Capacity demand at Schiphol Airport in 2030

seo amsterdam economics

Amsterdam, 16 April 2018
Commissioned by the Ministry of Infrastructure and Water Management

Capacity demand at Schiphol Airport in 2030

And the possibilities to free up capacity in the inbound and outbound peaks

Joost Zuidberg
Kjeld Vinkx (To70)

seo amsterdam economics

Roetersstraat 29 - 1018 WB Amsterdam - T (+31) 20 525 1630 - F (+31) 020 525 1686 - www.seo.nl - secretariaat@seo.nl
ABN-AMRO IBAN: NL14ABNA0411744356 BIC: ABNANL2A - ING: IBAN: NL96INGB0004641100 BIC: INGBNL2A
KvK Amsterdam 41197444 - BTW NL 003023965 B

"Solid research, Sound advice"

SEO Amsterdam Economics carries out independent applied economic research on behalf of national and international clients – both public institutions and private sector clients. Our research aims to make a major contribution to the decision-making processes of our clients. Originally founded by, and still affiliated with, the University of Amsterdam, SEO Amsterdam Economics is now an independent research group but retains a strong academic component. Operating on a nonprofit basis, SEO continually invests in the intellectual capital of its staff by granting them time to pursue continuing education, publish in academic journals, and participate in academic networks and conferences. As a result, our staff is fully up to date on the latest economic theories and econometric techniques.

SEO-report nr. 2018-35

ISBN 978-90-6733-919-3

Table of contents

1 Introduction

Recently, SEO and To70 have analyzed the capacity utilization at Schiphol Airport in 2023 and the extent to which a traffic distribution rule and operational measures can free up capacity in the inbound and outbound peak periods. In addition, the ministry has asked SEO and To70 to provide insight in the capacity utilization at Schiphol Airport in 2030 as well. The analysis roughly follows the same structure as the analysis for 2023. However, (1) the list of leisure destinations has been updated based on more recent traffic figures and (2) a lower boundary annual traffic growth scenario has been applied.

1.1 Background

As a sequel on the earlier analysis of the capacity utilization at Schiphol Airport in 2023, the Dutch Ministry of Infrastructure and Water Management has asked SEO Amsterdam Economics (SEO) and To70 to provide insight in the following issues, against the background of the Dutch selectivity policy:

- The value and relevance of the hub operation at Schiphol Airport for the Dutch economy;
- The level of capacity demand of the different inbound and outbound peaks during the day;
- The extent to which those peaks are used by leisure traffic;
- To what extent a traffic distribution rule can assist in freeing up capacity during the inbound and outbound peaks of Schiphol Airport's hub operation in 2030;
- To what extent additional operational measures can be of assistance if it comes to freeing up capacity during abovementioned inbound and outbound peak periods.

This report sets out the economic value of the hub operation in Chapter 2, making use of existing literature on the issue. Chapter 3 outlines the research method and the most important assumptions. In turn, Chapter 4 shows the current capacity demand, whereas Chapter 5 presents the capacity demand in 2030. Chapter 6 identifies the leisure segment and shows its presence in the relevant inbound and outbound peaks of the hub operation. Finally, Chapter 7 shows the effects of specific operational measures and Chapter 8 sums up the most important conclusions drawn from the analyses.

1.2 Main findings of the 2023 analysis

As said, the analysis of the capacity demand of Schiphol Airport for 2030 is a sequel on the 2023 that has been finished in February 2018. The main conclusion is found below.

The 2023 analysis showed that in certain waves of inbound and outbound traffic distributing leisure traffic from the Schiphol Airport peaks to Lelystad Airport may free up substantial capacity. However, in the important morning (wave 2) and evening (wave 6) waves, leisure traffic is largely absent. Hence, operational measures are needed to cope with capacity shortages in those periods of the day. All in all, the analysis made clear that only a combination of a traffic distribution rule and operational measures can free up enough capacity to enable further growth until 2023 during the most congested peak periods of the day.

1.3 Main differences between the 2023 and 2030 analysis

The 2030 analysis roughly follows the same pattern. However, there are two major differences between the 2023 and 2030 approach. Unlike the 2023 analysis, the 2030 analysis is based on a low growth scenario (1.5 per cent annual growth from 2021 onwards), which means that the results of the 2030 analysis must be seen as lower boundary results, implying that with higher average growth figures the capacity shortage will be substantially larger. Additionally, the list of leisure destinations has been updated based on 2017 traffic (2016 traffic has been used for the 2023 analysis). This resulted in the removal of a few relatively large destinations (in terms of number of aircraft movements) from the list of leisure destinations. The most profound ones are Milan Malpensa (approximately 3,200 aircraft movements in 2016), Malaga (almost 2,700 aircraft movements in 2016), Istanbul Sabiha Gokcen (approximately 2,450 aircraft movements in 2016) and Porto (almost 1,400 aircraft movements in 2016). As a result, the leisure segment is smaller in the 2030 analysis (little over 38,000) than in the 2023 analysis (almost 49,000).

2 The value of the hub operation at Schiphol Airport

On the short-term, the loss of the hub operation at Schiphol Airport results in a decrease in value added of more than 4 billion euro and the loss of 55,000 jobs. Without connecting passengers most intercontinental destinations currently served from Schiphol Airport cannot be operated viably. The same holds for an important part of the European network. To be able to operate a premium hub network of high-quality connections sufficient peak hourly capacity is essential. In that light, the Dutch government foresees in the implementation of a traffic distribution rule that aims at the distribution of leisure traffic from the inbound and outbound peaks at Schiphol Airport to Lelystad Airport in order to free up capacity for the hub operation at Schiphol Airport.

2.1 The economic value of the hub operation of Schiphol Airport

Recently, Decisio[1] has estimated the value added of Schiphol Airport at approximately 9 billion euro and 114,000 jobs (95,000 fte) (direct and indirect backward[2]). Based on those results, SEO has estimated that almost 40 per cent of the direct Schiphol Airport network will disappear in a scenario in which the full hub operation is ceased ("non-hub scenario").[3] In that scenario only routes with sufficient local demand remain. This network deterioration leads to a decrease in value added of more than 4 billion euro and 55,000 jobs on the short-run.[4] The negative effects on consumer welfare as a result of longer travel times and higher ticket prices are more than 630 million euro.[5]

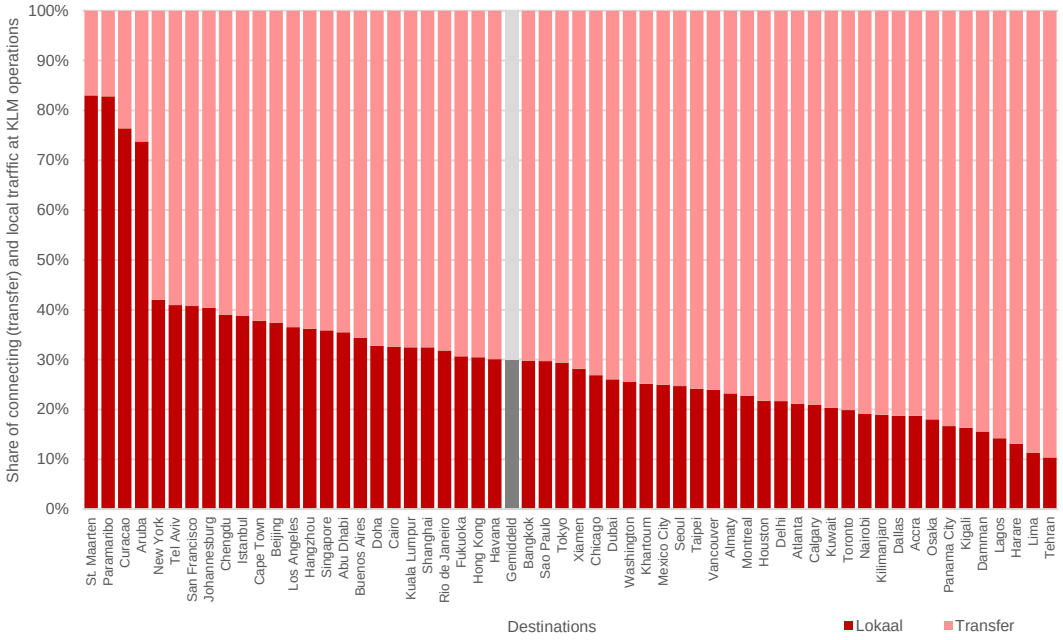
2.2 The relevance of the hub operation for the Schiphol Airport network

The hub operation at Schiphol Airport facilitates the operation of a large number of (intercontinental) destinations that are not viable with only local traffic. Figure 2.1 shows that almost all intercontinental routes operated by KLM consist for at least 60 per cent of connecting passengers. Once again, a substantial number of those routes cannot be viably operated with only local traffic and are therefore likely to be cancelled if the hub operation at Schiphol Airport disappears. Moreover, a large part of the European feeder operations also consist of considerable numbers of connecting passengers. Part of those European feeder operations also runs the risk of cessation or rationalization in the "non-hub scenario". SEO estimated the net decrease in the

1 See Decisio (2015) – *Economisch belang van de mainport Schiphol. Analyse van directe en indirecte economische relaties.*
2 Decisio has not quantified the indirect forward effects. Existing literature points at the positive impact of aviation on business location. However, the size of such effect is very hard to be made explicit.
3 Recent examples of dehubbing cases (see e.g. Zurich, Brussels, Milan Malpensa and Budapest) show that a hub operation should not be taken for granted.
4 See SEO (2015) – *Economisch belang van de hubfunctie van Schiphol.* SEO-report 2015-22.
5 The results of the analyses of the effects on value added and jobs and of the consumer welfare effects are based on different methodologies and are not comparable and cannot be added up.

number of intercontinental destinations at 26 per cent and at 6 per cent for European destinations in the "non-hub scenario". In terms of aircraft movements this is 38 and 39 per cent respectively.[6]

Figure 2.1 On average, KLM's intercontinental operations consist of 70 per cent connecting passengers



Source: MIDT 2013, analysis SEO Amsterdam Economics.

2.3 Peak hourly capacity facilitates the hub operation

The viability of a hub network depending to a large extent on connecting traffic is very much related to the quality of the connections offered at the airport. After all, the level of competition is substantial at most large connecting markets: connecting passengers can often choose between a large variety of intermediate hub airports. In that sense, it is essential to have sufficient capacity during the inbound and outbound peaks (waves) of the hub operation. This especially holds for a hub airport like Schiphol Airport with a relatively small local market, hence a relatively high dependence on connecting traffic. A peaked coordination of inbound and outbound traffic flows seamlessly connected to each other is important for maintaining or even gaining market share in the connecting market and, with that, for the continuity of Schiphol Airport's hub operation.

2.4 The public interest of the Schiphol Airport network

In the 2009 *Luchtvaartnota* the Dutch government stresses the importance of an aviation network of direct intercontinental connections for the Dutch economy. Schiphol Airport is the only airport in The Netherlands that can facilitate such network. In turn, the Dutch government considers the direct intercontinental aviation network at Schiphol Airport as a public interest.[7] Based on that, the

6 See SEO (2015) – *Economisch belang van de hubfunctie van Schiphol*. SEO-report 2015-22.
7 See Commissie Shared Vision (2012) - *Advies over uitvoering selectiviteitsbeleid Schiphol.*

Dutch government considers it is justified to take measures that intervene on the aviation network at Schiphol Airport in order to respond to the current and future capacity scarcity in the inbound and outbound peaks of the hub operation and the growth limits following from environmental preconditions. For the further development of the hub operation especially the former is relevant. Increasing the annual capacity at Schiphol Airport eventually does not lead to an increase in peak hourly capacity, but merely to additional capacity during the off-peak periods.

2.5 Concluding remarks

Since it is assumed that the possibilities to increase the current peak hourly capacity are limited, the Dutch government foresees, in the light of the public interest it connects to the network development of Schiphol Airport and the hub operation's dependence on connecting traffic, to free up capacity in the most important inbound and outbound peaks by implementing a traffic distribution rule.[8] The remainder of this report presents the capacity demand in 2017 (Chapter 4) and 2030 (Chapter 5), sheds light on the presence of leisure traffic in the inbound and outbound peaks (Chapter 6) and reflects on the operational measures (Chapter 7) that can additionally free up capacity in the inbound and outbound peaks.

[8] This study does not reflect in any way on the legal validity of the traffic distribution rule.

3 Research method and assumptions

The research method used in the analysis is based on two steps. Firstly, the effects on the intensity of use of the inbound and outbound peaks of implementing a traffic distribution rule is presented. Secondly, the effects of several operational measures is mapped. This chapter sheds light on the most important assumptions and briefly outlines the different research steps.

3.1 Introduction

This chapter outlines the research steps and the most important assumptions used. It distinguishes between (1) the implementation of a traffic distribution rule that foresees in the accommodation of leisure traffic at Lelystad Airport and (2) operational measures to free up the inbound and outbound peaks at Schiphol Airport.

3.2 Traffic distribution rules

First of all, the analysis presents the current capacity demand of the separate 20 minutes brackets at Schiphol Airport related to the declared capacity by Airport Coordination Netherlands (ACNL). The analysis distinguishes between inbound and outbound capacity. After all, both the inbound and outbound capacity per 20 minutes bracket differ over the day as a result of the peaked traffic distribution at Schiphol Airport. The capacity demand is mapped for the 15th busiest day in 2017 (Thursday 3rd of August),[9] which is an accepted reference point to recognize the relative large capacity burden at specific (summer) peak periods without overestimating by taking the busiest day.[10]

For the estimation of traffic in 2030 the following assumptions have been used:

- Up to and including 2020 the number of aircraft movements is maximized at 500,000 annually. In practice, this implies that the growth rate of traffic between 2016 (almost 497,000 aircraft movements) and 2020 is 0.7 per cent for the full period.
- From 2021 the assumed annual growth rate is 1.5 per cent.[11]
- Based on the assumptions above, the average annual growth rate between 2016 and 2030 is 1.2 per cent.
- The same growth rate is applied to all traffic segments.
- In 2030, the annual capacity at Lelystad Airport is assumed to be 25,000 aircraft movements. This implies that 12,500 inbound and 12,500 outbound flights can be accommodated at the airport in 2030.
- Based on the capacity demand in the different inbound and outbound peaks the following prioritizing with respect to the distribution of leisure traffic to Lelystad Airport is used in the analyses (capacity utilization between parentheses):

9 The 30th busiest day of 2016 (Wednesday 17th of August) shows a similar picture if it comes to capacity utilization.
10 The busiest day can be the result of incidental events.
11 This is a rather conservative growth rate and may therefore be considered as a lower boundary.

- Wave 2: inbound peak 07:50 – 09:19 and outbound peak 09:20 – 10:39 (100.0 per cent);
- Wave 6: inbound peak 18:20 – 19:59 and outbound peak 20:00 – 21:39 (91.6 per cent);
- Wave 3: inbound peak 11:00 – 11:39 and outbound peak 11:40 – 12:39 (88.4 per cent);
- Wave 4: inbound peak 13:00 – 13:59 and outbound peak 14:00 – 14:59 (77.5 per cent);
- Wave 5: inbound peak 15:20 – 16:19 and outbound peak 16:20 – 17:59 (79.8 per cent);
- Outbound peak 07:00 – 07:19 (92.0 per cent).[12]

3.3 Assumptions operational measures

In the analysis of the effects on capacity demand of additional operational measures, we distinguish between the following measures:[13]

- *Increase peak hourly capacity*: The ability to increase the declared peak hourly capacity (110 aircraft movements per hour during an outbound peak and 106 aircraft movements during an inbound peak, see section 4.2) for the for the short term is limited. To analyze the potential effect of a capacity increase, a capacity gain of 1 to 2 movements per hour is assumed for the next years, e.g. if the work load can be reduced. For the period up to 2030, the potential effect of an assumed further increase of the capacity to 114/116 movements is analyzed.
- *Increase the number of peak periods*. During the period 7:00 – 23:00, most periods are currently identified as an inbound or outbound peak. Each inbound peak period is separated from a preceding outbound peak mode period by a 20 minutes off peak mode ("firebreaks"). These firebreaks are a strategic measure for punctuality and reliability purposes, which are intended to create some margin in the planning to be able to cope with operational disturbances. During the period 7:00 – 23:00, only the period 21:40 – 23:00 is not used as a peak mode. However, the current and expected traffic volume for this period is limited. An additional peak mode during this period is useful if traffic volume exceeds the off peak capacity.
- *Extend (specific) peak periods*. Inbound peak mode period 6 currently ends at 20:00, with high traffic volumes towards the end of the peak period. The subsequent outbound peak mode starts at 20:00, with a relative low number of departures in the first 20 minutes interval. An extension of the inbound peak mode towards 20:20 will free up capacity during the inbound peak. The subsequent outbound peak will then start at 20:20 and is followed by an off peak mode until 23:00. If needed, the outbound peak can be extended.
- *Efficient use of runway capacity during transition from arrival to departure peaks*. Each wave consists of an inbound peak followed by an outbound peak. Arrival and departure peaks don't overlap. The inbound and outbound peak period times are based on the planned on-block (arrival) and off-block (departure) times. Actual times of arrival and departure may vary due to operational factors. Taxi time creates a natural shift between on- and off-block times and runway times. Combined with operational disturbances, this frequently results in 2+1 runway modes during the firebreak periods. On the other hand, the runway capacity demand during the transition from an arrival peak to a departure peak is lower than expected based on the slot declaration. This might allow to schedule a 10 to 20 minute overlap between the arrival and departure peak.

12 Although the small early morning outbound peak is fully utilized, it is assumed to be of less importance for the hub operation, since it does not follow an inbound peak and therefore is not part of a connecting wave.

13 It should be stressed that that the operational and economic feasibility of the measures has not been assessed.

- *Accommodate slots in adjacent periods*. Peak period 2 is the most busy period during the day, with a limited share of leisure traffic. If the capacity demand cannot be met during that period, remaining slots in adjacent periods might be used.

4 Capacity demand of the Schiphol Airport peaks

Air Traffic Control the Netherlands determines the general peak hourly capacity, while ACNL further details the general peak hourly capacity into inbound and outbound declared capacity per 20 minutes bracket. The analysis of the current capacity demand of the inbound and outbound peaks at Schiphol Airport especially shows scarcity in the morning peak between 07:50 and 10:39 and the evening peak between 18:20 and 21:39. In the mid-day peak periods show some room for further growth. These findings raise the question to what extent the capacity scarcity will be increased in 2030 and, in turn, to what extent distribution of leisure traffic to Lelystad Airport and operational measures lead to freeing up inbound and outbound peak capacity.

4.1 Introduction

This chapter sheds light on the determination of the peak hourly capacity of Schiphol Airport, in which inbound and outbound capacity is distinguished per 20 minutes bracket. In turn, the results in this chapter shows the level of capacity demand per bracket, based on scheduled arrival and departing times as documented by Schiphol Airport. The results are presented at the 20 minutes bracket level, since ACNL publishes the capacity declaration at that level as well.

4.2 Peak hourly capacity

This section describes the "peak hourly capacity" at Schiphol Airport and how the peak hourly capacity is determined.

Definition

The *declared* peak hourly capacity by the ACNL, reflects the "maximum number of movements by commercial aviation". This declared capacity is a "sustainable" capacity figure, taking into account the differences in capacity per runway combination, the availability of runway combinations due to e.g. weather conditions, the capacity per runway combination and other operational influences.

The declared capacity is being used for slot declaration. Based on the circumstances, the *actual* peak hourly capacity will be equal or higher than the declared capacity, but there will also be situations that the actual capacity is lower.

Declared capacity versus actual capacity

Air Traffic Control The Netherlands has defined the peak hourly capacity numbers for the most common runway combinations at Schiphol Airport. A distinction is made between:

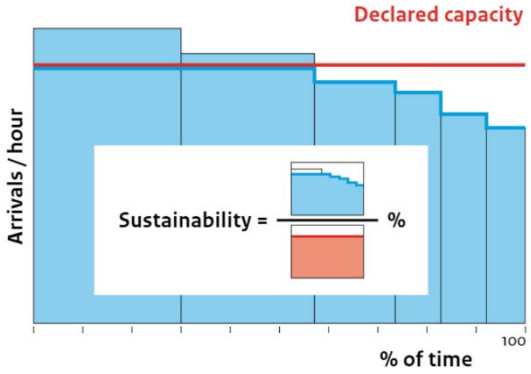
- Night mode: 23:00 – 06:00 local time (LT);
- Off peak mode: 1 runway for arrivals and 1 runway for departures;
- Inbound peak or arrival peak mode: 2 runways for arrivals and 1 runway for departures;
- Outbound peak of departure peak mode: 1 runway for arrivals and 2 runways for departures.

Multiple runway combinations are available for each situation. Which runway and runway combinations are used, is primarily determined by the weather. Environmental rules at Schiphol Airport play a significant role in selecting the runway combination. This noise preferential runway selection is done on the basis of a preference order of runway combinations. The runway dependencies that apply to a runway combination determine the differences in capacity between runway combinations, where one runway combination offers higher capacity than the other.

Per runway combination, the runway capacity is given by visual and cloud base conditions. At best, traffic managers can use visual observations to separate aircraft. When visibility is limited, for example low clouds, the separation distance between the aircraft increases, which results in a lower capacity. A distinction is made between "good", "marginal" and "limited visual conditions".

There may be (large) capacity differences between the various weather situations. The extent to which these differences are predictable and the frequency during a season or year are of major importance for the capacity numbers to be used for a robust flight scheduling. The relationship between the number of landings per hour, the sustainability and capacity is shown in figure 4.1 The declared capacity relative to the actual capacity that can be provided for x percent of the time determines the sustainability of the capacity.

Figure 4.1 Capacity graph



Source: Luchtruimvisie, 2012.

Current declared peak hourly capacity

During the day time period (7:00 – 23:00 local time) the slot declaration is based on a 2+1 runway use, which means subsequent inbound peaks and outbound peaks. The following rules apply for the capacity numbers per 20 minutes intervals (see table 4.1):

- Arrival and departure peak modes should not overlap. Each arrival peak mode period shall be separated from a preceding departure peak mode period by an off peak mode period.
- Between the first departure and arrival peak, the duration of this off peak mode period should be at least 30 minutes. The duration of this off peak mode period between any other departure and arrival peak shall be at least 20 minutes.
- Each departure and arrival peak mode shall have a minimal duration of 40 minutes, except for the first peak mode at 05:00 UTC, which has a minimum duration of 20 minutes.

Table 4.1 Declared capacities per hour and per 20 minutes bracket

Operational mode	Local time	Nominal hourly capacity		Nominal capacity per 20 minutes[14]	
		Inbound	Outbound	Inbound	Outbound
Outbound peak	07:00 – 22:40	36	74	12	25
Inbound peak mode	07:00 – 22:40	68	38	23	13
Off peak mode	06:00 – 06:40	24	30	8	10
	06:40 – 07:00	24	40	8	14
	07:00 – 22:40	36	40	12	14
	22:40 – 23:00	36	25	12	9
Night mode	23:00 – 06:00	24	25	8	9

Source: Airport Coordination Netherlands - Capacity declaration Amsterdam Airport Schiphol summer 2018.

Table 4.1 indicates that the total capacity during an outbound peak is 110 aircraft movements per hour and the total capacity during an inbound peak is 106 aircraft movements per hour. During the night, the capacity is significantly lower. ACNL sets the capacity allocation for Schiphol Airport over the day. In addition to the factors mentioned above, the capacity allocation takes into account the peaks in traffic throughout the day.

Double peaks: 2 + 2 runway use

The use of two runways for departures and two runways for arrivals, the so-called 2 + 2 runway use, is not part or the capacity allocation of ACNL. In practice, 2 + 2 runway use can be used, in situations with more departures during the inbound peak or more arrivals during the outbound peak. Based on the circumstances, the use of an extra runway can result in a higher capacity in, but it is not always a "linear increase" of capacity by simply adding the extra capacity of the extra runway. Adding an additional runway can lead to:

- Additional runway dependencies;
- The occurrence of additional conflicts in the air;
- Achieving the maximum capacity of the Terminal Maneuvering Area (TMA) or Area Control Centers (ACC).

Depending on the current runway combination, 2 + 2 runway use relative to 2 + 1 runway use can result in:

1. A significant increase in total capacity (usually with independent runway combinations);
2. A small increase in total capacity (usually with dependent runway combinations);
3. A lower total capacity, for example in case the Buitenveldertbaan (09) is used as second departure runway next to the Polderbaan (36L), using the Aalsmeerbaan (36R) and Zwanenburgbaan (36C) as landing runways.

It should be noted that although the total capacity increase for situations 1 and 2 is only caused by an increase of the outbound capacity when deploying an additional (second) runway for departures during an inbound peak or an increase in inbound capacity when deploying an additional runway

[14] At the 20 minutes level the capacity for some brackets is 1 lower to end up at the available peak hourly capacity, which is defined at the 1 hour level. To illustrate: an hour that consists of three 20 minutes brackets labelled as inbound peak consists of two 20 minutes brackets with a capacity of 23 and one 20 minutes bracket with a capacity of 22. After all, 23+23+22 = 68, the declared peak hourly capacity.

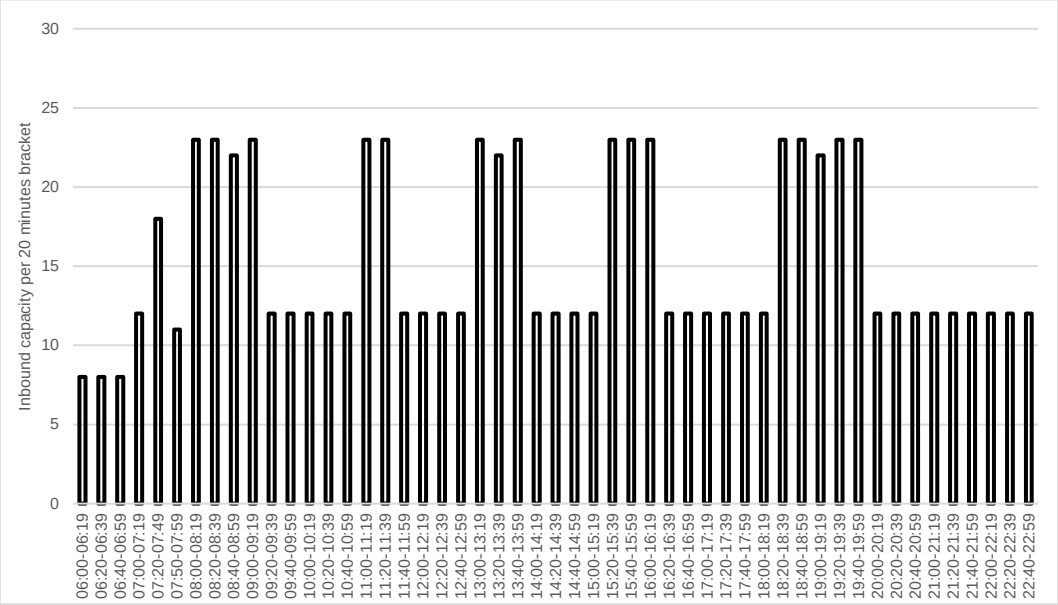
for arrivals during an outbound peak. These increases may be accompanied by a decrease in inbound capacity during the inbound peak and outbound capacity during the outbound peak.
For the current 2 + 1 runway use system, a fourth runway can be used to accommodate disturbances. Temporary 2 + 2 runway use can provide sufficient capacity in such situations to avoid (extra) delays, which would not be possible with 2 + 1 runway use. The 2008 Alders agreements are based on 2 + 1 slot declaration, with a limited use of 2 + 2 runways.

For capacity declarations based on a 2 + 2 runway system, constraints occur earlier and more frequently (more dependencies in runway use) with greater impact in capacity than for a 2 + 1 runway system. The reliability of high capacity is therefore relatively low in a 2 + 2 runway system.

4.3 Capacity demand in 2017

Figure 4.2 and figure 4.3 show the declared capacity per 20 minutes bracket, as published in ACNL's most recent capacity declaration. The figures clearly show the peaked pattern of the hub operation, consisting of a sequence of inbound peaks followed by outbound peaks. This coordination of inbound and outbound flights leads to high-quality connections.

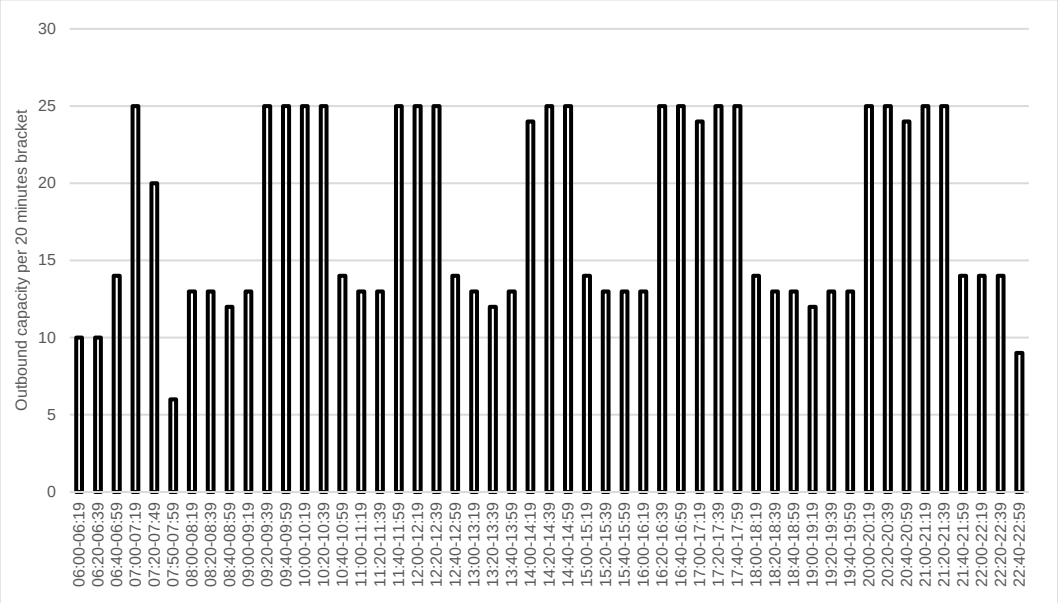
Figure 4.2 Declared inbound capacity per time bracket[15]



Source: Airport Coordination Netherlands - Capacity declaration Amsterdam Airport Schiphol, analysis SEO Amsterdam Economics.
Note: Local time.

15 At the 20 minutes level de capacity for some brackets is 1 lower to end up at the available peak hourly capacity, which is defined at the 1 hour level. To illustrate: an hour that consists of three 20 minutes brackets labelled as inbound peak consists of two 20 minutes brackets with a capacity of 23 and one 20 minutes bracket with a capacity of 22. After all, 23+23+22 = 68, the declared peak hourly capacity.

Figure 4.3 Declared outbound capacity per time bracket[14]



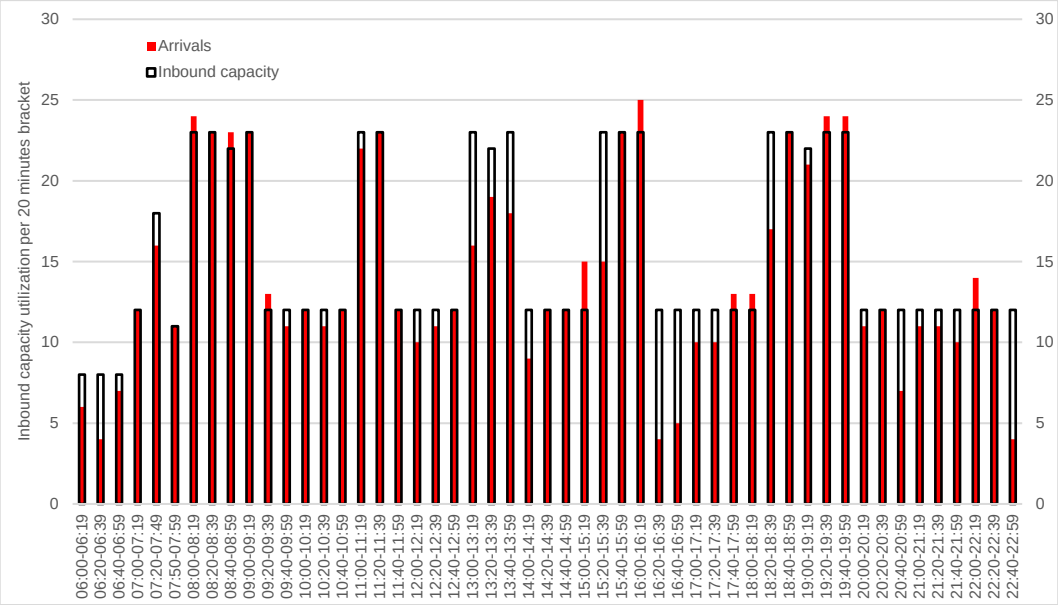
Source: Airport Coordination Netherlands - Capacity declaration Amsterdam Airport Schiphol, analysis SEO Amsterdam Economics.
Note: Local time.

Figure 4.4 (arrivals) and figure 4.5 (departures) show the confrontation of the scheduled 2016 traffic for the 15th busiest day of the year with the declared capacity as shown above. Especially the inbound peak between 07:50 and 08:59 is almost fully utilized. The same holds for the final three brackets of the evening inbound peak between 19:00 and 19:59. Some individual 20 minutes brackets of the mid-day inbound peaks are almost fully utilized as well (between 11:00 and 11:19, between 13:20 and 13:39 and between 15:40 and 15:59). Still, in those inbound peaks adjacent 20 minutes brackets offer some available peak capacity.

De demand in the outbound peaks is highest between 09:20 and 10:19 and at the end of the day between 20:20 and 21:39.[16] In other outbound peak periods, single 20 minutes brackets show high levels of demand (between 14:20 and 14:39 and between 16:40 and 16:59), but also here adjacent brackets offer some spare capacity. In general, the outbound peaks show more spare capacity for departures than the inbound peaks for arrival. This especially holds for the mid-day outbound peaks, but also at the edges of the morning and evening peak there is more spare outbound than inbound capacity. To a large extent this is related to the slightly higher peak hourly capacity for outbound flights (74) than for inbound flights (68) during the respective peaks.

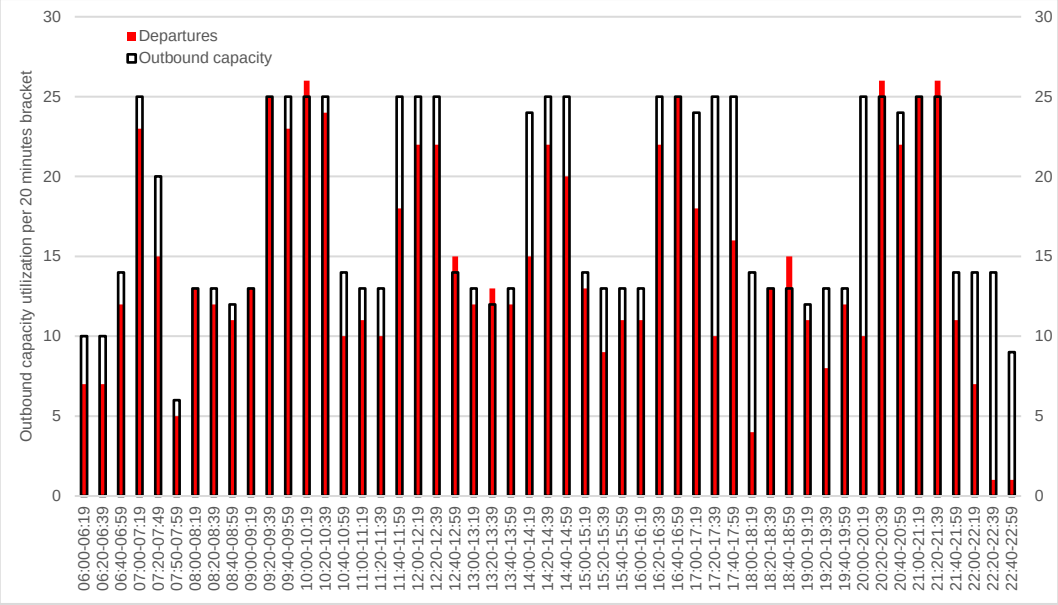
16 The single outbound peak bracket between 07:00 and 07:20 also shows a high utilization. However, since this peak is not part of a coordinated inbound and outbound peak (wave), it has not the highest priority if it comes to freeing up peak capacity.

Figure 4.4 The inbound capacity demand during inbound peaks is especially high between 07:50 and 08:59 and between 19:00 and 19:59



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: The red bars represent scheduled traffic at the 15th busiest day in 2017 (3rd of August).

Figure 4.5 The outbound capacity demand during outbound peaks is especially high at the start and at the end of the day



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: The red bars represent scheduled traffic at the 15th busiest day in 2017 (3rd of August).

4.4 Concluding remarks

Especially in the inbound and outbound peaks between 07:50 and 10:39 and in the evening between 18:20 and 21:39, the available capacity is scarce. In many 20 minutes brackets, the declared capacity is almost fully utilized. In this light, it is relevant to assess the possibilities to free up capacity in the inbound and outbound peaks with the highest capacity demand, which might enhance the facility of Schiphol Airport's hub function. The remainder of the report focuses on the capacity scarcity in 2030 (Chapter 5), the role a traffic distribution rule can play in freeing up capacity in the peaks (Chapter 6) and the role operational measures can play in additionally creating possibilities for further growth in the peaks (Chapter 7).

5 Capacity demand in 2030

Especially the inbound peak capacity is insufficient to accommodate aviation demand in 2030. However, also the outbound peak capacity is lower than the demand in many individual peak brackets. In general, the results show scarcity during the morning peak between 07:50 and 10:39 (wave 2) and during the evening peak between 18:20 and 21:39 (wave 6). Especially during the mid-day waves 4 and 5 there is some room in the shoulders of the respective peak periods. The profound capacity scarcity in 2030 underlines the relevance to investigate the possibilities to free up capacity by (1) implementing a traffic distribution rule and by (2) operational measures.

5.1 Introduction

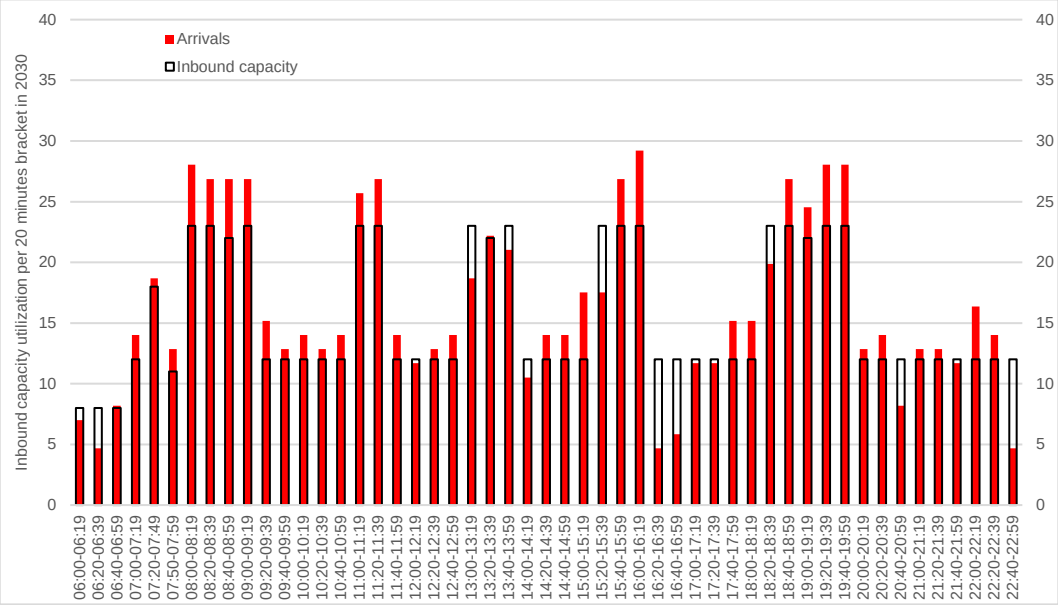
This chapter shows the capacity demand in 2030 based on the assumptions described in Chapter 3. In short, the analysis allows for traffic growth above 500,000 annual aircraft movements only from 2021 onwards. From 2021 until 2030 an annual growth rate of 1.5 per cent has been assumed for all different segments. This means that in 2030, Schiphol Airport traffic accounts for approximately 580,000 aircraft movements without distributing leisure traffic to Lelystad Airport. However, it is assumed that Lelystad Airport can accommodate 25,000 of the Schiphol Airport aircraft movements in 2030.

5.2 Capacity demand during specific peaks

Figure 5.1 and figure 5.2 show the capacity demand in 2030 for both inbound and outbound traffic. First of all, the results show that in the morning (between 07:50 and 10:39) and evening peak (between 18:20 and 21:39), capacity scarcity is most profound. After all, in the vast majority of the brackets, the declared capacity is exceeded, with only some capacity left during the edges of the evening inbound (between 18:20 and 18:39) and outbound (between 20:00 and 20:19) peaks. The morning inbound and outbound peaks are completely used in 2030. The three peak periods between the morning and the evening peak show slightly more available capacity. Still, also during these peaks there are several brackets in which demand exceeds capacity. At the same time, adjacent brackets offer some spare capacity in most instances. This especially holds for waves 4 and 5.

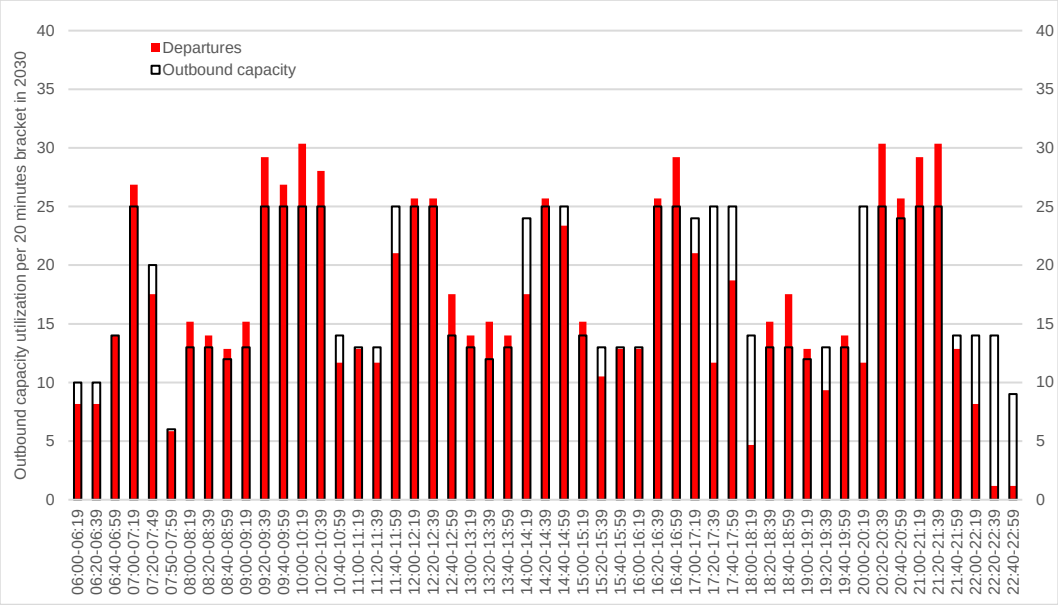
In addition, the figures show that especially during the inbound peaks, the lack of spare capacity is most apparent. During outbound peaks, (1) the capacity exceedances are smaller and (2) more alternative capacity in adjacent brackets is available. To a large extent, this is related to the slightly higher peak hourly capacity for outbound traffic (74) than for inbound traffic (68).

Figure 5.1 Scheduled arrivals versus inbound capacity in 2030



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: The red bars represent the increased scheduled traffic at the 15th busiest day in 2017 (3rd of August).

Figure 5.2 Scheduled departures versus outbound capacity in 2030



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: The red bars represent the increased scheduled traffic at the 15th busiest day in 2017 (3rd of August).

5.3 Concluding remarks

The capacity demand in 2030 shows substantial capacity shortages during the inbound and outbound peaks at Schiphol Airport. This especially holds for the inbound and outbound brackets of the morning and evening peaks. Especially in waves 4 and 5 there is some alternative capacity available in adjacent brackets. The results presented in this chapter stress the relevance of mapping the possibilities of freeing up peak capacity at Schiphol Airport. As said, this study reflects on the impacts of the implementation of a traffic distribution rule (Chapter 6) and on (additional) operational measures (Chapter 7) to free up the inbound and outbound peaks.

6 The effects of leisure traffic distribution to Lelystad Airport

The Dutch government foresees to free up inbound and outbound peak capacity by implementing a traffic distribution rule that aims at distributing leisure traffic from the Schiphol Airport peaks to Lelystad Airport. The results show that the traffic distribution rule is able to free up capacity in especially the mid-day connecting waves (3, 4 and 5). During these periods the leisure presence is highest. In the busy morning peak (wave 2), however, the leisure segment is largely absent. In the evening peak (wave 6) the number of leisure aircraft movements is limited as well. Therefore, the possibility to free up capacity during these periods using the traffic distribution rule is rather limited. Given the still constrained capacity during these important waves of the hub operation, it is worthwhile to have insight in operational measures to additionally free up capacity in the inbound and outbound peak.

6.1 Introduction

This chapter shows the effects of a traffic distribution rule aiming at freeing up peak capacity at Schiphol by distributing of leisure traffic to Lelystad Airport. In turn, it focuses on the leisure capacity use in the different 20 minutes brackets, with special attention to the extent to which leisure traffic[17] takes place during the inbound and outbound peaks related to the hub operation.

6.2 The leisure segment explained

In consultation with the Ministry of Infrastructure and Water Management a destination is labeled as a leisure destination if it complies with the following characteristics, based on Schiphol Airport 2016 traffic data[18]:

- *Distance < 4000 kilometers from Schiphol Airport*: destinations that are located further away can face operational limitations at Lelystad Airport related to the foreseen length of the runway of the airport.[19]
- *Distance > 700 kilometers from Schiphol Airport*: at short(er) distance leisure passengers hardly make use of air travel. If the travel distance is between 600 and 800 kilometers 16 per cent of the leisure travelers use the aircraft is travel mode. The remaining 84 per cent uses an alternative travel mode. On the contrary, 62 per cent of the business travelers uses air travel at a travel distance between 600 and 800 kilometers. Therefore, it is assumed that destinations at less than 700 kilometers from Schiphol Airport are to a large extent used by business travelers and therefore are not labeled as leisure destination.[20]
- *< 10 per cent connecting passengers*: offering connecting flights is an important feature of the hub operation at Schiphol Airport. Destinations consisting for at least 10 per cent of connecting

17 In this analysis the destinations in Appendix A are considered leisure destinations. The list is based on all 2016 traffic at Schiphol Airport. Destinations that are not served in 2016 are not on the list, but can be leisure destinations as well.

18 This study does not reflect in any way on the legal validity of the traffic distribution rule.

19 Partly, this is also related to the aircraft type used.

20 See Laplace, I., Chertier, C, Baron, A. & Maczka, M. (2007). 'Mobility in European countries', Transactions of the Institute of Aviation No 205.

passengers are therefore considered as important for the hub operation and, in turn, are not labeled as leisure destination.
- *No capital*. Connections with capitals of European countries is expected to be essential for both business as well as political purposes. These are therefore not labeled as leisure destination.

Next to that, destinations with less than 10 aircraft movements in 2017 are not taken into account, since these are to a large extent ad hoc (unscheduled) flights that are not a fixed element of the Schiphol Airport network. Finally, to avoid confusion, Dutch destinations are not considered leisure destinations, contrary to the 2023 analysis.[21]

6.3 Traffic mix: size of the leisure segment

In 2017 Schiphol Airport has almost 497,000 aircraft movements.[22] Little over 69,000 are operations to and from intercontinental destinations (> 4,000 kilometers). Of the almost 410,000 European aircraft movements, more than 340,000 are related to the hub operation (> 10 per cent connecting traffic), little over 38,000 are operations to or from leisure destinations, while less than 30,000 are other European destinations.[23] Finally, Schiphol Airport has almost 18,000 freighter operations in 2017.

6.4 Peak demand by leisure traffic in 2017

Full year 2017

Table 6.1 shows the division of Schiphol Airport's leisure traffic in 2017 over the day. The black hatched cells represent the inbound and outbound peaks. For the hub operations those peaks are important. It is therefore especially relevant to map the extent to which leisure traffic makes use of those peaks.

Leisure traffic is hardly found in the morning inbound peak. However, the brackets of the mid-day inbound peaks (between 11:00 and 11:39, between 13:00 and 13:59 and between 15:20 and 16:19) are for at least 3.7 per cent used by leisure operations. Also, the first two brackets of the inbound evening peak (between 18:20 and 18:59) are to a substantial extent used by the leisure segment.

Outbound leisure traffic is to a large extent also found in the mid-day outbound peaks (between 11:40 and 12:39, between 14:00 and 14:59 and between 16:20 and 17:59). In those brackets the leisure share is at least 2.2 per cent. Also the early morning outbound peak between 07:00 and 07:19 is for an important part used by leisure operations. In the busy morning peak between 09:20 and 10:39 and especially in the evening peak between 20:00 and 21:39 the use of capacity by the leisure segment is in most brackers rather limited.

---

21 In the 2023 analysis, Dutch destinations with at least 10 aircraft movements are considered leisure destinations, since flights to these airports are in almost all instances part of a multi-stop operation to leisure destinations in the Mediterranean. It must be noted that the relative size of these destinations is limited. Hence, labeling them as leisure or not does not alter the final conclusions.

22 Almost 480,000 are operated between 06:00 and 23:00.

23 These are European destinations that are not labeled as leisure destination nor do they have more than 10 per cent connecting passengers.

Table 6.1 Size of the leisure segment in 2017 by 20 minutes bracket

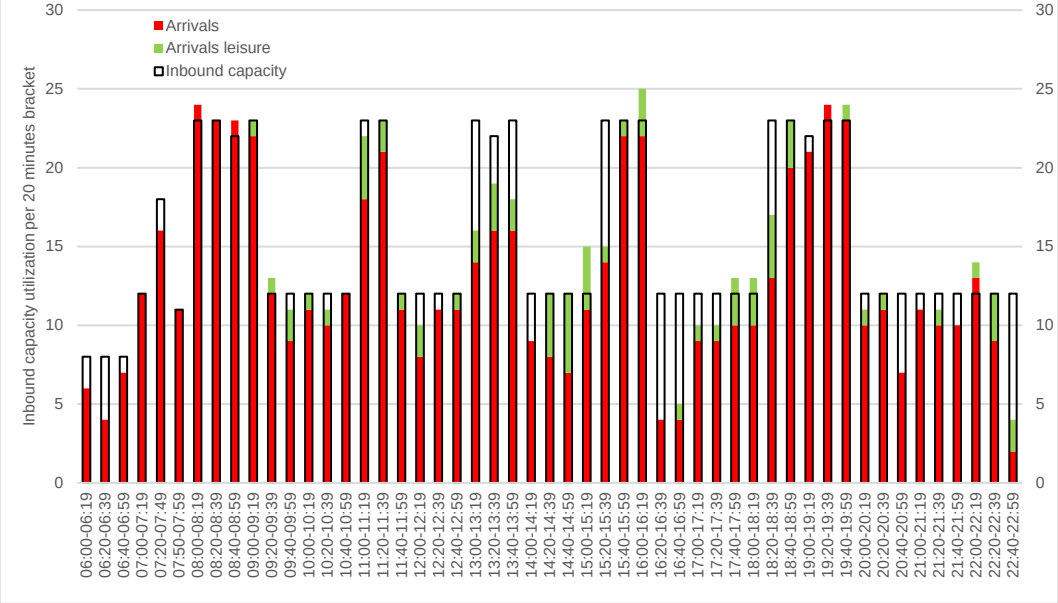
	Leisure segment 2017, total		Leisure segment 2017, capacity share	
Time bracket	Arrivals	Departures	Arrivals	Departures
06:00-06:19	8	1304	0,3%	35,6%
06:20-06:39	25	1054	0,9%	28,8%
06:40-06:59		384	0,0%	7,5%
07:00-07:19	2	863	0,0%	9,4%
07:20-07:49	34	969	0,5%	13,2%
07:50-07:59	4	145	0,1%	6,6%
08:00-08:19	9	175	0,1%	3,7%
08:20-08:39	3	87	0,0%	1,8%
08:40-08:59	1	101	0,0%	2,3%
09:00-09:19	35	311	0,4%	6,5%
09:20-09:39	221	45	5,0%	0,5%
09:40-09:59	103	231	2,3%	2,5%
10:00-10:19	167	144	3,8%	1,6%
10:20-10:39	136	372	3,1%	4,1%
10:40-10:59	186	207	4,2%	4,0%
11:00-11:19	395	205	4,7%	4,3%
11:20-11:39	392	64	4,7%	1,3%
11:40-11:59	227	335	5,2%	3,7%
12:00-12:19	725	229	16,5%	2,5%
12:20-12:39	249	451	5,7%	4,9%
12:40-12:59	215	626	4,9%	12,2%
13:00-13:19	664	321	7,9%	6,7%
13:20-13:39	298	291	3,7%	6,6%
13:40-13:59	599	343	7,1%	7,2%
14:00-14:19	273	702	6,2%	8,0%
14:20-14:39	256	461	5,8%	5,0%
14:40-14:59	390	389	8,9%	4,3%
15:00-15:19	518	372	11,8%	7,3%
15:20-15:39	425	372	5,0%	7,8%
15:40-15:59	467	459	5,5%	9,6%
16:00-16:19	764	275	9,1%	5,8%
16:20-16:39	300	524	6,8%	5,7%
16:40-16:59	401	686	9,1%	7,5%
17:00-17:19	200	299	4,6%	3,4%
17:20-17:39	276	198	6,3%	2,2%
17:40-17:59	403	384	9,2%	4,2%
18:00-18:19	337	155	7,7%	3,0%
18:20-18:39	576	117	6,8%	2,5%
18:40-18:59	663	173	7,9%	3,6%
19:00-19:19	54	373	0,7%	8,5%
19:20-19:39	204	371	2,4%	7,8%
19:40-19:59	93	357	1,1%	7,5%
20:00-20:19	231	110	5,3%	1,2%
20:20-20:39	170	80	3,9%	0,9%
20:40-20:59	168	67	3,8%	0,8%
21:00-21:19	324	43	7,4%	0,5%
21:20-21:39	170	42	3,9%	0,5%
21:40-21:59	275	147	6,3%	2,9%
22:00-22:19	326	146	7,4%	2,8%
22:20-22:39	428	73	9,7%	1,4%
22:40-22:59	315	20	7,2%	0,6%
Totaal	**13.705**	**16.652**	**4,7%**	**5,0%**

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: Full year 2017 figures.
Note 3: Black hatched cells represent inbound and outbound peaks.

15th busiest day in 2017

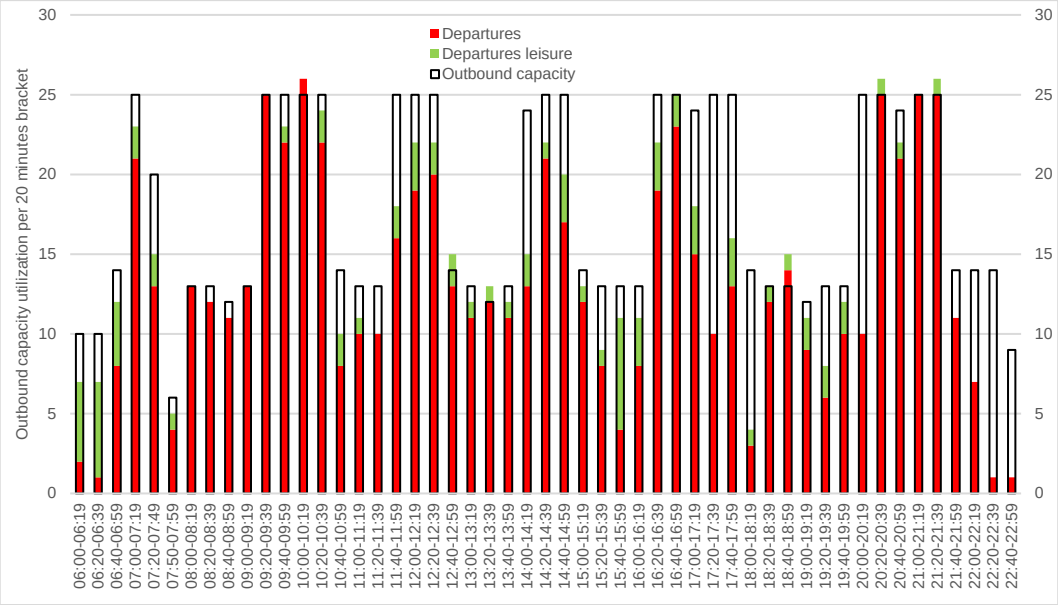
Figure 6.1 (arrivals) and figure 6.2 (departures) present the number of leisure aircraft movements during every 20 minutes bracket between 06:00 and 23:00 at the 15th busiest day in 2017. They show a similar picture as presented by table 6.1: leisure arrivals are largely absent in the morning inbound peak between 07:50 and 09:19, while in the other inbound peak periods to some extent leisure traffic takes place. During the morning outbound peak between 09:20 and 10:39 hardly any leisure traffic takes place as well. The number of leisure departures is also limited during the evening outbound peak between 20:00 and 21:39. However, during the other outbound peaks, leisure traffic makes use of substantial peak capacity.

Figure 6.1 Hardly any leisure traffic is present in the inbound peak of the early morning wave (2)



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: The red bars represent the scheduled non-leisure traffic; the green bars the scheduled leisure traffic.
Note 3: Traffic at the 15th busiest day in 2017 (3rd of August).

Figure 6.2 Limited leisure traffic is present in the outbound peaks of the early morning wave (2) and the evening wave (6)



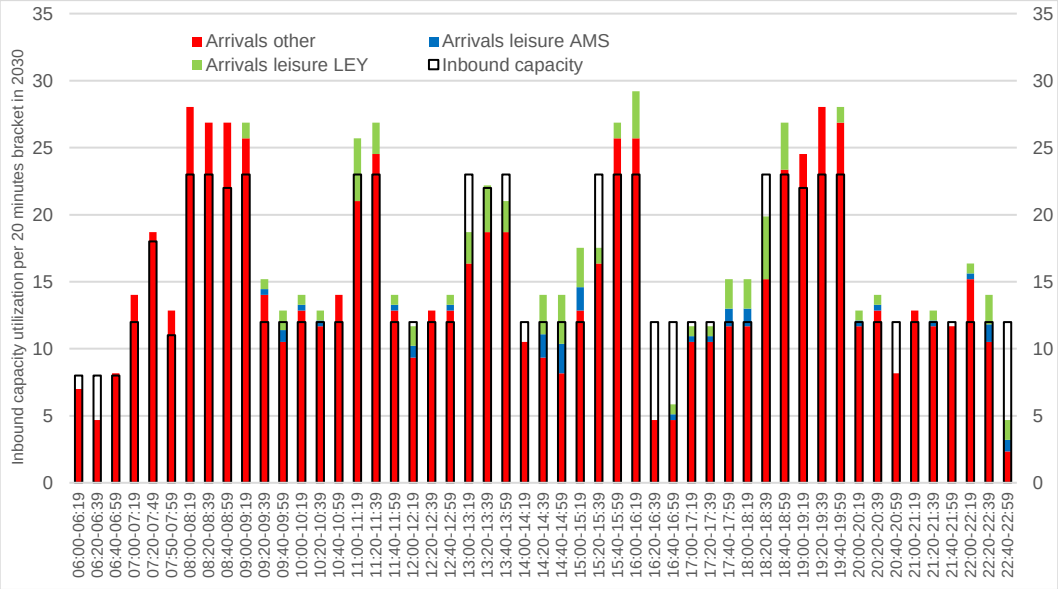
Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: The red bars represent the scheduled non-leisure traffic; the green bars the scheduled leisure traffic.
Note 3: Traffic at the 15th busiest day in 2017 (3rd of August).

6.5 Peak demand by leisure traffic in 2030

Figure 6.3 and figure 6.4 show the capacity demand in 2030, divided by non-leisure traffic, leisure traffic distributed to Lelystad Airport and leisure traffic still accommodated at Schiphol Airport.

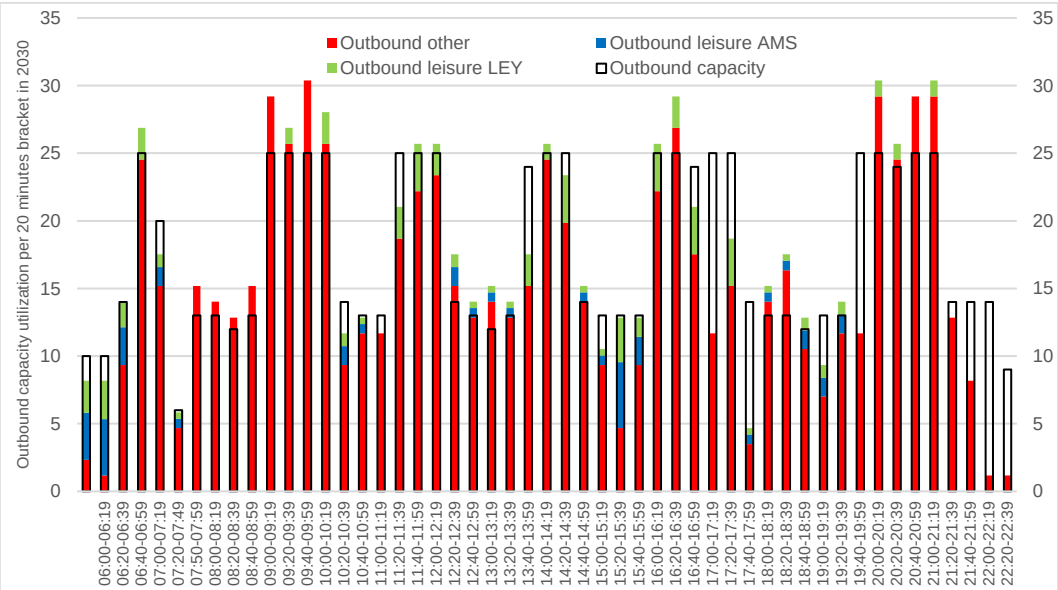
The results show that in 2030 in several peak brackets demand exceeds the declared capacity. This especially holds for the morning and evening waves and especially regarding inbound traffic. Based on the priorities with respect to freeing up capacity as set out in Chapter 3, the figures present to what extent leisure traffic can be accommodated at Lelystad Airport in 2030. The morning wave between 07:50 and 10:39 and the evening wave between 18:20 and 21:39 have the highest priority. It is assumed that the available capacity at Lelystad Airport in 2030 (25,000 aircraft movements) will initially be used by traffic from the inbound and outbound peaks within abovementioned waves. In 2030, all leisure traffic during the other peak periods can be accommodated at Lelystad Airport as well. The assumed capacity of 25,000 at Lelystad Airport in 2030 even provides space for approximately half of the leisure movements outside the peak periods.

Figure 6.3 Inbound traffic in 2030, divided by non-leisure traffic, distributed leisure traffic to Lelystad Airport and leisure traffic at Schiphol Airport



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: The red bars represent the scheduled non-leisure traffic; the green bars the scheduled leisure traffic distributed to Lelystad Airport (LEY); the blue bars the scheduled leisure traffic accommodated at Schiphol Airport (AMS).
Note 3: Increased traffic at the 15th busiest day in 2017 (3rd of August).

Figure 6.4 Outbound traffic in 2030, divided by non-leisure traffic, distributed leisure traffic to Lelystad Airport and leisure traffic at Schiphol Airport



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis SEO Aviation Economics.
Note 1: Local time.
Note 2: The red bars represent the scheduled non-leisure traffic; the green bars the scheduled leisure traffic distributed to Lelystad Airport (LEY); the blue bars the scheduled leisure traffic accommodated at Schiphol Airport (AMS).
Note 3: Increased traffic at the 15th busiest day in 2017 (3rd of August).

6.6 Concluding remarks

To a certain degree, leisure traffic takes place during the inbound and outbound peaks at Schiphol Airport. However, differences between the different waves exist. Leisure traffic is largely absent in the busy morning wave and to a lesser extent in the busy evening wave. On the contrary, during the mid-day waves, leisure traffic has a higher presence. Distributing leisure traffic from Schiphol Airport to Lelystad Airport frees up substantial Schiphol capacity in 2030, assuming a capacity at Lelystad Airport of 25,000. In fact, the leisure traffic in the peak periods of all waves can be accommodated at Lelystad Airport. Additionally, approximately half of the leisure traffic in the off-peak periods can be accommodated at Lelystad Airport. However, especially during aforementioned morning wave, capacity will still be insufficient after distributing leisure traffic to Lelystad Airport. To a lesser extent, this also holds for the evening wave, in which some spare capacity exists in adjacent peak brackets. Given the still constrained capacity during important waves of the hub operation, it is worthwhile to have insight in operational measures that possibly additionally free up capacity in the inbound and outbound peaks. The next chapter sheds light on those possibilities.

7 Operational measures

This chapter sheds light on the possibilities of operational measures to free up relevant peak capacity. Four different measures are considered in this chapter: an increase in peak hourly capacity, extending one of the peak periods, introducing an overlap between arrival peak and departure peak period and the accommodation of operations in adjacent peaks or periods. The results show that a combined implementation of all operational measures substantially frees up capacity in the inbound and outbound peaks at Schiphol Airport. However, those measures alone are not sufficient to lower demand in 2030 below the declared capacity in many peak periods. This implies that a combination of distributing traffic to Lelystad Airport and operational measures provides the best result if it comes to freeing up capacity in the inbound and outbound peaks of Schiphol Airport. However, even if distribution and operational measures are combined, in 2030 bottlenecks still exist with capacity demand being over 90 per cent in (some of) the peaks of waves 2, 6 and 3.

7.1 Introduction

This chapter presents the benefits of potential operational measures to increase peak capacity and/or free up capacity during the most critical peaks. Five measures, in addition to the distribution of leisure traffic to Lelystad Airport, have been identified:

- *Increase peak hourly capacity*: The ability to increase the declared peak hourly capacity (110 aircraft movements per hour during an outbound peak and 106 aircraft movements during an inbound peak, see section 4.2) for the short term is limited. To analyze the potential effect of a capacity increase, a capacity gain of 1 to 2 movements per hour is assumed for the next years, e.g. if the work load can be reduced. For the period up to 2030, the potential effect of an assumed further increase of the capacity to 114/116 movements is analyzed.
- *Increase the number of peak periods*. During the period 7:00 – 23:00, most periods are currently identified as an inbound or outbound peak. Each inbound peak period is separated from a preceding outbound peak mode period by a 20 minutes off peak mode ("firebreaks"). These firebreaks are a strategic measure for punctuality and reliability purposes, which are intended to create some margin in the planning to be able to cope with operational disturbances. During the period 7:00 – 23:00, only the period 21:40 – 23:00 is not used as a peak mode. However, the current and expected traffic volume for this period is limited. An additional peak mode during this period is (only) useful if traffic volume exceeds the off peak capacity. Based on the study results, this is currently not the case. Therefore, this measure is not analysed in more detail in this study.
- *Extend (specific) peak periods*. Inbound peak mode period 6 currently ends at 20:00, with high traffic volumes towards the end of the peak period. The subsequent outbound peak mode starts at 20:00, with a relative low number of departures in the first 20 minutes interval. An extension of the inbound peak mode towards 20:20 will free up capacity during the inbound peak. The subsequent outbound peak will then start at 20:20 and is followed by an off peak mode until 23:00. If needed, the outbound peak can be extended.
- *Efficient use of runway capacity during transition from arrival to departure peaks*. Each wave consists of an inbound peak followed by an outbound peak. Arrival and departure peaks don't overlap. The inbound and outbound peak period times are based on the planned on-block (arrival) and

off-block (departure) times. Actual times of arrival and departure may vary due to operational factors. Taxi time creates a natural shift between on- and off-block times and runway times. Combined with operational disturbances, this frequently results in 2+1 runway modes during the firebreak periods. On the other hand, the runway capacity demand during the transition from an arrival peak to a departure peak is lower than expected based on the slot declaration. This might allow to schedule a 10 to 20 minute overlap between the arrival and departure peak.

- *Accommodate slots in adjacent periods*. Peak period 2 is the most busy period during the day, with a limited share of leisure traffic. If the capacity demand cannot be met during that period, remaining slots in adjacent periods might be used.

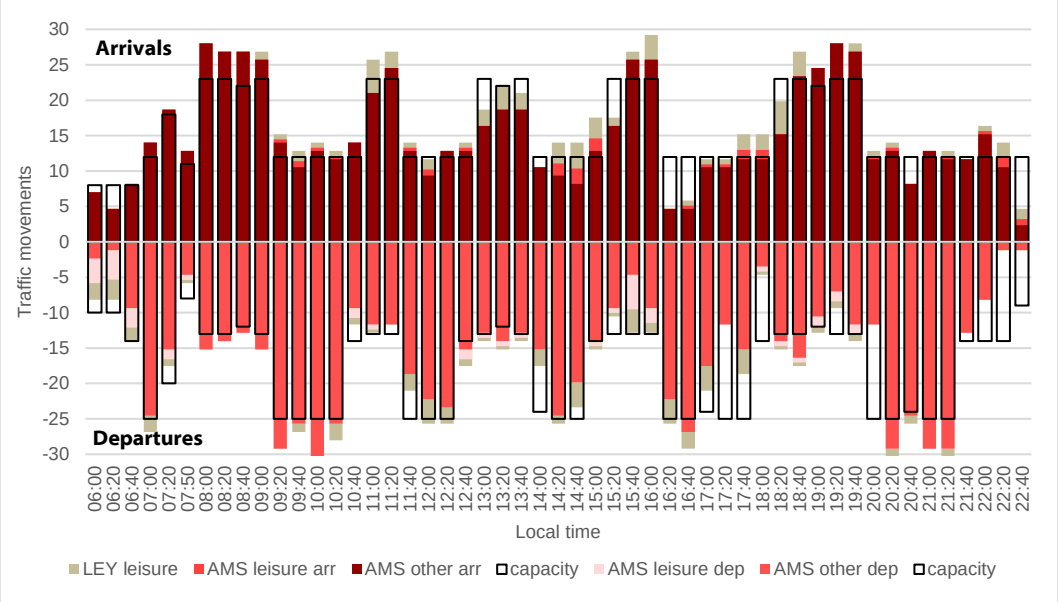
For these measures, an analysis is performed to identify the impact on the capacity demand during the peak periods. The capacity demand is defined as the demand as a percentage of the capacity. If the capacity demand is more than 100 per cent, the demand exceeds the capacity. The analysis is based on the 15th busiest day for 2030. Besides the operational measures, the analysis also shows the capacity demand for the situation with and without traffic distribution.

Finally, it should be stressed that that the operational and economic feasibility of the measures has not been assessed.

7.2 Situation without additional measures

Figure 7.1 presents the traffic demand for 2030 with the number of arrivals (upper part of the figure) and departures (lower part of the figure) per 20 minutes bracket plotted against the capacity. The different traffic segments are indicated in the graph, including the distribution of 10,000 leisure flights from Schiphol Airport to Lelystad Airport in the most constrained Schiphol peaks.

Figure 7.1 Traffic demand over the day in 2030 with traffic distribution to Lelystad Airport



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

Based on the expected traffic demand, table 7.1 shows the capacity demand for the different peak periods. Again it appears that for periods 2, 6 and 3 the expected demand exceeds the capacity, especially for inbound traffic.

Table 7.1 Capacity demand with all leisure traffic at Schiphol Airport

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	119%	114%
6	18:20 - 19:59	20:00 - 21:39	112%	103%
3	11:00 - 11:39	11:40 - 12:39	114%	97%
4	13:00 - 13:59	14:00 - 14:59	91%	90%
5	15:20 - 16:19	16:20 - 17:59	107%	86%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

Table 7.2 illustrates the situation after the distribution of leisure traffic to Lelystad Airport, which has the potential to free up capacity for most peak periods substantially. Due to the low number of leisure movements in wave 2, the impact on the capacity for that period is limited. The demand for period 6 also still exceeds the capacity. For most of the other periods, the capacity demand will be less than 90 per cent, except for the inbound peak periods of wave 3 and 5 with is close to the capacity.

Table 7.2 Capacity demand after distribution of leisure traffic to Lelystad Airport

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	118%	111%
6	18:20 - 19:59	20:00 - 21:39	103%	100%
3	11:00 - 11:39	11:40 - 12:39	99%	86%
4	13:00 - 13:59	14:00 - 14:59	79%	81%
5	15:20 - 16:19	16:20 - 17:59	98%	75%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

7.3 Increase peak hourly capacity

The potential increase of the hourly peak capacity for the short term (next 5 years) is expected to be limited. This section illustrates the impact on the capacity demand of 1 extra movement per hour. The analysis takes the situation after the distribution of leisure traffic to Lelystad Airport as starting point, i.e. with the resulting capacity demand from table 7.2. The result of an increased peak hourly capacity on the capacity demand is limited, see table 7.3.

.

Table 7.3 Capacity demand, with limited increased peak hourly capacity

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	117%	110%
6	18:20 - 19:59	20:00 - 21:39	103%	99%
3	11:00 - 11:39	11:40 - 12:39	99%	85%
4	13:00 - 13:59	14:00 - 14:59	78%	79%
5	15:20 - 16:19	16:20 - 17:59	98%	75%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

To analyze the effect of a further increase of the capacity, table 7.4 shows the impact on the capacity demand with an assumed capacity of 114/116 movements. That capacity increase lowers the capacity demand with approximately 6 per cent for the arrival peak periods and 4 per cent for the departure peak periods.

Table 7.4 Capacity demand, with a further increase of the peak hourly capacity

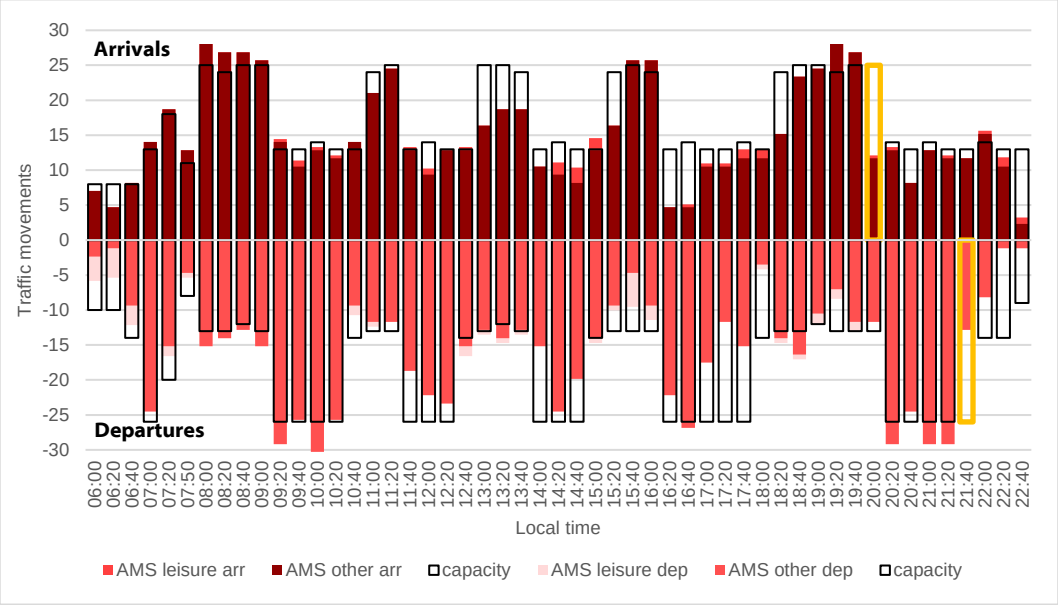
Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	109%	107%
6	18:20 - 19:59	20:00 - 21:39	96%	95%
3	11:00 - 11:39	11:40 - 12:39	93%	82%
4	13:00 - 13:59	14:00 - 14:59	73%	76%
5	15:20 - 16:19	16:20 - 17:59	93%	72%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

7.4 Extend peak periods

The inbound peak mode period 6 currently ends at 20:00, with high traffic volumes towards the end of the peak period. The subsequent outbound peak mode starts at 20:00, with a relative low number of departures in the first 20 minutes interval. An extension of the inbound peak mode (conversion from outbound to inbound) towards 20:20 will free up capacity during the inbound peak. The subsequent outbound peak will then start at 20:20 and is followed by an off peak mode until 23:00. If needed, the outbound peak can be extended. The extension of both the inbound and outbound peak is illustrated in figure 7.2.

Figure 7.2 Extended outbound and inbound peak period in wave 6



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

Based on the resulting situation after distribution of leisure traffic to Lelystad Airport and increased peak hourly capacity, the extension of the inbound peak frees up the peak capacity from 96 to 88 per cent (see table 7.5).

Table 7.5 Capacity demand, extending peak period 6

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	109%	107%
6	18:20 - 20:19	20:20 - 21:59	88%	96%
3	11:00 - 11:39	11:40 - 12:39	93%	82%
4	13:00 - 13:59	14:00 - 14:59	73%	76%
5	15:20 - 16:19	16:20 - 17:59	93%	72%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

7.5 Overlap between arrival and departure peak

Caused by the shift between on- and off-block times and runway time, the runway capacity demand during the transition from an arrival peak to a departure peak is lower than expected based on the slot declaration. This increases with departure delays and aircraft arriving before scheduled times. This allows for an overlap for the between the arrival peak and the subsequent outbound peak for the slot declaration, without exceeding the 2+1 runway capacity. With a 10-minute overlap, the arrival or departure peak capacity increases with 6 movements. Based on the resulting situation after distribution of leisure traffic to Lelystad Airport, increased peak hourly capacity and the altered peak period 6 (i.e. the results of section 7.4), a 10-minute overlap between the arrival peak and departure peak increases the peak capacity for all waves, see table 7.5.

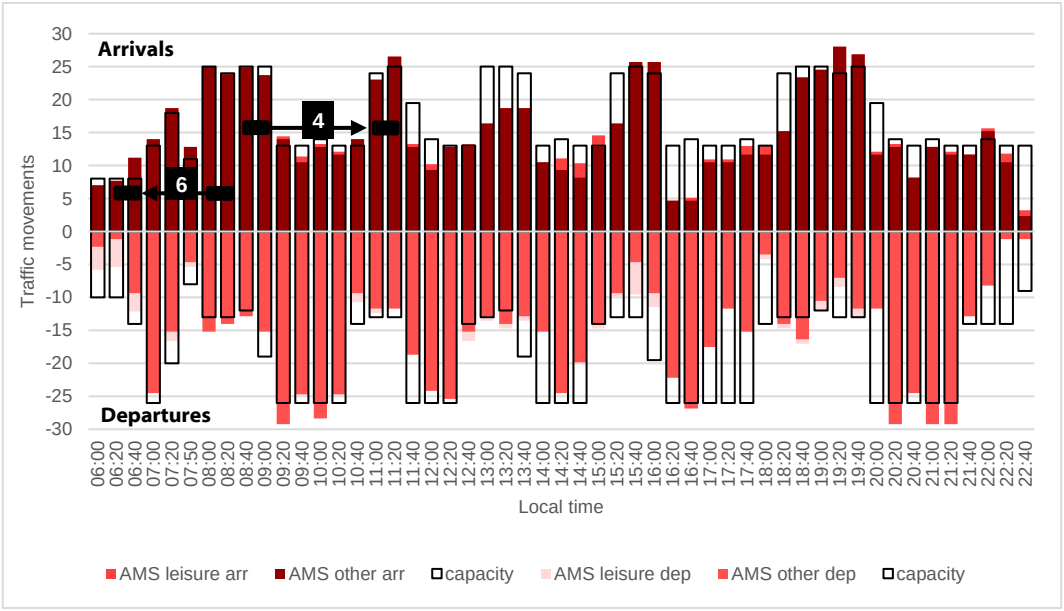
Table 7.6 Capacity demand, overlap between arrival and departure peak periods

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:10 - 10:39	109%	101%
6	18:20 - 20:19	20:10 - 21:59	88%	92%
3	11:00 - 11:49	11:40 - 12:39	86%	82%
4	13:00 - 13:59	13:50 - 14:59	73%	73%
5	15:20 - 16:29	16:20 - 17:59	82%	72%

7.6 Accommodate slots in adjacent periods

After all measures, wave 2 is still the most busy period during the day, with a limited number of leisure flights. If the capacity demand cannot be met during that period, remaining slots in the adjacent wave 3 and early morning period might be used. This is illustrated in figure 7.3, for the shift of six arrivals to the early morning period and four arrivals to wave 3. Please note that the ability to shift movements to the night time period (23:00 – 7:00) also requires night time capacity, e.g. created by distributed leisure traffic from that period.

Figure 7.3 Accommodate slots in adjacent brackets



Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.

Note: Local time.

Table 7.7 shows the resulting capacity demand for each of the peak periods. Some periods remain 'critical', but in all cases the capacity does not exceed the capacity.

Table 7.7 Capacity demand, accommodating slots in adjacent periods

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:10 - 10:39	100%	98%
6	18:20 - 20:19	20:10 - 21:59	91%	92%
3	11:00 - 11:49	11:40 - 12:39	92%	87%
4	13:00 - 13:59	13:50 - 14:59	83%	73%
5	15:20 - 16:29	16:20 - 17:59	82%	72%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

7.7 No distribution of leisure flights to Lelystad Airport

As a concluding analysis, the impact of the aforementioned operational measures is assessed for the situation without the distribution of leisure traffic to Lelystad Airport. In that situation, the demand exceeds the capacity for three peak periods, which clearly shows the benefits of distributing leisure traffic to Lelystad Airport.

Table 7.8 Capacity demand without distributing leisure traffic to Lelystad Airport

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	101%	101%
6	18:20 - 20:19	20:20 - 21:59	98%	104%
3	11:00 - 11:39	11:40 - 12:39	104%	98%
4	13:00 - 13:59	14:00 - 14:59	84%	81%
5	15:20 - 16:19	16:20 - 17:59	89%	82%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

7.8 Concluding remarks

In addition to the distribution of leisure traffic to Lelystad Airport, operational measures potentially result in lower capacity demands during the most critical peak periods. Table 7.9 provides a summary of the impact of both the distribution of leisure traffic to Lelystad Airport and operational measures on the capacity demand.

Table 7.9 Summary of the potential impact of the distribution of leisure traffic to Lelystad Airport and/or operational measures on the capacity demand

No operational meausures

No outplacement

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	119%	114%
6	18:20 - 19:59	20:00 - 21:39	112%	103%
3	11:00 - 11:39	11:40 - 12:39	114%	97%
4	13:00 - 13:59	14:00 - 14:59	91%	90%
5	15:20 - 16:19	16:20 - 17:59	107%	86%

Outplacement

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	118%	111%
6	18:20 - 19:59	20:00 - 21:39	103%	100%
3	11:00 - 11:39	11:40 - 12:39	99%	86%
4	13:00 - 13:59	14:00 - 14:59	79%	81%
5	15:20 - 16:19	16:20 - 17:59	98%	75%

Operational meausures

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	101%	101%
6	18:20 - 20:19	20:20 - 21:59	98%	104%
3	11:00 - 11:39	11:40 - 12:39	104%	98%
4	13:00 - 13:59	14:00 - 14:59	84%	81%
5	15:20 - 16:19	16:20 - 17:59	89%	82%

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:10 - 10:39	100%	98%
6	18:20 - 20:19	20:10 - 21:59	91%	92%
3	11:00 - 11:49	11:40 - 12:39	92%	87%
4	13:00 - 13:59	13:50 - 14:59	83%	73%
5	15:20 - 16:29	16:20 - 17:59	82%	72%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

8 Conclusions

The hub operation at Schiphol Airport is an important cornerstone in the quality of Schiphol Airport's aviation network. The cessation of the hub operation leads to a decrease in value added of more than 4 billion euro and 55,000 jobs on the short-term. The Dutch government considers the network development of Schiphol Airport and the hub operation's dependence on connecting traffic of public interest. In that light, the Ministry of Infrastructure and Water Management has asked SEO Amsterdam Economics and To70 to map the effects a distributing leisure traffic to Lelystad Airport on capacity demand in the inbound and outbound peaks at Schiphol Airport. In addition the Ministry has asked for an outline of operational measures that can additionally free up capacity in the inbound and outbound peaks. The results show that only a combination of a traffic distribution rule and operational measures decrease capacity demand below the declared capacity in 2030. Also then, bottlenecks will exist with certain peak periods having a capacity demand of more than 90 per cent in 2030 after distributing leisure traffic to Lelystad Airport and implementing operational measures.

Background

On the short-term, the loss of the hub operation at Schiphol Airport results in a decrease in value added of more than 4 billion euro and the loss of 55,000 jobs. Without connecting passengers most intercontinental destinations currently served from Schiphol Airport cannot be operated viably. The same holds for an important part of the European network. To be able to operate a premium hub network of high-quality connections sufficient peak hourly capacity is essential. In that light, the Dutch government foresees in the implementation of a traffic distribution rule that aims at the distribution of leisure traffic from the inbound and outbound peaks at Schiphol Airport to Lelystad Airport in order to free up capacity for the hub operation at Schiphol Airport. In addition, SEO and To70 have been asked to map the possible capacity benefits of operational measures in the inbound and outbound peaks in 2030. In a separate report, SEO and To70 have presented the capacity implications at Schiphol Airport for 2023.

Current capacity demand

The analysis of the current capacity demand of the inbound and outbound peaks at Schiphol Airport especially shows scarcity in the morning peak between 07:50 and 10:39 and the evening peak between 18:20 and 21:39. In the mid-day peak periods show some room for further growth. These findings raise the question to what extent the capacity scarcity will be increased in 2030 and, in turn, to what extent distribution of leisure traffic to Lelystad Airport and operational measures lead to freeing up inbound and outbound peak capacity.

2030 capacity demand

Especially the inbound peak capacity is insufficient to accommodate aviation demand in 2030. However, also the outbound peak capacity is lower than the demand in many individual peak brackets. In general, the results show scarcity during the morning peak between 07:50 and 10:39 (wave 2) and during the evening peak between 18:20 and 21:39 (wave 6). During the mid-day peak periods there is some room in the shoulders of the respective peak periods, especially in waves 4 and 5. The profound capacity scarcity in 2030 underlines the relevance to investigate the possibilities to free up capacity by (1) implementing a traffic distribution rule and by (2) operational measures.

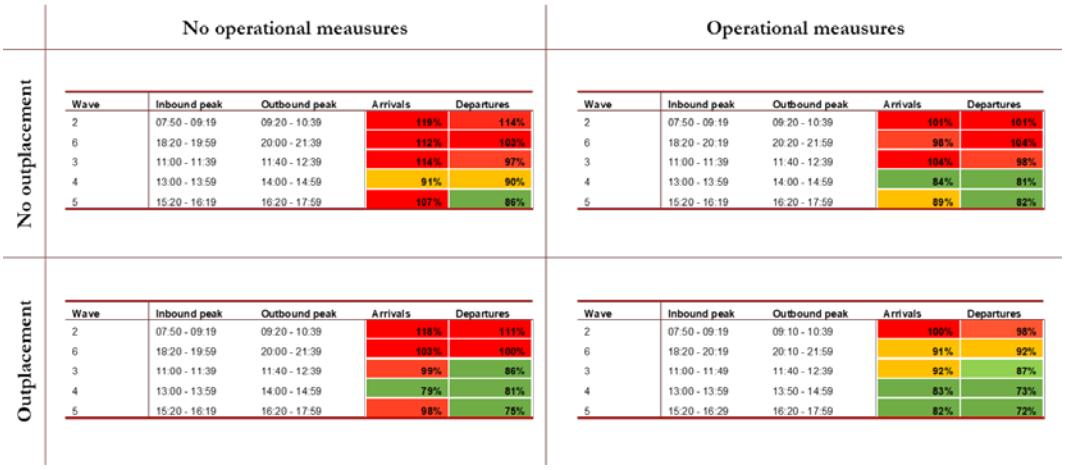
Freeing up peak capacity by distributing leisure traffic to Lelystad Airport

The analysis of the effects of distributing leisure traffic to Lelystad Airport by means of a traffic distribution rule especially shows the freeing up of capacity during the mid-day connecting waves (3, 4 and 5). During these periods the leisure presence is highest. In the busy morning peak (wave 2), the leisure segment is largely absent. In the evening peak (wave 6) the number of leisure aircraft movements is limited as well. Therefore, the possibility to free up capacity during these periods using the foreseen traffic distribution rule is rather limited. Given the still constrained capacity during the most congested waves of the hub operation, it is worthwhile to have insight in operational measures to additionally free up capacity in the inbound and outbound peak.

Freeing up additional peak capacity by operational measures

The analysis of the effects of operational measures is based on five different measures, namely: (1) an increase in peak hourly capacity, (2) an increase in the number of peak periods, (3) an extension of specific peak periods, (4) a more efficient use of runway capacity during transition periods between arrival and departure peaks and (5) the accommodation of operations in adjacent peaks or periods. The results show that a combined implementation of all operational measures substantially frees up capacity in the inbound and outbound peaks at Schiphol Airport (see table 8.1). However, those measures alone are not sufficient to lower demand in 2030 (well) below the declared capacity in many peak periods. This implies that a combination of distributing traffic to Lelystad Airport and operational measures provides the best result if it comes to freeing up capacity in the inbound and outbound peaks of Schiphol Airport. However, even if distribution and operational measures are combined, in 2030 bottlenecks still exist with capacity demand being over 90 per cent in (some of) the peaks of waves 2, 6, 3 and 5.

Table 8.1 Summary of the potential impact of the distribution of leisure traffic to Lelystad Airport and/or operational measures on the capacity demand



No operational meausures

No outplacement

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	119%	114%
6	18:20 - 19:59	20:00 - 21:39	112%	103%
3	11:00 - 11:39	11:40 - 12:39	114%	97%
4	13:00 - 13:59	14:00 - 14:59	91%	90%
5	15:20 - 16:19	16:20 - 17:59	107%	86%

Outplacement

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	118%	111%
6	18:20 - 19:59	20:00 - 21:39	103%	100%
3	11:00 - 11:39	11:40 - 12:39	99%	86%
4	13:00 - 13:59	14:00 - 14:59	79%	81%
5	15:20 - 16:19	16:20 - 17:59	98%	75%

Operational meausures

No outplacement

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:20 - 10:39	101%	101%
6	18:20 - 20:19	20:20 - 21:59	98%	104%
3	11:00 - 11:39	11:40 - 12:39	104%	98%
4	13:00 - 13:59	14:00 - 14:59	84%	81%
5	15:20 - 16:19	16:20 - 17:59	89%	82%

Outplacement

Wave	Inbound peak	Outbound peak	Arrivals	Departures
2	07:50 - 09:19	09:10 - 10:39	100%	98%
6	18:20 - 20:19	20:10 - 21:59	91%	92%
3	11:00 - 11:49	11:40 - 12:39	92%	87%
4	13:00 - 13:59	13:50 - 14:59	83%	73%
5	15:20 - 16:29	16:20 - 17:59	82%	72%

Source: Schiphol statistics and Capacity declaration Amsterdam Airport Schiphol, analysis To70.
Note: Local time.

Appendix A Leisure destinations

Country	Destination (IATA code)	Destination	Aircraft movements 2017
Albania	TIA	Tirana	176
Austria	INN	Innsbruck	561
Austria	SZG	Salzburg	367
Bulgaria	BOJ	Burgas	329
Bulgaria	VAR	Varna	34
Croatia	DBV	Dubrovnik	372
Croatia	PUY	Pula	135
Cyprus	PFO	Paphos	256
Cyprus	LCA	Larnaca	252
Cyprus	ECN	Ercan	48
Egypt	HRG	Hurghada	753
Egypt	RMF	Marsa Alam	435
Egypt	SSH	Sharm el Sheikh	20
Finland	KTT	Kittila	80
Finland	KAO	Kuusamo	59
Finland	RVN	Rovaniemi	40
Finland	IVL	Ivalo	34
France	AJA	Ajaccio	170
France	EGC	Bergerac	36
France	CMF	Chambery	30
Greece	HER	Heraklion	1624
Greece	KGS	Kos	1136
Greece	RHO	Rhodes	805
Greece	ZTH	Zakynthos	782
Greece	SKG	Thessaloniki	600
Greece	CFU	Corfu	583
Greece	PVK	Preveza/Lefkada	359
Greece	MJT	Mytilini	227
Greece	CHQ	Chania	225
Greece	SMI	Samos	220
Greece	EFL	Kefallinia	193
Greece	AOK	Karpathos	146
Greece	JTR	Santorini	121
Greece	KLX	Kalamata	105
Greece	JMK	Mykonos	82
Greece	JSI	Skiathos	48
Greece	VOL	Volos	25
Greece	KIT	Kithira	25
Greece	KVA	Kavala	22
Ireland	SNN	Shannon	10
Italy	NAP	Naples	1418
Italy	BRI	Bari	519
Italy	OLB	Olbia	464
Italy	VRN	Verona	419
Italy	PMO	Palermo	166
Italy	TPS	Trapani	42
Macedonia	OHD	Ohrid	231
Montenegro	TIV	Tivat	42
Morocco	CMN	Casablanca	1053
Morocco	NDR	Nador	819
Morocco	TNG	Tanger	632
Morocco	RAK	Marrakech	608
Morocco	AGA	Agadir	231
Morocco	AHU	Al Hoceima	143
Morocco	FEZ	Fez	116
Morocco	OUD	Oujda	38
Norway	TOS	Tromso	23
Poland	KTW	Katowice	208
Poland	LCJ	Lodz	100
Portugal	FAO	Faro	1954
Portugal	FNC	Funchal	519
Portugal	PDL	Ponta Delgada	74
Portugal	TER	Terceira	25
Portugal	PXO	Porto Santo	23
Spain	IBZ	Ibiza	2020
Spain	PMI	Palma Mallorca	1965
Spain	LPA	Las Palmas	1884
Spain	TFS	Tenerife	1552
Spain	ACE	Arrecife	990

Spain	SVQ	Seville	796
Spain	FUE	Fuerteventura	735
Spain	GRO	Gerona	492
Spain	SPC	Santa Cruz de la Pal	341
Spain	MAH	Menorca	182
Spain	SCQ	Santiago de Compostela	164
Spain	LEI	Almeria	154
Spain	REU	Reus	136
Sweden	SFT	Skelleftea	12
Tunesia	NBE	Enfidha	24
Turkey	AYT	Antalya	2139
Turkey	ADB	Izmir	698
Turkey	BJV	Bodrum	548
Turkey	DLM	Dalaman	430
Turkey	ASR	Kayseri	238
Turkey	GZP	Alanya	161
Turkey	KYA	Konya	140
United Kingdom	BFS	Belfast	879

seo amsterdam economics

Roetersstraat 29 . 1018 WB Amsterdam . T (+31) 20 525 16 30 . F (+31) 20 525 16 86 . www.seo.nl