# 5 Sustainable aviation

*"The Dutch Association of Travel Agents and Tour Operators (ANVR) is the trade association for entrepreneurs in travel in the Netherlands. The increasing prosperity and standard of living in the Netherlands has made it possible for a growing group of people to travel the world. This gives an enormous boost to our economy. At the same time, social and climatological trends demand our attention. The ANVR wants to contribute actively to a sustainable vision for transport and mobility, addressing such topics as connectivity, diversity and liveability. In future policy, the ANVR envisions enthusiastic Dutch travellers not only as 'employees' and 'neighbours', but also as 'consumers'. In that policy, diversity is crucial – in terms of destinations, frequency and market parties. Finally, the government must take a more directive role in embracing sustainability as a 'hygiene factor', so that ambitious parties can be rewarded more appropriately for sustainable initiatives."*

**– ANVR**

**Implementing the Sustainable Aviation Agreement will drastically reduce greenhouse gas emissions from civil aviation by 2050. Dutch airports (including ground operations) and domestic aviation in the Netherlands will then have zero $CO_2$ emissions. More stringent targets will also significantly reduce $CO_2$ emissions from international flights departing from the Netherlands. In addition, non-$CO_2$ greenhouse gas emissions will also be an integral part of climate policy for the aviation sector.**

By 2050, aircraft will probably be able to use a combination of energy sources to power their engines, depending on flight distances. Aircraft will be fully electric on short-haul flights, running on battery power as well as hydrogen-generated electricity. On medium-haul and long-haul flights, they will increasingly use hybrid engines that can run on multiple energy sources. Aviation fuels will satisfy strict EU sustainability criteria in force at that time.

In 2050, the Netherlands will still play a central role in refining and distributing aviation fuels through western Europe – but now focused exclusively on sustainable fuels. Developing, producing and maintaining components for the new generation of aircraft that will come on the market from 2030 will also yield economic benefits.

### Key decisions

1. Adopting the Sustainable Aviation Agreement.
2. Safeguarding the climate targets set out in the Sustainable Aviation Agreement. $CO_2$ emissions from international flights departing from the Netherlands will be equal to 2005 levels by 2030, at or below half the 2005 level by 2050, and zero by 2070. A package of instruments and measures is being developed to this end, including a $CO_2$ emissions ceiling.
3. Advocating more ambitious international climate targets and instruments for the aviation sector in the framework of ICAO and the EU. Once ICAO sets a more ambitious climate target, the government will adopt that target for outbound international aviation from the Netherlands.
4. In due course the Netherlands aims to align the climate approach for the aviation sector with the EU climate goals and the National Climate Agreement (reflecting the Paris Agreement), so that the aviation sector will be practically climate-neutral in 2050.
5. Sustainable fuels (e.g. synthetic kerosene) and sustainable aircraft will be needed to achieve the climate ambitions. Various parties are exploring the best ways to incentivise the development and use of sustainable fuels, new aircraft designs and new types of engines (e.g. powered by electricity or hydrogen fuel).
6. The Netherlands advocates the introduction of a European blending obligation for sustainable aviation fuels. If it proves difficult to introduce a European obligation in good time, the Netherlands will aim to introduce a national blending obligation in 2023.
7. Developing an approach that incorporates non-$CO_2$ greenhouse gas emissions into climate policy for aviation.

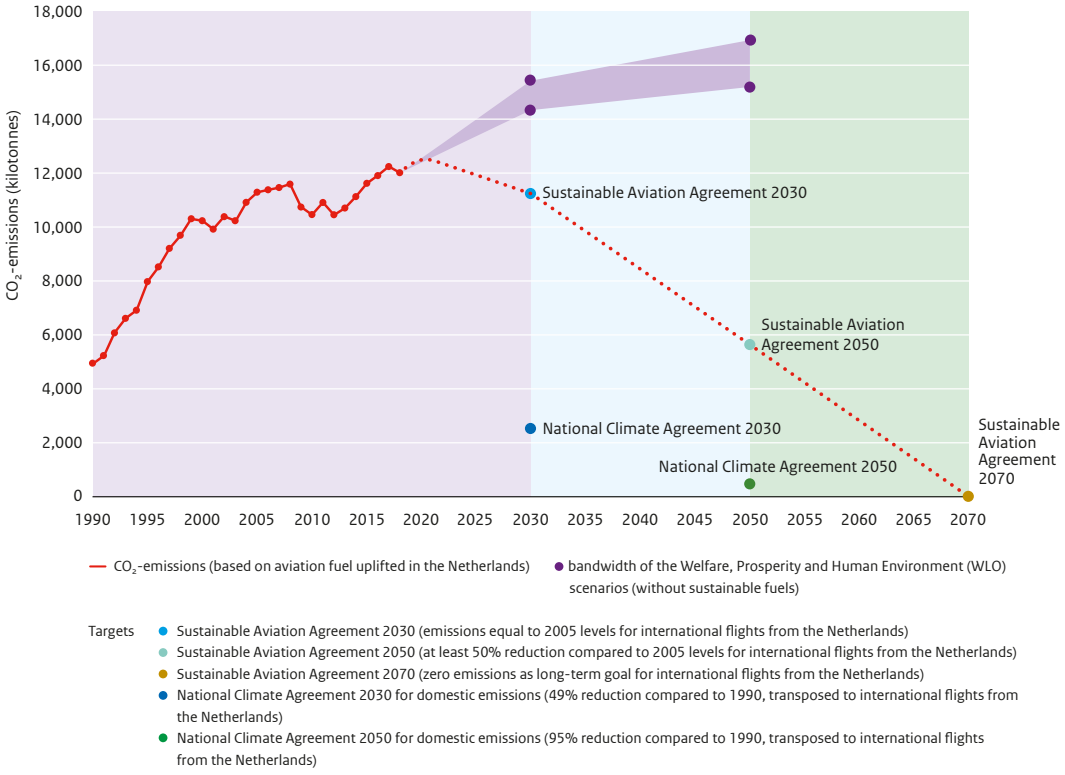
## 5.1 The climate challenge

The global aviation sector faces the challenge of reversing course on rising greenhouse gas (GHG) emissions, and achieving emissions reduction in the framework of the Paris climate goals. Emissions from international aviation deserve particular attention, more so than emissions from domestic flights. As a small country, the Netherlands has little domestic aviation and a high volume of international air traffic. Globally, too, international aviation generates more $CO_2$ emissions than domestic aviation. Dutch climate policy on aviation will be more effective if it also leads to international agreements. Such agreements would also limit the risk of disrupting the level playing field in the aviation sector.

$CO_2$ emissions generated by international flights departing from the Netherlands have increased significantly over the past decades because of the enormous growth of aviation. Following a temporary drop

during the COVID-19 crisis, emissions from aviation are expected to increase further in the next few years, according to the scenario study on Welfare, Prosperity and the Human Environment (WLO).[1] A new method has been used to estimate $CO_2$ emissions associated with the sale of bunker fuels. The figure below shows historic trends in emissions and how they are projected to develop in the future under the various scenarios. These scenarios do not take into account such factors as future use of sustainable fuels, nor do they incorporate the effects of the COVID-19 crisis. The various targets are plotted in the chart for indicative purposes.

**Figure 5.1 Trends in $CO_2$ emissions from flights departing from the Netherlands and indication when targets could be achieved**




For international flights departing from the Netherlands, the government will use the targets for $CO_2$ emissions from aviation, as set out in the February 2019 Sustainable Aviation Agreement:

- 2030: at most equal to aviation emissions in 2005. This is a national target;
- 2050: at least 50% reduction compared to 2005 emissions. This is in line with the global objectives for international civil aviation;
- 2070: zero emissions. This is a national target.

The aviation sector must reduce its own emissions. Fossil fuel uplifted in the Netherlands is the standard used here. Carbon offsetting through schemes like EU ETS and CORSIA primarily contribute to the achievement of international targets set by the European Union and by ICAO.

Achieving the Paris climate goals will require a more ambitious long-term goal for international aviation worldwide. The Netherlands will work with other European countries to advocate that position within ICAO and the EU. The parties to the national Sustainable Aviation Table also want to contribute, as set out in the Sustainable Aviation Agreement. These parties want to align as much as possible with EU and national targets for domestic emissions in the framework of the Paris Agreement before 2050.

[1] *Netherlands Environmental Assessment Agency (PBL). November 2020. Long-term aviation emission scenarios. https://www.pbl.nl/publicaties/co2-emissie-van-de-luchtvaart-op-de-lange-termijn*

This means 95% fewer $CO_2$ emissions than in 1990. Once ICAO sets a more ambitious emission reduction target for 2050 than 50% compared to 2005 levels, the government will adopt that target for international flights departing from the Netherlands.

By 2030 ground operations in civil aviation, such as transport of baggage, passengers and cargo, must be zero-emission. By 2050 the entire civil aviation sector in the Netherlands must be zero-emission. These goals are set out in the Sustainable Aviation Agreement, and give the Dutch aviation sector a head start on other sectors for which goals for domestic emissions have been set. The government is adopting these goals.

## 5.2 The climate approach

The letter to the House of Representatives of 27 March 2019[2] provides an overview of climate policy and instruments for the aviation sector. The Sustainable Aviation Agreement was also presented in an annex to that letter. This chapter supplements the aforementioned letter by setting out a more extensive policy framework, identifying a number of policy focus areas, providing a response to the Sustainable Aviation Agreement and proposing several concrete measures.

### 5.2.1 Policy framework

#### National and international approach

Greenhouse gases are a global problem. Reducing $CO_2$ emissions from international aviation therefore requires an international approach first and foremost. The Netherlands works with other countries in the framework of the EU and ICAO to develop international measures. An international approach will eventually lead to more $CO_2$ emissions reduction, since measures will be implemented by more countries. It will also prevent travellers and airlines from diverting to other countries that have less stringent rules.

Where a global approach is not yet feasible, European agreements could be considered. An approach based on international agreements and cooperation reduces the risk of political and legal conflicts with other countries – and the potential for countermeasures. Measures implemented only on a national level have a negative impact on the competitive position of the Dutch aviation sector. This could lead to a deterioration of network quality and the business climate, without actually having a beneficial impact on climate on the global level.

This does not mean no efforts are being made on the national level. The government also wants the Netherlands to commit to reducing $CO_2$ emissions from the aviation sector on the national level. A national approach that is based on coalitions with other countries, for example, could serve as a model for international agreements and reinforce the credibility of the Netherlands on the international level.

National efforts will also boost innovation in the Netherlands and thus lead to economic opportunities. The focus on sustainable aviation fuels in particular offers major opportunities for the chemical industry, airports and maritime ports, and knowledge institutions, while opportunities for the Dutch manufacturing industry are to be found in new aircraft designs, new materials and new types of engine, powered by electricity or hydrogen fuel, for example.

$CO_2$ emissions from international aviation may be attributed to individual countries in the future, just as emissions from domestic activities are now. The aviation sector in the Netherlands is relatively large compared to the size of its economy and population. If international aviation emissions were attributed to individual countries, $CO_2$ emissions from aviation would have to be added to the Netherlands' national $CO_2$ budget. In that case, aviation would take a large chunk of the budget, which could potentially have major consequences for aviation as well as for other sectors. By formulating national climate policy on aviation, the government is anticipating this issue and mitigating the impact of this risk.

[2] *Kamerstukken II, 2018-2019, 31 936, nr. 585; https://zoek.officielebekendmakingen.nl/kst-31936-585.html*

### Safeguarding the climate targets

The Sustainable Aviation Agreement sets clear targets for reducing emissions in the Netherlands. This is an important step for the aviation sector and the government. In reducing $CO_2$ emissions from domestic flights and ground operations, the Dutch aviation sector is performing better than other sectors in the Netherlands that have to achieve emission reduction targets.

By setting a national target for $CO_2$ emissions from international flights departing from the Netherlands, our country is already a step ahead of most other countries. That also applies to the fact that this target is to be achieved entirely by the aviation sector, by reducing the volume of fossil fuels uplifted in the Netherlands.

Providing safeguards for achievement of the targets aims to offer certainty. To this end, a package of measures and instruments, including a $CO_2$ emissions ceiling, will be developed over the next few years. It is important to consider the climate approach coherently with other interests and frameworks when making future decisions about aviation. To that end, the current national targets must be transposed to the level at which decisions are made and permits are granted for aviation in the Netherlands: the airports. Section 5.2.3 describes the approach adopted by this government.

### Focus in the measures

Reducing $CO_2$ emissions from the aviation sector can generally be achieved along three tracks:

1. More sustainable flights: using sustainable fuels and other technological innovations, such as new aircraft designs and new types of engine, powered by electricity or hydrogen fuel, for example.
2. Offsetting $CO_2$ emissions from aviation in other sectors via international schemes such as EU ETS and CORSIA.
3. Alternatives to flying: aviation pricing and other incentives to encourage the use of international trains, as well as raising awareness and promoting behavioural change.

The three tracks are ranked according to preference. The government's preference is for the most direct and effective climate instruments, in which the costs for sector parties contribute as much as possible to actual reduction of $CO_2$ emissions in the aviation sector. The climate instruments selected will have to help accelerate the energy transition in the aviation sector, must be suitable for upscaling within the Netherlands and beyond (for extra impact), and contribute to the earning power of companies in a sustainable economy.

The first track scores best on these criteria. Technological innovation will have the greatest effect and be most likely to lead to achievement of the climate targets for the aviation sector, in both the shorter and longer term. The government has therefore elected to pursue an approach focusing primarily on research into and use of sustainable fuels and technological innovations. Within the first track, the government expects to achieve the highest $CO_2$ emission reduction in the short term by using sustainable fuels (like renewable biofuels and synthetic kerosene) and in the medium term by adopting innovations in aircraft designs, materials and engines.[3] The government places extra emphasis on this aspect. The greening of the aviation sector through the use of biofuels will be implemented in accordance with the sustainability framework for biofuels.

Offsetting emissions via reductions in other sectors through international systems such as EU ETS and CORSIA, part of the second track, would lead to direct $CO_2$ emission reduction outside the aviation sector and is important to achieving international targets. The national targets for international aviation departing from the Netherlands are determined based on the volume of aviation fuel (fossil fuel and others) uplifted in the Netherlands. That will not decrease as a result of carbon offsetting.

[3] *Royal HaskoningDHV. 21 March 2019. Potential for emissions reduction in Dutch aviation. https://www.natuurenmilieu.nl/wp-content/uploads/2019/04/Emissiereductie-in-de-Luchtvaart-Royal-HaskoningDHV.pdf*
*Royal HaskoningDHV, Buck Consultants International & Netherlands Aerospace Centre. Environmental Impact Assessment of the Civil Aviation Policy Memorandum. https://planmerlvn.ireport.royalhaskoningdhv.com*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The effects of measures in the third track (alternatives to flying) depend heavily on other factors, so the effects are indirect and less certain. Moreover, these measures do not contribute to the energy transition in the aviation sector, can often be difficult or impossible to scale up to global level, and do not contribute to the earning power of Dutch companies in a sustainable economy. One example of a measure in the third track is an aviation tax. This could have an indirect effect as airlines might pass on the higher costs to passengers through higher ticket prices. This, possibly combined with greater awareness, could lead to a decline in passenger demand, which could eventually lead to reduced air traffic and lower $CO_2$ emissions. An impact study[4] shows that available airport capacity plays a leading role in achieving $CO_2$ impact. If demand outstrips supply, then a limited national tax will not lead to fewer flights, but to less scarcity. The Netherlands is therefore focusing primarily in favour of pricing instruments on a European or global level.

In the framework of the third track, one of the solutions sometimes advocated is reducing the number of flights to and from the Netherlands. The government wants to safeguard achievement of the climate targets and encourage the development and use of sustainable fuels and other technological innovations. By setting clear limits to permitted $CO_2$ emissions, it is possible for the aviation sector to earn growth within those boundaries.

### Aviation pricing

Aviation pricing can serve various purposes: fiscal greening, internalising costs and reducing $CO_2$ emissions from aviation.

Through green fiscal policies, the government ensures that individuals and companies pay more for choices that lead to pollution (the 'polluter pays' principle). This government considers it more logical to tax what our society does not want (pollution) than what we do want (work, enterprise). A flight tax would contribute to greener taxation. The proposed flight tax would comprise a tax charged to each departing passenger (flight ticket tax) and a tax charged to each departing cargo aircraft based on weight and noise category. Transit passengers would not have to pay flight tax. A flight tax would also ensure that aviation pricing better reflects the costs of aviation to society.

[4] *CE Delft. April 2019. Economic and environmental effects of aviation taxation. https://www.rijksoverheid.nl/documenten/kamerstukken/2019/05/14/bijlage-5-onderzoek-ce-delft-economische-en-duurzaamheidseffecten-vliegbelasting*

Internalising costs prioritises the 'polluter pays' principle (or, in this case, the user pays). Competition between transport modalities would be fairer if they all internalised their costs. For mobility and transport this involves the sum total of external costs and infrastructure costs. Research by CE Delft[5] shows that, given the same destination, aviation costs are more internalised than train or bus costs. However, taxes and levies for travel by aircraft, train and bus are lower than the actual external and infrastructure costs.

For climate policy on aviation, it is important that costs for the aviation sector contribute as much as possible to achievement of the climate targets. The costs of government policy will be reported periodically and their contribution to achieving the climate targets will be weighed. As described above under the heading 'Focus in the measures', the government's main focus is on measures that contribute directly to $CO_2$ emissions reduction in the aviation sector.

To that end, the government is exploring options for a voluntary surcharge on tickets for business travellers and passengers with package deals. These funds could be used to finance national innovation projects that contribute to increased sustainability in aviation. The government is negotiating a green deal to this end with parties in the aviation sector, employers and companies that offer business travel and package tours.

The guiding principle for the government is that the aviation sector should in principle pay for the measures that are needed to achieve the sector's climate targets. In the upcoming period, the government will be talking to the aviation sector about how it plans to achieve and finance action on the climate targets.

#### Dealing with uncertainty

There is a very real chance that climate targets and measures will become more ambitious between now and 2050, both globally and in neighbouring surrounding countries, although the government cannot currently predict the extent and timing. Emissions of greenhouse gases other than $CO_2$ are also likely to be included in international climate policy for the aviation sector. Finally, the pace and scale at which sustainable fuels and new aircraft designs and engines will reduce $CO_2$ emissions are still uncertain. Various studies have looked at the effects under different scenarios.[3,6] This demands an adaptive climate policy for the aviation sector.

### 5.2.2 Sustainable Aviation Agreement

#### Government response

The letter to parliament of 27 March 2019 stated that the government's response to the Sustainable Aviation Agreement will be set out in the Civil Aviation Policy Memorandum.[7] The government has decided to incorporate the Agreement in this Civil Aviation Policy Memorandum , particularly the targets for $CO_2$ emission reduction and the concrete agreements on sustainable fuels and electrification of the aviation sector.

Scope for flexibility is provided through adaptive measures, since the pace of technological progress is difficult to predict. The government considers it important at this time to safeguard the goals and implement the Agreement, doing more where possible and advocating more ambitious international agreements on climate targets and instruments. See also section 5.1 'The climate challenge' and the description under the heading 'More ambitious international climate targets and instruments' in section 5.2.3.

#### Continuation of the Sustainable Aviation Table

The Sustainable Aviation Agreement was concluded in March 2019 by the Sustainable Aviation Table, a consultative body whose members include the Ministry of Infrastructure and Water Management, sector parties, knowledge institutions, industry bodies and civil society organisations.

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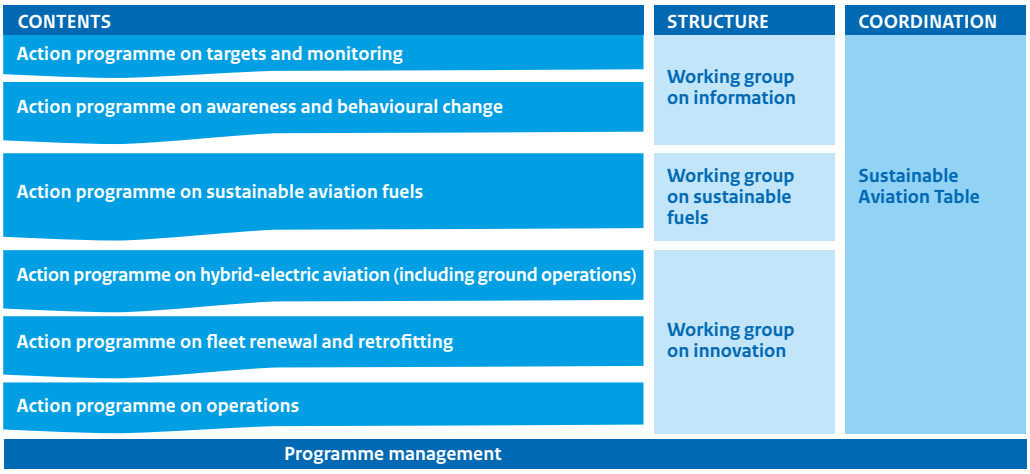
5 *CE Delft. November 2019. Costs of air travel. https://www.rijksoverheid.nl/documenten/rapporten/2019/11/18/rapport-de-prijs-van-een-vliegreis-van-ce-delft*

6 *Netherlands Environmental Assessment Agency (PBL). May 2019. Paris agreement and aviation. https://www.pbl.nl/publicaties/parijsakkoord-en-luchtvaart*

7 *Note: this document is a translation of chapter 5 of the 'Luchtvaartnota', which translates to the Civil Aviation Policy Memorandum. The full document was published on the 20th of November 2020. Only the summary and this chapter have currently been translated.*

In the coming period, the Sustainable Aviation Table will continue its work, with a focus on implementing the agreement. Activities addressing specific themes or thematic clusters will be brought together in action programmes, and participants will draw up plans for each action programme. The participants will discuss progress on the programmes in working groups. The Sustainable Aviation Table will monitor and coordinate the overall process. In implementing the Sustainable Aviation Agreement, scope for flexibility is provided through an adaptive approach. The approach is depicted in the figure below.

**Figure 5.2 Approach for implementing the Sustainable Aviation Agreement**




An important element in implementing the agreement is ensuring funding for the activities in order to achieve the climate targets and to accelerate efforts where possible. The government will determine specific amounts and financing mechanisms based on the action programmes. Besides the deployment of existing instruments, new ones will also be considered in order to support the ambitions of the public-private partnership.

### 5.2.3 Supplementary measures

#### More ambitious international climate targets and instruments

The International Civil Aviation Organization (ICAO), a specialised agency of the United Nations, is working on a long-term goal for $CO_2$ emissions reduction, as agreed at the three-yearly ICAO general assembly in September-October 2019, in part following a concerted EU effort. Various options will be developed in the run-up to the next general assembly in 2022. Global dynamics make this a highly politicised and precarious process, The new ICAO Council, on which the Netherlands will have a seat for the next three years, has laid down the process.

The Council has asked the ICAO Committee on Aviation Environmental Protection (CAEP) to offer advice on this matter. The Netherlands has a permanent seat on the Committee's steering group and also participates in various technical working groups. The government will be dedicating extra attention to these efforts in the coming years, together and in consultation with other European countries and the European Commission. Where necessary, the government will ask parties to the Sustainable Aviation Table for their technical expertise and other parties in the sector to send supportive messages to their international umbrella organisations.

At the same time, the Netherlands supports the global effort to establish CORSIA as a carbon offsetting mechanism. The aim is to ensure that it functions as well and as effectively as possible, and to create or maintain support for that system among other countries. Beyond that, the Netherlands aims to use CORSIA, and particularly the $CO_2$ emissions ceiling, to safeguard achievement of its long-term climate targets.

The European Commission will conduct a coherent review of both the global CORSIA system and the EU ETS with a view to maximising their effectiveness in $CO_2$ emission reduction. A decision on how to continue the EU ETS will have to be reached before 31 December 2023, when the current directive expires. The Netherlands is taking part in this European process and advocates a logical and effective combination of these two systems, which are both based on market forces.

The Netherlands will propose concrete measures to the new European Commission for greening the aviation sector, which could be included in the European Green Deal that is currently being developed. The Netherlands would prefer to act as part a leading group of likeminded member states. Developing sustainable fuels and promoting their use is a priority for the Netherlands. A blending obligation is one of the options on the table. In addition, the Netherlands wants European innovation programmes to facilitate radical innovation to accelerate the greening of aviation.

The Netherlands also strives for EU agreements regarding aviation pricing. To that end, the Netherlands has joined with nine European countries in a statement calling on the European Commission to establish aviation pricing. Since aviation is a global sector, the Netherlands will also join forces with other European countries to raise the issue of pricing on the international level. An international approach will ultimately result in a greater reduction of $CO_2$ emissions.

### Safeguarding the climate targets

Where possible the government will put safeguards in place to ensure achievement of the $CO_2$ emission reduction targets for international flights from the Netherlands, as set out in the Sustainable Aviation Agreement and based on the volume of fossil fuel (bunker fuels) uplifted in the Netherlands. The same will be done for the $CO_2$ emission targets from domestic aviation and ground operations.

The government is looking at how achievement of $CO_2$ emission reduction targets for the Netherlands can be ensured, and whether it is possible to use the European Green Deal or a system similar to that defined in the Climate Act. The government is exploring whether limit values for $CO_2$ emissions for each civil airport can be laid down in legislation regulating airports and aviation, and what the basis of such

a ceiling should be. If this is possible, $CO_2$ emissions would become part of the framework regulating the development of Dutch civil airports, just as the noise limits and requirements concerning safety and security. Within these parameters, the aviation sector could earn growth.

Future environmental impact assessments for civil airports will have to provide insight into $CO_2$ emissions for the entire duration of outbound flights up to the intended destinations. The government is still working out the frameworks for monitoring, supervision and enforcement.

### Sustainable fuel blends

The goal is for 14% of all aviation fuel uplifted in the Netherlands to be sustainable by 2030 and increasing to 100% by 2050, as agreed by the parties to the Sustainable Aviation Table. This will require large quantities of sustainable fuels in the short term, such as renewable biofuels and synthetic kerosene. Currently, however, there is only limited demand for sustainable fuels among airlines, because they are more expensive than fossil fuels and therefore only used occasionally.

The price of biofuel is currently two to three times higher than for fossil fuels, while synthetic kerosene is four to six times as expensive. Due to uncertainty about market demand, fuel companies are hesitant to scale up production sufficiently. In the short term and medium term, government policy will encompass both sustainable biofuels and synthetic kerosene. Sustainable synthetic kerosene has high potential for the medium term so the government will continue promoting and incentivising developments related to synthetic kerosene. Both routes – sustainable biofuels and synthetic kerosene – will be needed if the aviation sector is to significantly reduce its own emissions in the short and medium term.

With a market share of nearly 50% in western Europe, the Netherlands plays a key role in kerosene production and trade. With its chemical industry, infrastructure (pipelines), airports and maritime ports, and knowledge institutions, the Netherlands is perfectly placed to play a leading role in growing the market for sustainable renewable fuels and becoming a major European supplier of sustainable alternative fuels. This is expected to yield economic advantages and new employment opportunities.

In the context of the Green Deal, the Netherlands will actively promote the introduction of a European obligation to blend conventional aviation fuel with sustainable aviation fuels, including sustainable biofuels and synthetic kerosene. If an EU blending obligation cannot be laid down in good time, the Netherlands aims to introduce a national blending obligation in 2023. An important consideration here is the availability of sufficient sustainable biomass and renewable electricity for the production of sustainable biofuels for the aviation sector. The greening of the aviation sector by means of biofuels will be implemented in accordance with the sustainability framework for biofuels. In addition, the use of sustainable fuels must not lead to increased emissions of nitrogen oxides ($NO_x$) and particulates (fine and ultrafine particulate matter).

### New aircraft designs and engines

New aircraft designs and new types of propulsion are needed to reduce $CO_2$ emissions from aviation. The Dutch aviation industry is part of an internationally operating sector. More fundamental and applied research is needed to identify the possibilities offered by radical innovations. That takes time – as does the process of certification for safety requirements and phased commissioning of new aircraft.

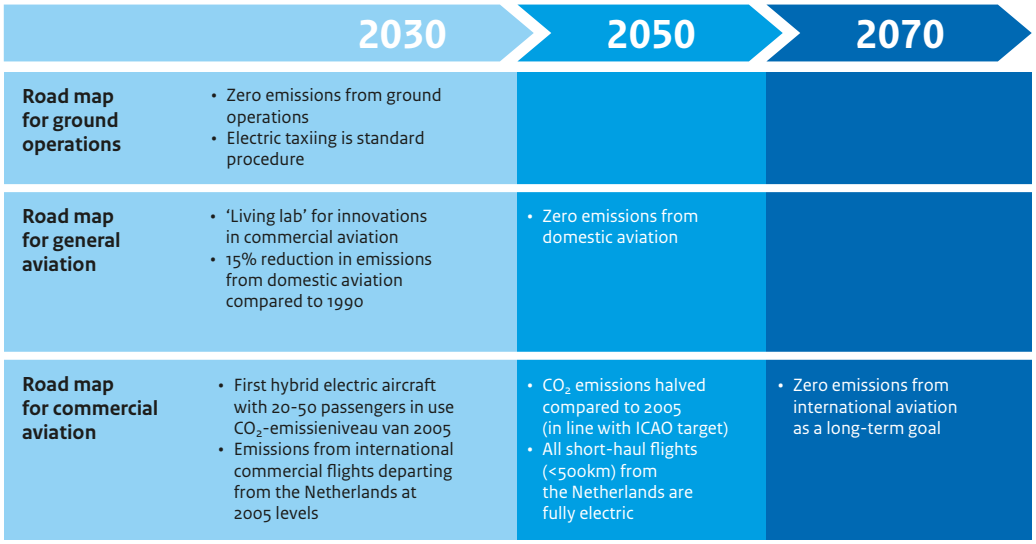
The long development horizon, payback period and uncertainty about which technology will ultimately be applied makes investment difficult for private parties. As achieving the climate targets is in the public interest it is necessary to accelerate a wide range of innovations in the areas of aircraft design and propulsion, also in the Netherlands.

The Netherlands has traditionally been a strong, innovative and enterprising player in aviation. The influence of parties like Fokker, KLM, Schiphol Amsterdam Airport, Delft University of Technology and the Royal Netherlands Aerospace Centre (NLR) on the aviation sector extends far beyond our national

borders — a strong position that will be leveraged to accelerate innovations, as agreed in the Sustainable Aviation Table.

The Netherlands wants to be an international leader in hybrid-electric aviation by 2030, enabling the Dutch knowledge infrastructure and manufacturing industry to contribute to the design of new aircraft with improved aerodynamics, materials, components, power trains and energy storage. The government is working with the private sector and with knowledge and research institutions on the Action Programme for Hybrid-Electric Aviation (AHEV). The programme also examines the scope for electrification of general aviation and ground operations. It will form the basis of a biennial working programme, reporting annually to the Sustainable Aviation Table. The Action Programme will be reviewed every five years.

**Figure 5.3 Ambitions for Sustainable Aviation**




Based on the Action Programme, the government and private parties will put innovation on the agenda on the national and European levels and in the framework of ICAO. The parties also encourage debate and foster dialogue between knowledge and research institutions, sector organisations, the aviation sector and civil society organisations. The government is also working on knowledge exchange and certification for general aviation and, where possible, it will be the launching customer for specific innovations.

By including the Sustainable Aviation Agreement in this Civil Aviation Policy Memorandum, the government has affirmed the importance of a joint approach.

### Developing an approach for non-$CO_2$ greenhouse gas emissions

The government wants more information about the emissions of greenhouse gases other than $CO_2$ and their climate impact, so that those emissions can eventually also be addressed in climate policy for the aviation sector. There is still a great deal of scientific uncertainty about the origin, behaviour and climate impact of the following substances:

- water vapour ($H_2O$)
- nitrogen oxides ($NO_x$)
- sulphur oxides ($SO_x$)
- carbon monoxide (CO)
- hydrocarbons (HC)
- fine particulates (including soot).

These emissions contribute to global warming, partly in direct ways and partly in indirect ways, for example by forming condensation trails and clouds, ozone ($O_3$), methane ($CH_4$) and aerosols (fine particles of dust or liquid that float suspended in the air). How these greenhouse gas (GHG) emissions are created and their climate impact depends on atmospheric conditions, such as the time and location of the emissions (geographic location, altitude and temperature).

Some advocate a calculation factor that derives the climate impact of non-$CO_2$ GHG emissions from the level of $CO_2$ emissions, as used in certain social cost-benefit analyses (SCBAs). However, there is no (proportional) correlation between $CO_2$ emissions and the climate impact of non-$CO_2$ GHG emissions at this time. Moreover, non-$CO_2$ GHG emissions only have a climate impact at high cruising altitudes and are relatively short-lasting (a few days to a maximum of 10 years), whereas $CO_2$ has the same climate impact at any altitude and persists in the atmosphere for centuries.

More research (nationally and internationally) is needed to gauge the scope and climate impact of non-$CO_2$ GHG emissions. The Netherlands contributes to the international body of knowledge through the Netherlands Aerospace Centre (NLR) and the Royal Netherlands Meteorological Institute (KNMI). The Netherlands also hosted an international symposium on this theme in 2019. In the upcoming period, the government will investigate whether it is possible to achieve a reliable estimate of the climate impact of non-$CO_2$ GHG emissions and how such impacts can be incorporated into climate policy for the aviation sector.

In 2020 the European Commission will present an analysis of aviation's effects in terms of non-$CO_2$ GHG. The Ministry of Infrastructure and Water Management will consult with the European Commission to determine possible further steps. Section 5.2.2, heading 'Continuation of the Sustainable Aviation Table, describes the action programmes being developed by that consultative body. The action programme on targets and monitoring will determine how the Sustainable Aviation Table can contribute to an approach to non-$CO_2$ GHG emissions.