Economic and sustainability impacts of an aviation tax: New variants

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Executive summary

In the Coalition Agreement *Faith in the Future*, the Dutch government announced that it is in favour of introducing an aviation tax. This would preferably be within a European framework, and focused on noisy, polluting aircraft. If neither route brings enough progress, a national aviation tax will be implemented in 2021.

In 2018 CE Delft carried out a study on the economic and sustainability impacts of a number of variants of an aviation tax (CE Delft, 2018). After the report was completed, the Ministry of Finance indicated it would like several new variants to be examined in which the tax would cover not only passenger departures but also cargo aircraft. The present report analyses the economic and sustainability impacts of these variants. It also recalculates the impacts of two of the earlier variants, as a new version of the AEOLUS model is now available.

Aviation tax variants examined

The analysis was performed for six variants of the aviation tax, which can be divided into three groups:

Table 1 - Aviation tax variants

Variant	Description	Tax rates (€)	Revenue (WLO Low,2021) (mln. €)
2a	A Dutch tax on noisy aircraft, indexed to noise certificate (TB, TC, TD, TE) and maximum take-off weight (MTOW) with a tax rate ratio of 8:4:2:1.	Per tonne MTOW: TB: 16 TC: 8 TD: 4 TE: 2	198
3d	A Dutch flat-rate aviation tax of € 7.45 per passenger. Freight and transfer passengers exempted.	Per OD passenger: 7.45	200
4a	A Dutch combined flat-rate tax per OD passenger and a charge on MTOW of full-freight aircraft indexed to noise level. Transfer passengers and belly-freight exempted.	Per OD passenger: 6.65 Per tonne MTOW: 3.85 for full-freight aircraft < 20 Δ EPNdB[1] 7.70 for other full-freight aircraft	200
4b	A Dutch combined tax with half the rate for freight, which means a higher rate for passengers. Transfer passengers and belly-freight exempted.	Per OD passenger: 7.00 Per tonne MTOW: 1.925 for full-freight aircraft <20 Δ EPNdB 3.85 for other full-freight aircraft	200
4c	Dutch implementation of variant 4a, but with € 415 mln. revenue (2017 prices), with rates for cargo flights and OD passengers raised proportionately.	Per OD-passagier: 14,74 Per tonne MTOW: 8.53 for full-freight aircraft <20 Δ EPNdB 17,06 for other full-freight aircraft	415

[1] In the current full-freight fleet only the Boeing 747-8 comes into this category; all other full-freight aircraft are noisier.

Variant	Description	Tax rates (€)	Revenue (WLO Low,2021) (mln. €)
4d	Dutch implementation of variant 4a, but with € 415 mln. revenue (2017 price level), with revenue over € 200 mln. recovered from OD passagiers.	Per OD passenger: 15.21 Per tonne MTOW: 3.85 for full-freight aircraft <20 Δ EPNdB 7.70 for other full-freight aircraft	415

AEOLUS model

The AEOLUS model was used to determine the physical effects of an aviation tax. This model calculates changes in number of aircraft movements, passenger numbers and emissions. These data were then used to establish the economic and sustainability impacts. The AEOLUS model was recently updated and has also been scientifically validated[2].

Aviation impacts of the tax

The impacts of all the variants were estimated in two WLO scenarios[3]: 'Low, restricted' and 'High, restricted' (versions of the basis scenarios factoring in capacity restrictions at Dutch airports). In 2021 aviation demand exceeds aggregate Dutch airport capacity in all the scenarios, in 2030 only in the 'High, restricted' scenario. In these cases demand for aviation is thus partly latent, i.e. unfulfilled.

An aviation tax will make air travel from Dutch airports more expensive. Some people will decide not to travel, others will opt for a different mode of transport, others will switch to a foreign departure airport and others will leave their plans unchanged. In all scenarios the vast majority of travellers (95% or more) continue to depart from Dutch airports, with less than 5% opting for an alternative. In the scenarios in which capacity is restricted, their seats shift partly to transfer passengers and if the number of passenger flights drops, the number of cargo flights rises. This reduces the overall impacts of the tax.

Table 2 shows the main impacts of the aviation tax on aviation in 2021 under the 'High, restricted' WLO scenario.

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[2] The model was externally validated by the Netherlands Bureau for Economic Policy Analysis (CPB) in 2006 (*Validatie van het Airport Catchment Area Competition Model (ACCM)*, CPB report dated 21 April, 2006) and 2009 (*Validatie Aeolus-gams*, CPB report dated 5 June, 2009). The CPB-defined tests were repeated when the model was updated in 2015. CPB concluded that the results of the various modelling exercises were largely plausible. The CPB report with the conclusions is available on the organization's website. Updating of the model over the past few years (update of AEOLUS: 2018; update of aviation projections: Febr. 2019) was overseen by a supervisory committee comprising CPB, the Netherlands Environmental Assessment Agency (PBL) and the Netherlands Institute for Transport Policy Analysis (KiM). In addition, Joris Melkert, an aviation expert at Delft University of Technology, was asked for advice on assumptions regarding future development of aviation technology and confirmed the plausibility of these assumptions.

[3] The WLO scenarios are two reference scenarios developed by the Netherlands Environmental Assessment Agency (PBL) and the Netherlands Bureau for Economic Policy Analysis (CPB) in their joint study 'The Netherlands in 2030-2050: two reference scenarios – Future exploration of welfare, prosperity and quality of the living environment' (in Dutch only). The 'High' scenario combines relatively high population growth with high economic growith of about 2% p.a., ambitious climate policy and rapid technological advance. The 'Low' scenario combines limited population growth with modest economic growith of about 1% p.a., limited climate policy and sluggish technological advance.

Table 2 – Physial impacts of aviation tax: WLO scenario 'High, restricted', 2021

	Reference	2a	3d	4a	4b	4c	4d
Passengers							
Total number of passengers (mln.)	84	0.8%	0.0%	0.2%	0.1%	0.8%	0.0%
Number of transfer passengers (mln.)	26	3.7%	3.5%	3.4%	3.3%	8.2%	7.0%
Number of OD passengers[a] (mln.)	58	-0.4%	-1.5%	-1.2%	-1.4%	-2.5%	-3.1%
via foreign airports		-0.6%	-0.8%	-0.7%	-0.7%	-0.9%	-1.1%
alternative transport mode		-0.9%	-0.9%	-0.8%	-0.9%	-1.8%	-1.9%
does not travel		1.0%	0.2%	0.3%	0.2%	0.3%	-0.1%
Flights							
Total number of flights (1,000)	588	-0.2%	-0.1%	-0.2%	-0.2%	-0.7%	-0.6%
Cargo flights (1,000)	18	-32%	0%	-9%	-3%	-40%	-10%
Passenger flights (1,000)	571	0.8%	-0.1%	0.1%	-0.1%	0.5%	-0.3%
AMS (1,000)	495	1.0%	0.0%	0.2%	0.0%	1.1%	0.2%
regional airports (1,000)	76	-0.8%	-0.8%	-0.7%	-0.7%	-3.6%	-3.6%
Cargo							
Cargo carried (tonnes)	1,691,000	-19%	7%	-7%	0%	-17%	0%
Aviation emissions							
CO_2[b] (Mt)	19	-0.8%	-0.5%	-0.4%	-0.4%	-1.1%	-1.3%
PM_{10} (tonnes)	102	-2.3%	0.3%	-0.4%	0.1%	-2.6%	-0.4%
NO_x (tonnes)	3,800	-2.9%	0.5%	-0.5%	0.1%	-3.2%	-0.3%
Tax revenue							
Revenue (€ mln.)	0	201	212	212	211	437	436
of which from passengers (€ mln.)	0	186	212	190	200	404	414
of which from cargo (€ mln.)	0	15	0	21	11	33	21

a: OD (origin/destination) passengers: departing and arriving passengers.

b: Dutch CO_2 emissions calculated as emissions on flights to and from Dutch airports plus those on flights to and from foreign airports to which passengers switch as a result of the aviation tax.

In all the tax variants the number of OD passengers (i.e. departing from or arriving at a Dutch airport) declines relative to the situation without a tax. In all the variants this decline is offset by a rise in the number of transfer passengers. On balance, passenger numbers rise by about 0-0.2% in most variants. There are two exceptions: Variant 2a, with a tax on departing flights, and Variant 4c, with a relatively high tax rate for cargo. In these variants the number of cargo flights decreases (by 32-40%) and the freed up capacity is taken over by passenger flights, opening up scope for greater growth in passenger numbers.

In all the variants, some travellers switch to foreign airports or an alternative transport mode. In the 'High' scenario, the number of people making a trip in 2021 increases slightly in all the variants except 4d. This counterintuitive result is due to the relatively large decline in scarcity costs in 2021 in this scenario. In all the other years and in the 'Low' scenario the total number of passengers declines.

In the 'High' scenario in 2021, the number of flights is determined by capacity restrictions, with the aviation tax having zero influence. What it does lead to is a shift between passenger and cargo flights. With a tax on departing flights (Variant 2a) or a combi-tax on full-freight and OD passengers (Variants 4a-4d), the number of cargo flights drops and the number of passenger flights rises; with a tax on departing passengers the opposite holds. Freight volume also drops, because cargo flights switch to foreign airports.

Emissions in the LTO phase (the portion of the flight below an altitude of 3,000 feet) decline with a declining number of cargo flights, because cargo aircraft are generally older and more polluting than passenger aircraft.

CO_2 emissions change as a result of changes in aircraft fleet composition and routing from Dutch airports, fewer flights from regional airports and more flights from foreign airports. On balance, CO_2 emissions decline in all the variants.

The shift in the type of flights affects connectivity. A tax also geared to cargo (Variants 2a, 4a-4d) leads to a shift from freight to passenger flights. These variants also lead to a shift from very short flights to longer-distance flights. This boosts both direct and indirect connectivity to intercontinental destinations as well as hub connectivity. An extra charge on OD passengers will trigger a shift from passenger to cargo flights. Because the tax only holds for OD passengers, there will also be a shift from OD to transfer passengers. This will have a positive impact on Schiphol's hub connectivity.

A tax that differentiates according to technology class (Variants 2a, 4a-4d) may have an impact on fleet renewal, but only after 2025, because most of the new aircraft delivered prior to that date will have already been ordered.

Table 3 shows the physical impacts in the 'Low, restricted' scenario. This scenario has lower economic growth, which means less aviation demand in 2021 compared with the 'High' scenario. In the reference scenario the capacity restrictions at Schiphol are still limiting, but in some variants the number of flights is below the capacity limit. What is most striking, though, when Tables 2 and 3 are compared, are the relatively minor differences in physical impacts between the two scenarios. This is due to the capacity restrictions.

Table 3 - Physial impacts of aviation tax: WLO scenario 'Low, restricted', 2021

	Reference	2a	3d	4a	4b	4c	4d
Passengers							
Total number of passengers (mln.)	82	-1.1%	-0.6%	-0.3%	-0.4%	-3.3%	-3.4%
Number of transfer passengers (mln.)	27	0.5%	2.3%	2.5%	2.4%	0.8%	0.7%
Number of OD passengers[a] (mln.)	55	-1.9%	-2.0%	-1.7%	-1.8%	-5.3%	-5.5%
via foreign airports		-0.5%	-0.5%	-0.4%	-0.5%	-1.0%	-1.0%
alternative transport mode		-0.8%	-0.9%	-0.8%	-0.8%	-1.8%	-1.8%
does not travel		-0.5%	-0.6%	-0.4%	-0.5%	-2.5%	-2.6%
Flights							
Total number of flights (1,000)	579	-2.4%	-0.4%	-1.0%	-0.7%	-4.9%	-4.1%
Cargo flights (1,000)	19	-36.3%	8.7%	-16.6%	-4.2%	-43.1%	-15.1%
Passenger flights (1,000)	560	-1.2%	-0.7%	-0.4%	-0.6%	-3.6%	-3.8%
AMS ('000)	494	-1.0%	-0.4%	-0.1%	-0.3%	-3.3%	-3.5%
regional airports (1,000)	66	-2.5%	-2.9%	-2.6%	-2.8%	-5.7%	-5.9%
Cargo							
Cargo carried (tonnes)	1,933,000	-21%	6%	-9%	-2%	-25%	-9%
Aviation emissions							
CO_2[b] (Mt)	19	-1.6%	-0.9%	-0.7%	-0.8%	-2.4%	-2.5%
PM_{10} (tonnes)	102	-3.8%	0.5%	-1.5%	-0.5%	-5.7%	-3.3%
NO_x (tonnes)	3,800	-5.5%	1.0%	-2.1%	-0.6%	-7.7%	-4.2%
Tax revenue							
Revenue (€ mln.)	0	198	200	200	200	415	415
of which from passengers (€ mln.)	0	183	200	179	188	383	394
of which from cargo (€ mln.)	0	15	0	21	12	32	21

a: OD (origin/destination) passengers: departing and arriving passengers.

b: Dutch CO_2 emissions calculated as emissions on flights to and from Dutch airports plus those on flights to and from foreign airports to which passengers switch as a result of the aviation tax.

Economic and sustainability impacts of the aviation tax

Physical changes in the aviation sector affect economic welfare. There will also be an impact on domestic spending. On the one hand, Dutch residents (Dutch travellers) opting not to travel will spend the money earmarked for air travel domestically on other services or products; on the other, there will be fewer foreign tourists visiting the Netherlands. There will be further changes in domestic spending as the government will be levying a tax on non-residents (foreign travellers) and airlines headquartered abroad.

Table 4 shows the welfare impacts of the aviation tax in 2021 in the 'High' WLO scenario. In this table all the environmental impacts are monetized to allow comparion with the monetary impacts.

Table 4 - Welfare impacts of aviation tax: WLO scenario 'High, restricted', 2021 (mln. € per annum)

	2a	3d	4a	4b	4c	4d
Costs						
Tax execution costs	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
Tax implementation costs	PM	PM	PM	PM	PM	PM
Impacts						
Lower CO_2 emissions, aviation	+24	+14	+11	+13	+31	+39
Higher CO_2 emissions, other transport	-2.1	-2.2	-2.0	-2.1	-4.1	-4.2
Air pollutant emissions, aviation	+5	-1	+1	0	+5	+1
Air pollutant emissions, other transport	-0.3	-0.4	-0.3	-0.3	-0.7	-0.8
Consumer surplus	0.0	-0.3	-0.3	-0.3	-1.2	-1.6
Producer surplus, aviation	+8+PM	+3+PM	+4+PM	+3+PM	+12+PM	+5+PM
Producer surplus, non-aviation	-2	-1	-16	-8	-27	-10
Agglomeration effects	PM	PM	PM	PM	PM	PM
Employment	0	0	0	0	0	0
Welfare impacts, government	+91	+103	+103	+103	+233	+237
Balance, WLO 'High'	**+123**	**+115**	**+99**	**+107**	**+248**	**+265**
Balance, WLO 'Low'	**+144**	**+119**	**+111**	**+115**	**+226**	**+235**

Note that costs and benefits accrue concurrently, which is why in this SCBA it was opted to present them p.a.

In all the variants, the aviation tax has a net positive monetary balance. The greatest benefits accrue to government and have three components:

1. The portion of the tax revenue coming from non-residents and airlines headquartered abroad is not at the expense of the welfare of residents and Dutch companies. The government has increased revenue, which it can use to reduce other taxes or for additional expenditures, both of which benefit Dutch residents and companies.
2. The additional domestic consumption associated with this moeity of the tax leads to higher revenues from consumption taxes (a multiplier effect).
3. Additional spending in the Netherlands due to stay-at-home residents as well as reduced revenue from non-residents no longer visiting both have an impact on consumption tax revenue.

The other benefits are more modest. Travellers staying at home or switching to other airports because of the aviation tax have a loss of consumer surplus valued according to the rule of half: on average, this loss is half the aviation tax they would have paid.

The producer surplus in the aviation sector is higher in the variants leading to higher passenger numbers as a result of higher scarcity rents. The producer surplus for cargo was not included in the SCBA because we know of no data on the share of air freight carried by Dutch airlines. This moiety of the producer surplus in the aviation sector is therefore indicated by 'PM' (pro memorie). The producer surplus in the other sectors decreases because of the change in domestic spending and reduced export of goods.

Besides the impacts quantified here, there may also be other, unquantifiable impacts with variants in which cargo is taxed. The combination of a reduction in the number of slots and introduction of a cargo tax will mean a decline in air cargo handling at Schiphol, which may in turn mean economic activity may shift abroad (e.g. logistics services).

CO_2 emissions are reduced, with a positive impact on welfare. Air-pollutant emissons lead to reduced welfare, which means that in variants in which these emissions increase there is an negative impact on welfare.

In this economic scenario, on average around 60% of the aviation tax is paid by airlines (from the scarcity rents accruing from the limits imposed by capacity restrictions at Schiphol, among other sources), the remaining 40% by passengers[4]. Beause around 60% of travellers using Schiphol fly on a Dutch-based airline, on average about 36% of the tax revenue consitutues a transfer of welfare from airlines to government. Nonetheless, because around half the OD passengers using Dutch airports are Dutch residents, on average some 20% of the revenue will be a transfer from residents to government.

Economic and sustainability impacts with lower economic growth

As Table 5 shows, with lower economic growth (WLO scenario 'Low, restricted') the net monetary balance is generally higher than with high economic growth. The exceptions are the variants in which total aviation tax revenue amounts to € 415 million.

The higher figure on the balance sheet in the 'Low' compared with the 'High' scenario is due mainly to it having higher welfare impacts for government, because the share of the the tax paid by non-residents and non-Dutch airlines is now higher.

Table 5 - Welfare impacts of aviation tax: WLO scenario 'Low, restricted', 2021 (mln. € per annum)

	2a	3d	4a	4b	4c	4d
Costs						
Tax execution costs	-0.6	-0.6	-0.6	-0.6	-0.6	-0.6
Tax implementation costs	PM	PM	PM	PM	PM	PM
Effects						
Lower CO_2 emissions, aviation	+12	+7	+5	+6	+18	+19
Higher CO_2 emissions, other transport	-0.4	-0.5	-0.4	-0.4	-0.9	-0.9
Air pollutant emissions, aviation	+9	-2	+3	+1	+13	+7
Air pollutant emissions, other transport	-0.4	-0.4	-0.4	-0.4	-0.9	-0.9
Consumer surplus	0	-1	0	-1	-5	-5
Producer surplus, aviation	-5+PM	-1+PM	0+PM	0+PM	-16+PM	-17+PM
Producer surplus, non-aviation	-5	0	-11	-6	-38	-23

[4] That the aviation tax is not paid entirely by airlines when scarcity rents arise is an artefact of the AOLUS model. A micro-economic explanation may be that not all airports have capacity limitations and that the scarcity rents do not always exceed the tax revenues.

	2a	3d	4a	4b	4c	4d
Agglomeration effects	PM	PM	PM	PM	PM	PM
Employment	0	0	0	0	0	0
Welfare impacts, government	+135	+117	+115	+116	+256	+257
Balance, WLO 'Low'	**+144**	**+119**	**+111**	**+115**	**+226**	**+235**
Balance, WLO 'High'	**+123**	**+115**	**+99**	**+107**	**+248**	**+265**

In the 'Low' scenario the aviation sector has a lower producer surplus in almost all the variants, because scarcity rents are far lower. In most variants, the benefits associated with reduced CO_2 emissions are about half those in the 'High' scenario. In 'High', the unit of CO_2 is valued around four times higher than in 'Low'.

Economic and sustainability impacts in 2030

According to the projections used, the number of flights and passengers increases from 2021 to 2030 in both scenarios, as aircraft become quieter and the flight ceiling can therefore be raised. This will increase the revenue from the tax as well as the welfare impact for the Dutch government. The sole exception is variant 2a, with a tax on flight departures, in 'Low'. In that scenario there is no longer any capacity restriction in 2030 anyway. A tax per aircraft then leads to deline in the number of transfer passengers, OD passengers and cargo flights and thus to reduced tax revenue.

The net social benefit increases in all the variants,with the exception of Variant 2a in the 'Low' scenario. The lower aviation CO_2 emissions have a greater positive impact on welfare (because they are priced higher), which together with the greater welfare impact for government offsets the higher losses (consumer and producer surplusses).

Impacts of the aviation tax on GDP

In the previous section, the impact of the aviation tax on Dutch economic welfare is described. A second way to estimate the economic effects is to analyse the impact on Gross Domestic Product.

The change in GDP resulting from the aviation tax is, by definition, the sum of the changes in final domestic spending by households, domestic investments, government spending and exports minus imports. In all cases the impact is positive, because government spending increases (because part of the tax revenue derives from non-residents and foreign companies) and because domestic Dutch spending rises (because residents who no longer fly spend more than non-residents would have done that no longer fly into the Netherlands as a result of the aviation tax).

Table 6 - GDP impacts of aviation tax

Variant	2021		2030	
	WLO Low	WLO High	WLO Low	WLO High
2a	+0.02%	+0.01%	-0.00%	+0.05%
3d	+0.03%	+0.02%	+0.01%	+0.05%
4a	+0.03%	+0.02%	+0.01%	+0.05%
4b	+0.03%	+0.02%	+0.01%	+0.05%
4c	+0.04%	+0.06%	+0.02%	+0.11%
4d	+0.05%	+0.06%	+0.02%	+0.11%

Impacts of the aviation tax on employment

The aviation tax does not lead to any structural change in labour supply and will therefore, only impact employment in the short term. That short term effect is made up of two contrasting effects. On the one hand, employment in the aviation sector will fall if there are fewer flights (as is the case in the 'Low' WLO scenario), while industries supplying that sector will also lose jobs. On the other hand, there will be increased spending in the Netherlands as fewer Dutch residents fly abroad and government spending rises (the lost revenue from foreigners no longer visiting the Netherlands is less than these cost items). This leads to a rise in employment in the rest of the economy. For all the variants in WLO 'High' the net result is slightly positive, as shown in Table 7. In WLO 'Low' the net result is slightly negative.

Table 7 - Employment impacts of the aviation tax (FTE in 2021)

Variant	WLO Low	WLO High
2a	-700	800
3d	-200	100
4a	0	300
4b	-100	200
4c	-2,400	1,200
4d	-2,500	500

In summary

The introduction of an aviation tax in the Netherlands will have a positive impact on economic welfare, regardless of future projections and tax variant. The single largest welfare impact is the tax revenue from non-residents and foreign companies. Depending on the current CO_2 price there is also a significant welfare impact owing to the reduced climate impact of aviation. The other impacts are generally smaller because the costs for certain groups (the tourism and aviation sectors, among others) are offset by the benefits for others (other economic sectors).