DECISIO

Measuring the cost-effectiveness of noise-mitigating measures for Schiphol Airport

Appendix Sensitivity Analysis, 31-8-2023

Sibren Vegter, Niels Hoefsloot (Decisio) and Rogier Lieshout (Beelining)

Introduction

The responses gathered from stakeholders during the consultation phase, gave rise to several sensitivity analyses:

1. Use a higher CO_2-price (in line with 2 degree scenario)
2. Use a lower value-of-time for travel to/from the airport
3. Use a European scope instead of a global scope
4. Apply an alternative method to assess the generalised travel costs for passengers that can not be accomodated to Schiphol anymore.

1. Use a higher CO_2-price (in line with 2 degree scenario)

The climate impacts are estimated using a CO_2 price of 94 euro per tonne in 2024. This corresponds to the price in the high growth ('Welvaart en Leefomgeving') scenario published by the Central Planning Bureau (CPB and Environmental Assessment Agency (PBL) of the Netherlands. The official guidelines for aviation specific Social Cost Benefit Analysis recommends to use this price (Werkwijzer luchtvaartspecifieke MKBA's, 2021 SEO/Decisio/To70/TG).

The guidelines also advise to perform a sensitivity analysis with the CO_2 prices in a 2 degrees scenario. The prices in a 2 degrees scenario have a lower and upper bandwith and range between 122 and 585 euro in 2024 per tonne (see table at the right).

Using a higher CO_2 price leads to larger climate impacts. First because of each tonne of CO2 is priced higher. Second, because the non-CO_2 impacts are derived from the (higher) CO_2 impacts through a multiplier.

CO_2 prices in standard WLO scenario's and 2 degrees scenario In 2022 prices :

	2021	2030	2050	**2024**
WLO laag (standard)	€ 21	€ 29	€ 57	**€ 23**
WLO Hoog (standard)	€ 85	€ 114	€ 229	**€ 94**
2 degrees scenario LAAG	€ 110	€ 143	€ 286	**€ 122**
2 degrees scenario Hoog	€ 528	€ 715	€ 1.430	**€ 585**

Source: CE Delft, Handboek Milieuprijzen 2023, corrected for 2022 prices Decisio/Beelining.

1. Use a higher CO_2-price (in line with 2 degree scenario)

- Using a higher CO_2 price only affects the results for the measure in which total annual capacity is reduced (440k/29k)
- The climate impacts are six times higher when the upper bandwidth in the 2 degrees scenario is used
- Consequently, total costs (incl. costs to society) decline, but still remain much higher with respect to other measures.
- Cost effectiveness is still worse compared to the other short-listed measures.

With respect to baseline 500k:	CO_2 price - Standard		CO_2-price - 2 degrees scenario (Tweegradenverkenning)	
	Low	High (main analysis)	Lower bandwith	Upper bandwith
Climate effects - CO2 and non CO2	€ 22,5	€ 90,9	€ 118,4	€ 568,2
Total costs (including indirect and external costs):	**-€ 972,5**	**-€ 904,0**	**-€ 876,6**	**-€ 426,8**
With respect to baseline 500k:	Lower bandwith	Upper bandwith	Low	High
Total costs per reduction of				
Houses within 58 dB(A) Lden contour	-€ 895.480	-€ 832.450	-€ 807.195	-€ 393.021
Highly annoyed people within 48 dB(A) Lden contour	-€ 1.293.206	-€ 1.202.181	-€ 1.165.710	-€ 567.580
Houses within 48 dB(A) Lnight contour	-€ 51.207	-€ 47.603	-€ 46.159	-€ 22.474
Severely sleep disturbed people within 40 dB(A) Lnight contour	-€ 370.682	-€ 344.591	-€ 334.137	-€ 162.690

2. Use a lower value-of-time for travel to/from the airport

Changes in travel times to and from the airport are specifically taken into account in the analysis. Passengers that can no longer be accommodated at Schiphol due to a lower cap on annual flight movements (i.e. the 440k/29k measure) may shift to other airports and incur higher pre- and post travel times

The official guidelines for aviation specific Social Cost Benefit Analysis advise to use the VoT of the main modality (in this case in-flight travel time) for pre- and post travel time. The VoT for air passengers is 74 euro p/h in 2024 which is used in our main analysis. However, a sensitivity analysis with the VoT of the mode of transport that is being used pre- and post flight is carried out.

As cars are the dominant modes of transport pre- and post flight (at least 75%), we use the VoT of a car passenger. The VoT of a car with a business motive is 41 euro p/h (share of 32%) and the VoT with motive other (leisure/VFR) is 11 euro p/h (share of 68%). This results in a VoT average of around 21 euro in 2024. This VoT is used as a sensitivity analysis, see results on the next page.

2. Use a lower value-of-time for travel to/from the airport

- Using a lower VoT for pre- and post-flight travel only affects the results for the measure in which total annual capacity is reduced (440k/29k)
- The table present the results of the main analysis in grey (with VoT of an air passenger pre- and post- flight).
- The sensitivity analysis shows a drop of generalised travel costs because of lower VoT Pre- and post- flight.
- This results in total costs being around half of the total costs of the 440k/29k measure of the main analysis. Still, total costs are much higher than in other measures.
- Cost effectiveness is still worse than the other short-listed measures.

With respect to baseline 500k:	Standard: VoT air passenger pre-/post-flight	Sensitvity analysis: VoT car passenger pre-/post- flight
Generalised travel cost passengers/freight	-€ 620,6	-€ 223,6
Total costs (including indirect and external costs):	**-€ 904,0**	**-€ 447,5**
With respect to baseline 500k:	**Standard: VoT air passenger pre-/post-flight**	**Sensitvity analysis: VoT car passenger pre-/post- flight**
M14 - 440k / 29k at night capacity restriction		
Houses within 58 dB(A) Lden contour	-€ 832.450	-€ 412.030
Highly annoyed people within 48 dB(A) Lden contour	-€ 1.202.181	-€ 595.032
Houses within 48 dB(A) Lnight contour	-€ 47.603	-€ 23.561
Severely sleep disturbed people within 40 dB(A) Lnight contour	-€ 344.591	-€ 170.559

3. Use a European scope instead of a global scope

In the main analysis the impacts were assessed on a global scale as the Balanced Approach procedure prescribes to take networks and cross border impacts specifically into account when assessing the cost-effectiveness.

However, an evaluation of the impacts *for the European Union* might be relevant. Some impacts only affect national stakeholders, such as impacts on the airport or local communities. These do not change when a European scope is chosen instead of a global scope. Climate impacts are global. As the EU has committed itself to global climate goals, the full climate impacts should be taken into account. Other impacts, such as those on passengers and airlines may, become smaller when a European scope is used.

In this sensitivity analysis we provide insight into which share of the impacts on passengers and airlines are borne by European passengers and airlines respectively.

Passengers: in 2019 around 55% of O/D passengers started their journey at Schiphol. These were all European passengers. The remainder 45% consisted of inbound O/D passengers of which 76% was European. Transfer passengers were mainly European, a small margin (2-3%) transferred from an ICA to ICA. Therefore, more than 90% of passengers at Schiphol are European. So the estimated impacts of the measures on passengers are borne for at least 90% by Europeans.

Airlines: the costs to airlines of the measures are ultimately borne by its owners/shareholders. The share of European and non-European shareholders of airlines active at Schiphol should be assessed to determine the impact on European citizens. This is a tricky exercise as ownership of shares and stocks are mostly private and change daily.

- For the case of Air France- KLM around 50% of shares are owned by ‘big’ European shareholders (Dutch and French state amongst others) and 7% by non-European. The other 43% are free floating shares, a fair assumption is that around half of these shares is owned by European shareholders. Thus, at least 70% of Air France-KLM shares are owned by European citizens and they also bear the costs of the measures.

In conclusion, the costs of the measures to passengers are for around 90% borne by European citizens and for airlines about 70%. As the lion’s share of the costs stay within Europe, applying a European scope lowers total costs only slightly compared to a global scope.

4. Apply an alternative method to assess the generalised travel costs for passengers

Passengers that can no longer be accommodated at Schiphol due to a lower cap on annual flight movements (i.e. the 440k/29k measure) shift to other airports and destinations, choose another mode of transport or stay at home (and do something different). Their welfare loss was proxied by the time loss associated to using an alternative airport (see also appendix C in the *initial report*).

An alternative method to calculate the welfare loss of passengers not able to fly anymore from Schiphol can be performed by using the increase in ticket prices at Schiphol as a proxy. When capacity is reduced, airlines are able to increase their prices up to the point that demand again meets supply.

Passengers that keep flying will be confronted with the full price increase. Passengers that shift to other airports and destinations, choose another transport mode or stop travelling altogether generally incur a smaller welfare impact (otherwise they would have paid the higher price at Schiphol). As we do not know at what price increase passengers stop flying from Schiphol, we use half of the ticket price increase (the so-called rule-of-half) to estimate their welfare loss.

In this sensitivity analysis we first estimate the ticket price increase that is required to balance demand and supply in the 440k/29k scenario. Ticket prices are based on distance and airline segment (low-cost or full service carriers). The price elasticities used differ between European and ICA destinations and are based on IATA (2022).

In the 440k/29k scenario we have already identified, together with to70, and made assumptions about which flights and segments will see a reduction. Most of these flights are European, about 80%. Destinations in Europe are more price sensitive than ICA destinations. Also, the ticket prices to destinations within Europe are mostly lower than to other destinations mainly because of distance but also because of competition. By looking at the reduction of flights on certain routes and see what price increase is needed to reach this reduction, we are able to calculate the welfare loss through ticket prices for those passengers not able to fly anymore (including the rule-of-half).

4. Apply an alternative method to assess the generalised travel costs for passengers

- The table present the results of the main analysis in grey using the VoT and travel costs to other nearby airports to calculate the generalized travel costs or welfare loss for passengers.
- The sensitivity analysis using the ticket prices method in white shows that the welfare loss is only about one third of the amount compared to the main analysis
- This results in total costs are about one half of the total costs of the 440k/29k measure of the main analysis. We still see that total costs are much higher than in other measures.
- Cost effectiveness is still worse compared to the other short-listed measures.

With respect to baseline 500k:	Generalized travel costs VoT method	Generalized travel costs ticket price method
Generalised travel cost passengers/freight	-€ 620,6	-€ 218,9
Total costs (including indirect and external costs):	**-€ 904,0**	**-€ 442,2**
With respect to baseline 500k:	Generalized travel costs VoT method	Generalized travel costs ticket price method
M14 - 440k / 29k at night capacity restriction		
Houses within 58 dB(A) Lden contour	-€ 832.450	-€ 407.142
Highly annoyed people within 48 dB(A) Lden contour	-€ 1.202.181	-€ 587.974
Houses within 48 dB(A) Lnight contour	-€ 47.603	-€ 23.282
Severely sleep disturbed people within 40 dB(A) Lnight contour	-€ 344.591	-€ 168.536