schedule for summer 2025. Second, the cost savings will not always outweigh the additional costs or loss of revenue. Third, as mentioned before, it may be more attractive for airlines to move noisy aircraft to the daytime, than to replace them by quieter types.

I&W expects – based on the assumed replacement shares - that about 20% (12,700 flights) of the flights that can be replaced will be replaced. Schiphol expects this to be 30% (19,900 flights). Given the large uncertainties, these share and flight numbers are not very far apart and both seem realistic. However, due to the uncertainties, it is advised to use a range of replacement shares. In doing so, Schiphol's figures can be given more weight, as they are partly based on market information (changes in flight schedules and contacts with airlines).

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[6] It is important to distinguish between aircraft replacements resulting from autonomous developments and replacements resulting from the new tariff scheme. Autonomous developments are included in the reference scenario of the Balance Approach. Including such developments again in a measure like tariff differentiation leads to double-counting of noise impacts.

Ratios between replacement shares

The financial incentive to replace an S1 aircraft is larger than the incentive to replace an S2 aircraft, which is larger than the incentive to replace an S3 aircraft and so on. Both I&W and Schiphol therefore assume that the replacement shares decrease for quieter aircraft types. This section looks at how the assumed replacement shares for the various noise categories relate to one another and judges whether the variations make sense based on the financial benefits than can be achieved by replacing aircraft in the various categories.

It is plausible to assume that the incentive to replace an aircraft is more or less linearly related to the financial benefit it generates. In other words, when a saving of 10 euros per tonne of MTOW results in 10% of aircraft being replaced, then a saving of 20 euros per tonne of MOTW will result in about 20% of aircraft being replaced.

Using this assumption and the savings that can be achieved by replacing noisy aircraft (in categories S1-S4) by quieter types (in categories S6 and S7),[7] allows us to determine the replacement ratios for the various noise categories (see Table 4).

TABLE 4 ESTIMATION OF REPLACEMENT RATIOS

TYPE BEING REPLACED	CHANGE IN TARIFF WHEN AIRCRAFT IS REPLACED BY S6/S7 (€ PER TON MOTW)			SAVINGS / REPLACEMENT RATIO (S4 = 1)			
	Day	Night		Day	Night		**Wgt. avg**
	Landing / Take-off	Landing	Take-off	Landing / Take-off	Landing	Take-off	**Estimate**
S1	-20.19	-88.54	-106.30	5.5	9.1	9.7	**6**
S2	-12.41	-25.30	-26.03	3.4	2.6	2.4	**3**
S3	-5.59	-11.68	-13.87	1.5	1.2	1.3	**1.5**
S4	-3.65	-9.73	-10.95	1.0	1.0	1.0	**1.0**

Source: Beelining based on 2025 landing charges for passenger aircraft with connected handling

The weighted average replacement ratios for S4, S3, S2 and S1 aircraft are roughly 1.0 : 1.5 : 3 : 6.[8] This means that – under the new tariff scheme – it is twice as likely that an S1 aircraft will be replaced by an S2 aircraft, which again is twice as likely to be replaced by and S3 aircraft. An S3 aircraft is 1.5 times more likely to be replaced than an S4 aircraft. The ratios between the replacement shares used by Schiphol seem to better reflect the savings that can be achieved by replacing aircraft in the various noise categories.

7 For the calculation, the average tariff per tonne MTOW was taken for S6 and S7 aircraft.

8 This calculation is a simplification of reality as changes to other costs and revenues are not taken into account when calculating the total savings. In reality the ratios are likely to be somewhat closer to one another.

BOX 1 DIFFERENTIATION OF REPLACEMENT SHARES BY CARRIER TYPE

I&W assumes lower replacement shares for low-cost carriers (other than easyJet) and cargo airlines (see Table 3). The reasoning behind this is that low-cost carriers and cargo airlines on average pay lower charges.[9] This dampens the effect of the stronger tariff differentiations, resulting in smaller tariff increases. On the other hand, however, low-cost carriers and cargo airline tend to operate in highly competitive markets and (therefore) have a stronger focus on cost minimization. This means that – given a certain tariff increase - they will be more likely to replace noisy aircraft by quieter types. Whether the smaller tariff increase for low-cost carriers and cargo airlines outweighs their larger cost sensitivity is difficult to say.

Schiphol recognizes that the replacement share may differ between airlines, but chooses a to use generic shares across carrier types. This implies that every airline reacts to a given cost saving in a similar way. Although this will not be the case in practice - due to the different focus on cost minimization - it is a logical simplification when specific replacement shares for individual carrier types cannot be adequately substantiated.

S5 and higher

I&W and Schiphol both assume that airlines do not replace aircraft in noise category S5 and above with quieter types. Although the tariffs for S7 aircraft are about half those for S5 aircraft, the absolute saving from such a replacement is limited. Also, the potential for airlines to replace S5 aircraft by quieter types is limited. The assumption is therefore justifiable.

OTHER AIRLINE RESPONSES

I&W and Schiphol assume that airlines that cannot replace their noisy aircraft (in categories S1-S4) with quieter types will continue to operate these aircraft at Schiphol at the set times. This is a simplification of reality. After all, the new tariff scheme also provides incentives to these airlines to adjust their operations:

- **Replace noisy aircraft with quieter types:** In their analyses, I&W and Schiphol assessed whether airlines could replace S1-S4 aircraft by quieter types. The possibility of replacing other types, such as an S1 or S2 aircraft by an S3 or S4 aircraft, was not assessed. For airlines that have no other choice, this could be an interesting option, as it would allow then to avoid a large part of the tariff increase (see Figure 1);
- **Move noisy aircraft from night to day:** As noted above, airlines that currently operate noisy aircraft at night can avoid much of the tariff increase by moving these aircraft to the daytime. This option is open to both visiting and home-based carriers. Visiting carriers can retime their flights, whereas home-based carriers can move flights with noisy aircraft to the daytime and flights with quieter aircraft to the night;

[9] As low-cost flights are – according to I&W – more often remotely handled for which lower charges apply. The same holds for cargo flights (see above).

- **Reduce flight operations:** For airlines that cannot replace their noisy aircraft with quieter types or shift flights to daytime, Schiphol may become too expensive. They might rationalize or completely terminate their operations at the airport. The slots will flow back into the slot pool and - due to the current slot scarcity - will be reallocated to another airline. Airlines may also transfer their slots to other companies within the same group or temporarily loan them to a partner (joint operation) until quieter aircraft enter their fleets. With the new tariff scheme, it is likely that the new user of the slots, will use them for flights with quieter aircraft.

By not taking the full spectrum of airline responses into account, the noise impact will be underestimated.[10] At the same time, the replacement shares for airlines that do have the possibility to replace their noisy aircraft (see Table 3) by quieter types are overestimated, as some of these flights shall either be moved to the daytime or be ceased.

I&W chose not to assess the possibility that airlines might move noisy night flights to the daytime, as other measures in the BA package already ensure that this will occur.[11] Although it is true that other measures are specifically aimed at reducing the use of noisy aircraft during the night, it does not mean that those measures have the same impact as stronger fare differentiation. By not explicitly including the possibility of moving night flights to the day for this measure, the full noise impact of the measure remains unclear. This also leads to an underestimation of the cost-effectiveness of the measure.

Schiphol mentions the possibility of moving night flights to daytime, but did not include it in their assessment. According to the airport, however, it is a reason to regard its replacement rates as conservative.

CONCLUSIONS

- I&W and Schiphol partly use different assumptions regarding the extent to which airlines replace noisy aircraft by quieter types available in their fleets:
  - The replacement shares assumed by I&W and Schiphol for the noisiest aircraft (category S1) seems somewhat optimistic at 100% for the short term. However, a limited overestimation of this percentage is unlikely to have a major impact on the calculated noise effect;
  - I&W expects – based on the assumed replacement shares - that about 20% (12,700 flights) of the flights that can be replaced will be replaced. Schiphol expects this to be 30% (19,900 flights). Given the large uncertainties, these shares and flight

10 When noisy aircraft are moved from day to night, only the noise impact at night (L_{night}) is affected; the 24-hour impact remains unchanged (L_{den}).

11 These include (1) a commitment by KLM to replace some of its noisier aircraft at night with quieter types and (2) a ban on noisy aircraft at night.

numbers are not very far apart and both seem realistic. The uncertainties can be reduced by conducting a more thorough quantitative assessment and collecting more information from relevant airlines. Schiphol has already been in contact with multiple airlines about the new tariff scheme and their likely responses. However, it remains largely unclear which airlines will actually deploy quieter aircraft in 2025 as a result of the new tariff scheme;
    - I&W assumes lower replacement shares for low-cost carriers (other than easyJet) and cargo airlines) as they are confronted with a smaller charge increase on average. However, this is partly or fully offset by their greater cost sensitivity. Which effect prevails is difficult to say without further analysis. When specific shares for individual carrier types cannot be adequately substantiated, it is advised to work with a generic percentage;
    - The ratios between the replacement shares used by Schiphol seem to better reflect the savings that can be achieved by replacing aircraft in the various noise categories;
- I&W and Schiphol do not specifically take into account the possibility that airlines move noisy aircraft from the night to the day and that airlines rationalize or terminate their operations at Schiphol. As a result, the noise impact of the new tariff scheme is underestimated. At the same time, the replacement shares for airlines that do have the possibility to replace their noisy aircraft by quieter types are overestimated, as some of these flights shall either be moved to the daytime or be ceased.

FINAL REMARKS

Design of the tariff scheme

The noise categories used to differentiate the tariffs are based on the EPNdB measure. This is a relative noise measure for a given size class. In practice, a heavier aircraft may have a better EPNdB score (because it produces less noise compared to another aircraft in the same size class), than a lighter aircraft, while still producing more noise in absolute terms. A stronger differentiation of charges based on the EPNdB measure could have the unwanted side effect that airlines replacing smaller aircraft with larger ones that, while having a better EPNdB score, produce more noise.

The lower charges that Schiphol applies for passenger flights that are handled disconnected and for cargo flights dampen the effect of tariff differentiations. As a result, the airlines concerned have a smaller incentive to replace their noisy aircraft than airlines that mainly operate passenger flights that are handled connected. This appears to be an undesirable side effect.

Capacity utilization

A number of airlines have indicated to Schiphol that they will replace noisy aircraft with quieter types as a result of the new tariff system. In many cases, the quieter aircraft seem to have a smaller capacity than the noisy ones. Given the current scarcity of capacity, this leads to a less efficient use of scarce capacity.

Longer-term impacts

After 2025, the base tariff will be increased further and the tariffs will be even stronger differentiated. The incentive to replace noisy aircraft and/or move these aircraft from the night to the day therefore increases in 2026 and 2027 as will the noise impact. Moreover, airlines have more time to prepare for the new tariffs, which also contributes to the effectiveness of the measure. In the longer term, it is to be expected that more airports shall differentiate their charges by aircraft category in order to prevent that the noisiest types will be deployed at their airport. This in turn will limit the effectiveness of the measure.