Carbon Performance assessment of airlines: note on methodology

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Transition Pathway Initiative

LSE

Grantham Research Institute on Climate Change and the Environment

About the LSE Transition Pathway Initiative Centre

The Transition Pathway Initiative Centre (TPI Centre) is an independent, authoritative source of research and data on the progress of corporate and sovereign entities in transitioning to a low-carbon economy.

The TPI Centre is part of the Grantham Research Institute on Climate Change and the Environment, which is based at the London School of Economics and Political Science (LSE). It is the academic partner of the Transition Pathway Initiative (TPI), a global initiative led by asset owners and supported by asset managers, aimed at helping investors assess companies' preparedness for the transition to a low-carbon economy and supporting efforts to address climate change. As of October 2024, over 150 investors globally, representing over US$80 trillion combined Assets Under Management and Advice, have pledged support for TPI.[1]

The TPI Centre provides research and data on publicly listed equities, corporate bond issuers, banks, and sovereign bond issuers. The TPI Centre's company data:

- Assess the quality of companies' governance and management of their carbon emissions and of risks and opportunities related to the low-carbon transition.
- Evaluate whether companies' current and planned future emissions are aligned with international climate targets and national climate pledges, including those made as part of the Paris Agreement.
- Form the basis for the Climate Action 100+ Net Zero Company Benchmark Disclosure Framework assessments.
- Are published alongside the methods online and fully open access at www.transitionpathwayinitiative.org.

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[1] This figure is subject to market price and foreign exchange fluctuations and, as the sum of self-reported data by TPI supporters, may double count some assets.

Contents

1. The TPI Centre's use of the Sectoral Decarbonisation Approach (SDA)

The TPI Centre's Carbon Performance assessments to date have been predominantly based on the Sectoral Decarbonisation Approach (SDA).[2] The SDA translates greenhouse gas emissions targets made at the international level (e.g. under the 2015 UN Paris Agreement) into appropriate benchmarks, against which the performance of individual companies can be compared.

The SDA recognises that different sectors of the economy (e.g. oil and gas production, electricity generation and automobile manufacturing) face different challenges arising from the low-carbon transition, including where emissions are concentrated in the value chain and how costly it is to reduce emissions. Other approaches to translating international emissions targets into company benchmarks have applied the same decarbonisation pathway to all sectors, regardless of these differences [1]. Such approaches may result in suboptimal insights, as not all sectors have the same emissions profiles or face the same challenges: some sectors may be capable of faster decarbonisation, while others require more time and resources.

Therefore, the SDA takes a sector-by-sector approach, comparing companies within each sector against each other and against sector-specific benchmarks, which establish the performance of an average company that is aligned with international emissions targets.

The SDA can be applied by taking the following steps:

- A global carbon budget is established, which is consistent with international emissions targets, for example keeping global warming below 2°C. To do this rigorously, some input from a climate model is required.
- The global carbon budget is allocated across time and to different regions and industrial sectors. This typically requires an integrated assessment model (IAM), and these models usually allocate emissions reductions by region and by sector according to where it is cheapest to reduce emissions and when. Cost effectiveness is, however, subject to some constraints, such as political and societal preferences, and the availability of capital. This step is therefore driven primarily by economic and engineering considerations, but with some awareness of political and social factors.
- In order to compare companies of different sizes, sectoral emissions are normalised by a relevant measure of sectoral activity (e.g. physical production or economic activity). This results in a benchmark pathway for emissions intensity in each sector:

$$\text{Emissions intensity} = \frac{\text{Emissions}}{\text{Activity}}$$

- Assumptions about sectoral activity need to be consistent with the emissions modelled and therefore should be taken from the same economy–energy modelling where possible.

[2] The Sectoral Decarbonisation Approach (SDA) was created by CDP, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF) in 2015. See Science-Based Targets Initiative [SBTi]: https://sciencebasedtargets.org/resources/files/Sectoral-Decarbonization-Approach-Report.pdf

- Companies' recent and current emissions intensity is calculated, and their future emissions intensity is based on emissions targets they have set (this assumes companies meet their targets).[3] Together, these establish emissions intensity pathways for companies.
- Companies' emissions intensity pathways are compared with each other and with the relevant sectoral benchmark pathway.

[3] Alternatively, companies' future emissions intensity could be calculated based on other data provided by companies on their business strategy and capital expenditure plans.

2. Applying the SDA to the airlines sector

2.1. Deriving the benchmark pathways

The TPI Centre evaluates companies against benchmark pathways, which translate the emission reductions required by the Paris Agreement goals into a measurable trajectory at the sectoral level. For each sector benchmark path, the key inputs are:

- A timeline for greenhouse gas emissions that is consistent with meeting a particular climate target (e.g. limiting global warming to 1.5°C) by keeping cumulative carbon emissions within the associated carbon budget.
- A breakdown of this economy-wide emissions pathway into emissions from key sectors (the numerator of sectoral emissions intensity), including the sector in focus.
- Consistent estimates of the timeline of physical production from, or economic activity in, these key sectors (the denominator of sectoral emissions intensity).

There are various models available that provide sector-specific emissions pathways and estimates of sectoral activity, under various scenarios.[4] These emissions pathways can be divided by activity to derive sectoral pathways for emissions intensity.

In the case of airlines, the focus of TPI's Carbon Performance assessment is on the airline sector as a whole, including international and domestic aviation, and both passenger and freight transport.

TPI uses inputs from the IEA via its Energy Technology Perspectives 2020 (ETP 2020) [2], Net Zero by 2050 (NZE 2050) [18] and World Energy Outlook (WEO) 2023 [19] reports. IEA modelling includes a specific module for the transport sector, the Mobility Model (MoMo) [2]. This provides projections of energy demand, carbon emissions and transport activity for each mode of transport, including air transport, under various scenarios. In addition, TPI uses activity data and forecasts from the International Civil Aviation Organisation [20] [21], to complement the benchmarks with freight activity data.

The IEA's work can be used to derive three benchmark emissions intensity pathways, against which airline companies are evaluated by TPI.

The three benchmarks employed for the airline sector are:

- An International Pledges scenario, which is consistent with the global aggregate of emissions reductions related to policies introduced or under development as of mid-2023. According to the IEA, this scenario does not take for granted that all government targets will be achieved. Instead, it takes a granular, sector-by-sector look at existing policies and measures. This scenario gives a probability of 50% of holding the global temperature increase to 2.4°C by 2100 [2].
- A Below 2°C scenario, which is consistent with the overall aim of the Paris Agreement to limit warming, albeit at the lower end of the range of ambition. This scenario gives a probability of 50% of holding the global temperature increase to 1.7°C by 2100 [2].
- A 1.5°C scenario, which is consistent with the overall aim of the Paris Agreement to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels" [22]. This scenario gives a probability of 50% of holding the global temperature increase to 1.4°C by 2100 [18].

2.2. Benchmark emissions reduction pathways

The measure of emissions intensity that TPI uses to derive benchmark pathways in the airline sector is the tank-to-wheel (TTW) CO_2 emissions (from conventional jet fuel only) in grams per revenue tonne kilometre (RTK). In its ETP2020, WEO2023 NZE 2050 reports, IEA directly provides TTW CO_2 emission projections from the aviation sector.

Figure 2.1. shows the benchmark emissions intensity pathways for the airline sector, while Table 2.1 provides the underlying data on emissions and air traffic, expressed as RTKs. For example, under the International Pledges scenario in 2030, total global TTW emissions from the airline sector (including both domestic and international aviation) are projected to be 1,195 million metric tonnes or megatonnes (Mt) of CO_2. Under the same scenario in 2030, total RTKs (for both passenger and freight transport) are projected to be 1,488 billion (assuming each passenger is equivalent to 95 kg). Therefore, the average carbon intensity of an airline aligned with the International Pledges path is 1,195 / 1,5488 = 0.802 megatonnes of CO_2 per RTKs. This equates to 802 grams of CO_2 per RTK. Note that figures used for 2020–2025 are consistent across all three scenarios, to reflect the short-term impact of the COVID-19 pandemic.

Figure 2.1. Benchmark global carbon intensity pathways for the airline sector

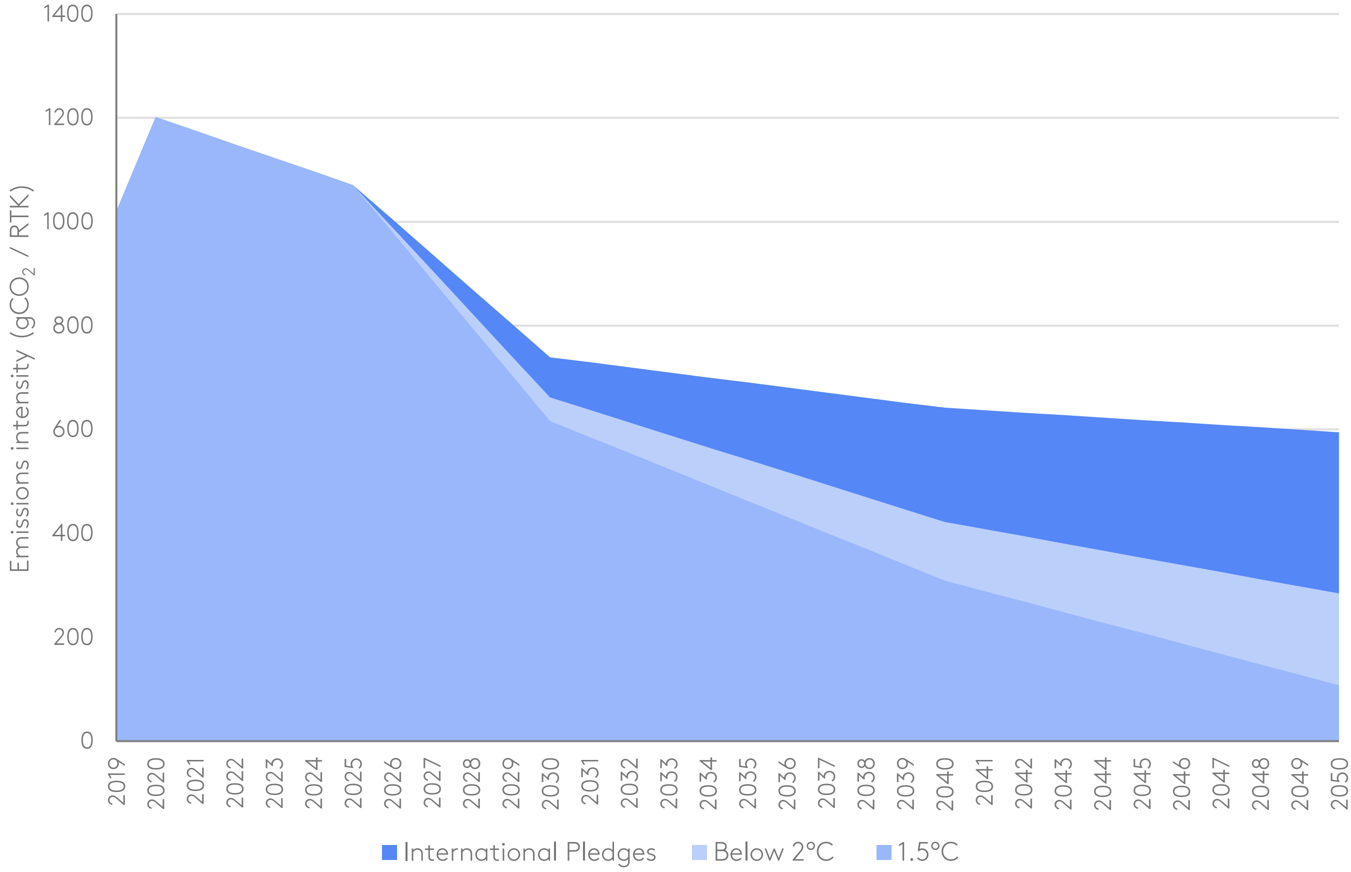


Table 2.1. Projections of emissions and tonne kilometres (passenger and freight) used to calculate emissions intensity benchmarks

	2020	2030	2040	2050
International Pledges				
TTW CO_2 emissions (Mt)	606	1,195	1,415	1,583
Passenger tonne kilometres (billions)	2,780	12,198	16,061	20,388
Freight tonne kilometres (billions)	231	330	470	669
Total revenue tonne kilometres (billions)	495	1,488	1,995	2,606
Carbon intensity (gCO_2 / RTK)	1,221	802	708	607
Below 2°C				
TTW CO_2 emissions (Mt)	605	1,129	1,097	979
Passenger tonne kilometres (billions)	2,780	12,097	15,890	20,313
Freight tonne kilometres (billions)	231	329	468	666
Total revenue tonne kilometres (billions)	495	1,478	1,978	2,596
Carbon intensity (gCO_2 / RTK)	1,222	763	554	377
1.5°C				
TTW CO_2 emissions (Mt)	605	932	544	208
Passenger tonne kilometres (billions)	2,780	10,969	12,843	16,545
Freight tonne kilometres (billions)	231	304	400	526
Total revenue tonne kilometres (billions)	495	1,346	1,620	2,097
Carbon intensity (gCO_2 / RTK)	1,222	692	342	99

3. Carbon Performance assessment of airlines

3.1. Calculating company emissions intensities

TPI Centre's Carbon Performance assessments are based on public disclosures by companies. Disclosure that is useful to our assessments tends to come in one of three forms:

1. Emissions intensity. Some companies disclose their emissions intensity and some companies have also set future emissions targets in intensity terms. Provided these are measured in a way that can be compared with the benchmark scenarios and with other companies (e.g. in terms of scope of emissions covered and measure of activity chosen), these disclosures can be used directly. In some cases, adjustments need to be made to obtain estimates of emissions intensity on a consistent basis. The necessary adjustments will generally involve sector-specific issues (see below).
2. Absolute emissions. Some companies disclose their emissions on an absolute (i.e. un-normalised) basis. Provided emissions are appropriately measured, and an accompanying disclosure of the company's activity can be found that is also in the appropriate metric, historical emissions intensities can be calculated.
3. Absolute emission targets. Some companies set future emissions targets in terms of absolute emissions. This raises the particular question of what to assume about those companies' future activity levels. The approach taken by the TPI Centre is to assume company activity increases at the same rate as the sector as a whole (i.e. assuming a constant market share), using sectoral growth rates from the same model that is used to derive the benchmark pathways, in order to be consistent. While companies' market shares are unlikely to remain constant, there is no obvious alternative assumption that can be made, that treats all companies consistently. Sectoral growth rates from the International Pledges Scenario (based on IEA's Stated Policies Scenario) are used.

The length of companies' emissions intensity pathways will vary depending on how much information companies provide on their historical emissions and the time horizon for their emissions reduction targets.

3.2. Emissions reporting boundaries

Companies disclose emissions using different organisational boundaries. There are two high-level approaches: (i) the equity share approach and (ii) the control approach, within which control can be defined as financial or operational. Companies are free to choose which organisational boundary to set in their voluntary disclosures, and there is variation across the companies assessed by the TPI Centre.

The TPI Centre accepts emissions reported using any of the above approaches to setting organisational boundaries, as long as:

- The boundary that has been set appears to enable a representative assessment of the company's emissions intensity.
- The same boundary is used for reporting company emissions and activity, to obtain a consistent estimate of emissions intensity.

Currently, limiting the assessment to one particular type of organisational boundary would severely restrict the breadth of companies that can be assessed.

When companies report historical emissions or emissions intensities using both equity share and control approaches, a reporting boundary is chosen based on which method provides the longest available time series of disclosures or is the most consistent with disclosure on activity and any targets.

3.3. Data sources and validation

All TPI Centre's data are based on companies' own disclosures. The sources for the Carbon Performance assessment include responses to the annual CDP questionnaire, as well as companies' own reports, e.g. sustainability reports.

Given that our Carbon Performance assessment is both comparative and quantitative, it is essential to understand exactly what the data in company disclosures refer to. Company reporting varies not only in terms of what is reported but also in terms of the level of detail and explanation provided. The following cases can be distinguished:

- Companies that provide data in a suitable form and with enough detail for analysts to be confident that appropriate measures can be calculated or used.
- Companies that provide enough detail in their disclosures, but not in a form that is suitable for the assessment (e.g. they do not report the measure of company activity needed). These companies cannot be included in the assessment.
- Companies that do not provide enough detail on the data disclosed (e.g. the company reports an emissions intensity estimate but does not explain precisely what it refers to). These companies are also excluded from the assessment.
- Companies that do not disclose their greenhouse gas emissions or activity.

Once a preliminary Carbon Performance assessment has been made, it is subject to the following procedure to provide quality assurance:

- Internal review: the preliminary assessment is reviewed by an analyst who was not involved in the original assessment.
- Company review: the reviewed assessment is sent to the company, which has the opportunity to review it and confirm the accuracy of the disclosures used. This review includes all companies, including those who provide unsuitable or insufficiently detailed disclosures.
- Final assessment: feedback from the company is reviewed and incorporated if it is considered appropriate. Only information in the public domain can be accepted as a basis for any change.

3.4. Responding to companies

Giving companies the opportunity to review their Carbon Performance assessments is an integral part of the TPI Centre's quality assurance process. Each company receives its draft assessment and the data that underpins the assessment, offering them the opportunity to review and comment on the data and assessment. We also allow companies to contact us at any point to discuss their assessment.

If a company seeks to challenge its result or representation, our process is as follows:

- The TPI Centre reviews the information provided by the company. At this point, additional information may be requested.
- If it is concluded that the company's challenge has merit, the assessment is updated.
- If it is concluded that there are insufficient grounds to change the assessment, the original assessment is published.
- If the company requests an explanation regarding its feedback after the publication of its assessment, the TPI Centre explains the decisions taken.
- If a company requests an update of its assessment based on data publicly disclosed after the research cut-off date communicated to the company, the new disclosure is noted. For corrections, we take this into consideration immediately, whereas general assessment updates will be incorporated in the next assessment cycle.

If a company chooses to further contest the assessment and reverts to legal means to do so, the company's assessment is withheld from the TPI Centre website and the company is identified as having challenged its assessment.

3.5. Presentation of assessment on the TPI Centre website

The results of the Carbon Performance assessments are posted on the TPI Centre's online tool (www.transitionpathwayinitiative.org/tpi/sectors). On each company page, its emissions intensity pathway is plotted on the same chart as the benchmark pathways for the relevant sector. Different companies can also be compared on the toolkit main page, with the user free to choose which companies to include in the comparison.

4. Specific considerations in the assessment of airlines

4.1. Measure of emissions intensity

In applying the SDA to the airlines, a significant portion of lifecycle emissions stem from the combustion of fuel itself. Therefore, the scope of a company assessment should include emissions from direct operational emissions (i.e. Scope 1).

Hence, in the airlines sector, the specific measure of emissions intensity used by TPI is:

- Tank-to-wheel (TTW) CO_2 emissions (from conventional jet fuel only) in grams per revenue tonne kilometre (RTK).
- The calculation of emissions intensity benchmarks for airlines requires suitable measures of both air transport activity and carbon emissions. The two main metrics for air transport activity used in the airline industry are:
- 'Passenger kilometres' or 'revenue passenger kilometres' (or RPKs), which is the total number of paying passengers multiplied by the distance flown.
- 'Revenue tonne kilometres' (or RTKs), which is the total number of revenue-generating tonnes of both passengers and freight multiplied by the distance flown.

The IEA uses RPKs as its activity metric. However, TPI uses RTKs, otherwise the Carbon Performance of individual airlines with freight businesses that are significantly larger or smaller than average can be distorted. To include freight in the activity metric we:

1. Convert the RPKs provided in the IEA model for each scenario to equivalent RTKs, using a conversion factor of 95 kilograms per passenger.[4] This is consistent with the assumptions of the IEA's 2020 Energy Technology Perspectives, ICAO's 2018 Annual Report, and the majority of airlines' own reporting practices.
2. Use ICAO's freight (and mail)[5] transport statistics (in RTKs) for 2019 and 2020 [21], as well as future projections to 2050, to derive freight activity as follows:
   i. For the International Pledges scenario, applying ICAO's projected average mid-range post-COVID annual growth rate for freight traffic of 3.6% between 2018 and 2050 (used as a proxy for 2019–2050) [20].
   ii. For the Below 2°C scenario, assuming that the freight traffic growth rate is proportionately different to passenger activity growth rate between the Below 2°C and International Pledges scenarios. This assumption results in an annual freight and mail traffic growth rate of 3.17% between 2019 and 2050.
   iii. For the 1.5°C scenario, assuming that the freight traffic growth rate is proportionately different to passenger activity growth rate between the 1.5°C and International Pledges scenarios. This assumption results in an annual freight and mail traffic growth rate of 2.27% between 2019 and 2050.
3. Summing the passenger RTKs and freight RTKs calculated in (1) and (2) above to obtain an activity metric for the airline sector of equivalent RTKs.

[4] In our previous aviation methodology note, published in October 2019, we used the conversion of 150kg per passenger. This conversion factor takes account of the mass of passengers and their luggage (estimated to be 100kg, on average) plus an additional 50kg, to include the mass of infrastructure required to transport passengers (such as seats, the galley, toilet facilities, and so on).

Emissions boundaries

In addition to an activity metric, the calculation of emissions intensity benchmarks requires an appropriate measure of carbon emissions. This varies by sector and depends on where emissions occur in the value chain. In the airline sector, the majority of lifecycle emissions arise from jet fuel combustion. These so-called 'Tank-to-Wheel' (TTW) emissions represent around 84% of total lifecycle (or well-to-wheel [WTW]) fuel emissions, the balance being upstream (well-to-tank) emissions occurring during fossil fuel extraction, refining and distribution [12]. Emissions from jet fuel combustion are reported by airlines under Scope 1 and are sometimes referred to as 'flight-only' or 'aircraft' emissions. Other emissions reported by airlines in Scope 1 relate to ground operations, but these are generally minimal (around 1% of total Scope 1 emissions). Airlines' Scope 2 emissions, which include emissions from purchased electricity, are also minimal (generally less than 1% of total Scope 1+2 emissions). Thus, jet fuel TTW or flight-only emissions are an appropriate measure of Carbon Performance in this sector, as they represent the majority of emissions within the scope of influence of airlines' sustainability policies. This is also consistent with IEA data, which exclude emissions from ground vehicles and electricity used in the air transport sector.

For each of its scenarios, the IEA model provides total TTW emissions projections for the air transport sector. The figures include full lifecycle emissions from conventional jet fuel, in addition to those from sustainable biofuels. Biofuels' share of total air transport energy demand is currently very small (around 0.1%), but it is projected to grow significantly in the coming decades. Emissions from combustion of biofuels (i.e. TTW emissions) are similar to those from conventional jet fuel combustion, but airlines apply a CO_2 emissions factor of zero for the combustion of biofuels. This is in line with the UNFCCC reporting guidelines, which recommend that biofuel emissions at the point of use are reported as zero in the energy sector. The assumption here is that negative emissions during the growing stage of the biofuel offset the emissions from combustion. It should be noted, however, that additional emissions occur in the feedstock production, processing, and distribution stages, resulting in net positive lifecycle emissions from biofuels [12]. Nevertheless, for comparability with emissions data currently reported by airlines, TPI assumes TTW emissions from biofuels are zero.

Thus, the measure of emissions intensity that TPI uses to derive benchmark pathways in the airline sector is the Tank-to-Wheel (TTW) CO_2 emissions (from conventional jet fuel only) in grams per revenue tonne kilometre (RTK).

Finally, we note that the COVID-19 pandemic dramatically increased company emissions intensities in 2020, while dramatically decreasing the sector's absolute emissions. This has led to a readjustment of the carbon budget allocated to the sector. COVID is having a persistent negative short-term impact on aviation activity and emissions levels. As underlying IEA scenario data is given in 10-year intervals, simple linear interpolation of emission intensity from 2019 to 2030 would not reflect the true state of the sector's emissions. IEA's NZE 2050 report provides a peak emissions estimate of 950 Mt in 2025 [18]. We use that figure, as well as NZE interpolated activity between 2020 and 2030, to calculate the benchmark intensity in 2025. Assuming that the shorter-term aviation activity recovery will be the same across scenarios, we keep the same projected intensity in 2019–2025 for all three scenarios. Note that figures used for 2020–2025 are consistent across all three scenarios, to reflect the short-term impact of the COVID-19 pandemic.

The benchmark pathways above take account of CO_2 emissions only. A critical point to note is that aviation has climate-change impacts that go beyond CO_2 emissions, which result from aircraft flying at high altitude. These impacts include the warming caused by nitrogen oxides (NOx) and water vapour emissions, and by the formation of contrails and increased cirrus cloudiness [14]. There is generally high uncertainty over the radiative forcing from non-CO_2 effects, but they are estimated to be significant and may double the overall climate change impact of aviation [14]. Furthermore, a recent study found that the radiative forcing effect specifically of contrail cirrus is expected to increase faster in the future than that due to CO_2 emissions. This is because the effects on cirrus cloud formation of growth in air traffic and change in traffic patterns (such as shifts to higher altitudes), will not be offset by the expected small reductions in radiative forcing from contrail cirrus as a result of factors such as reduced soot emissions from alternative fuels [15]. For now, TPI's analysis does not take into account the non-CO_2 impacts of aviation, due to the current uncertainty in quantifying them, but if these impacts were to be taken into account the TPI benchmarks would almost certainly be tighter. This issue is currently under review.

4.2. Calculating airlines' historic and current emissions intensities

Airlines report emissions in various ways. While some provide a breakdown of Scope 1 emissions from flight and ground operations, others do not provide this split. A small number of airlines do not provide a breakdown of total emissions between Scope 1 and 2. In these cases, in the absence of further information and given that emissions from jet fuel combustion make up more than 98% of all Scope 1 and 2 emissions, TPI takes the total Scope 1 emissions reported (or total Scope 1 and 2 emissions, where applicable) as being all jet fuel emissions.

The greenhouse gas emissions reported by airlines also vary, with some providing CO_2 emissions separately, while others report all greenhouse gas emissions in equivalent tonnes of CO_2. IEA provides an estimate of CO_2 emissions only. The non-CO_2 emissions reported by airlines (such as methane and nitrous oxide) are very small, typically less than 1% of airlines' total greenhouse gas emissions, so TPI allows the comparison of emissions intensities expressed in terms of all greenhouse gases, as reported by some airlines, with the CO_2-only benchmark intensities.

Another variation between airlines relates to the coverage of flight operations included in Scope 1 emissions. Some airlines operate regional services through third-party partners and emissions from those flights are generally reported under Scope 3 as indirect emissions. In several cases, these emissions represent around 10–15% of an airline's total flight emissions. For such airlines, TPI calculates the emissions intensity to ensure consistency with the activity figures reported by the airline. Thus, if the passenger and freight activity data include third-party flights, then the emissions from those operations are also included in the carbon intensity calculation.

Airlines also report their activity in a number of ways. Frequently, an airline's passenger and freight activity are reported separately, in terms of passenger kilometres and freight tonne kilometres, respectively. In such cases, TPI converts the reported passenger kilometre figures to tonne kilometres using the same conversion factor as used for the benchmarks (i.e. assuming each passenger is equivalent to 95 kg). The resulting passenger tonne kilometres are added to the airline's reported freight tonne kilometres, to obtain total RTKs. This is then combined with the reported flight emissions to calculate the airline's carbon intensity.

Some airlines report their activity in terms of total RTKs transported (including passenger and freight activity). In those cases, TPI assumes airlines use a conversion factor of around 90–95 kg per passenger and therefore directly uses the reported RTKs to calculate the airline's carbon intensity.

Some airlines, particularly low-cost carriers, report only RPKs but no freight activity data. In such cases, TPI assumes that the airline has no freight transport business and converts RPKs to RTKs, assuming 95 kg per passenger.

In a small number of cases, airlines report only carbon intensity, expressed in terms of emissions per RPK, but do not disclose the underlying RPK or CO_2 data. While we are unable to verify the carbon intensities in such cases, TPI takes the reported intensities at face value, as long as there is enough confidence that they have been calculated based on flight-only carbon emissions[8] and revenue passenger kilometres. TPI then expresses the reported intensities in terms of RTKs, assuming 95 kg per passenger.

4.3. Estimating airlines' future emissions intensities

Compared with other sectors such as electricity and steel production, there is unusual uniformity in the airline sector in terms of how companies state their emissions targets. This is attributable to the coordinating role of the airline industry body, the International Air Transport Association (IATA). The majority of airlines have adopted an intensity target proposed by IATA to improve fuel efficiency by an average of 1.5% per year between 2009 and 2020. While the IATA target relates to international aviation, most airlines have adopted the targets across their entire operations, both international and domestic. This target is generally expressed in terms of fuel consumption per revenue tonne kilometre. As fuel efficiency improvements translate directly to carbon emissions reductions, TPI applied this target to carbon intensity in previous research cycles. However, currently, targets for the year 2020 are not included in company assessments as they are no longer forward-looking.

While most airlines set an intensity target based on jet fuel combustion, several apply the intensity target to all Scope 1 or total Scope 1 and 2 emissions. In such cases, it is assumed – in the absence of any other specific information – that the intensity target applies equally across all scopes. This is in line with TPI practice in other sectors.

Beyond 2020, many airlines replace their carbon intensity (or fuel efficiency) target above with an absolute emissions reduction target – that is, one based on total CO_2 emissions, rather than emissions per revenue tonne kilometre. This is in line with the target that has been included in the Carbon Offset and Reduction Scheme for International Aviation (CORSIA), which was proposed by IATA and then agreed by ICAO member states in 2016. The target seeks to stabilise CO_2 emissions from international aviation at the 2020 level, through the use of carbon offsetting, whereby airlines fund climate reduction projects in other sectors. Under the scheme, the ***gross*** absolute emissions from international aviation may grow beyond 2020, but the ***net*** absolute emissions (i.e. after carbon offsetting) are expected to level off.

In addition to the target derived from CORSIA, some airlines adopt a longer-term target based on IATA's industry goal to reduce ***net*** absolute emissions from international aviation by 50% by 2050, based on 2005 levels. Again, this target is based on the expectation that net absolute emissions will be reduced, at least in part, through carbon offsetting. There is no equivalent industry target for emissions reductions within the sector, that is, for emissions reductions that could be achieved without the use of offsets.

The IEA model produces a carbon budget for air transport, excluding the use of offsets. Thus, emissions reductions are assumed to be achieved directly within the airline sector rather than in other sectors. This is based on the rationale that the IEA's economy-wide carbon budget is allocated between sectors in a cost-effective way and that emissions reduction in other sectors are already taken into account in the overall carbon budget and hence would not be available for purchase by airlines in the form of offsets [2]. As the emissions intensity benchmark pathways derived from the IEA model do not allow for offsets, TPI does not use any airline targets that are based on net absolute emissions reductions.

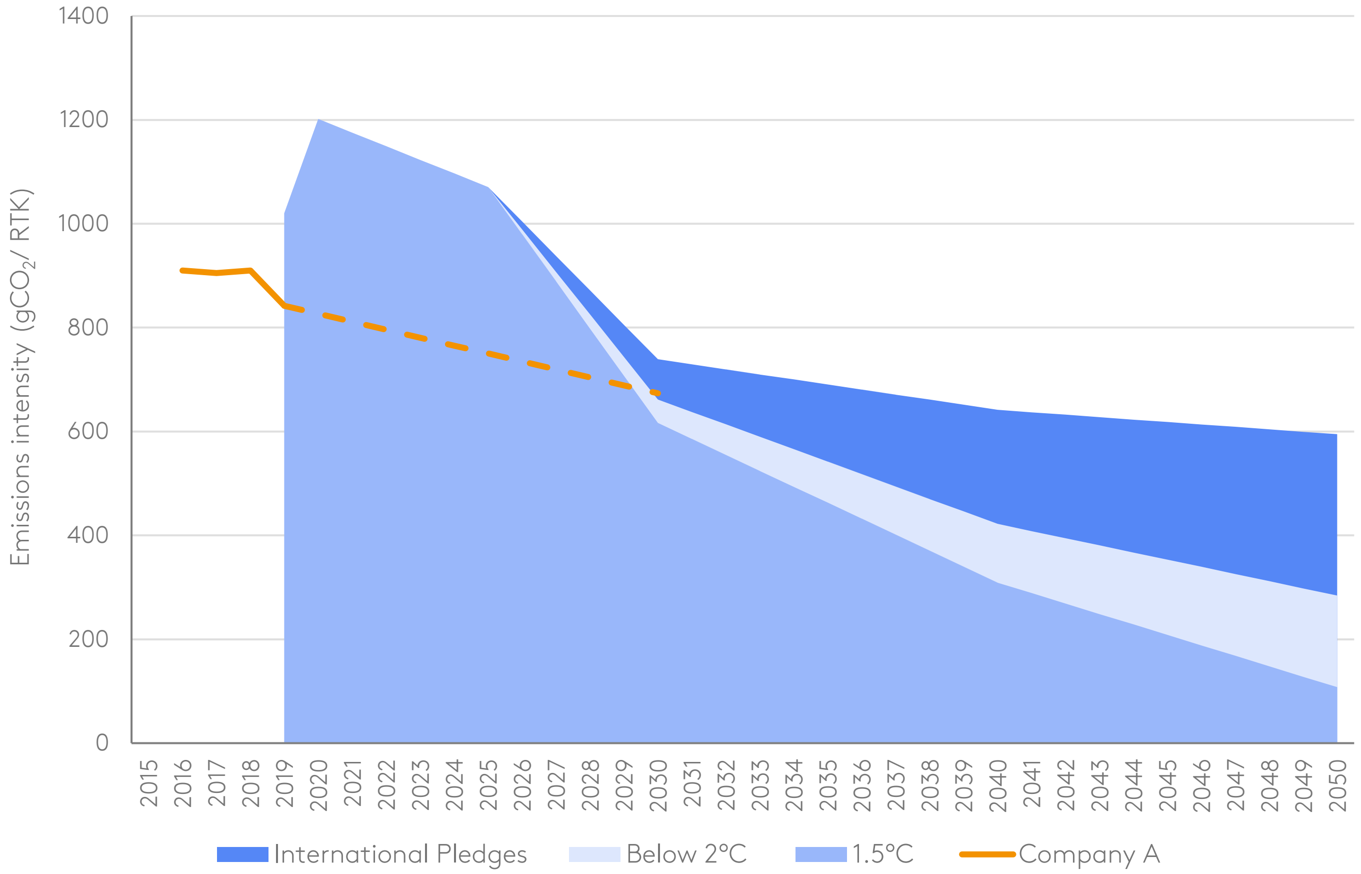
4.3. Worked examples

Company A: a simple case

Company A reports its historical emissions intensity in terms of CO_2 emissions from jet fuel combustion per revenue passenger kilometre. For example, in 2019 it was 80 gCO_2/RPK. TPI has been able to independently verify the emissions intensity using separate company disclosures of emissions and passenger kilometres. Company A does not disclose any data for freight activity, so TPI assumes that Company A has no freight operations. Thus, TPI converts the reported intensity figures to carbon emissions per RTK by assuming that one passenger is equivalent to 95 kg or 0.095 tonnes. Therefore, Company A's carbon intensity for 2019 can be expressed as 80/0.095 t = 842 grams of CO_2 per RTK.

Company A has also set a target to reduce the intensity of its aircraft carbon emissions per passenger kilometre by 20% from 2019 by 2030. This can be applied to the carbon intensity expressed in RTKs, given that all Company A's operations relate to passenger transport. Therefore the 2030 target is to reduce CO_2 intensity to 842 x (1 - 0.2) = 674 gCO_2/RTK.

Figure 4.1. Carbon Performance of Company A compared with sector benchmarks



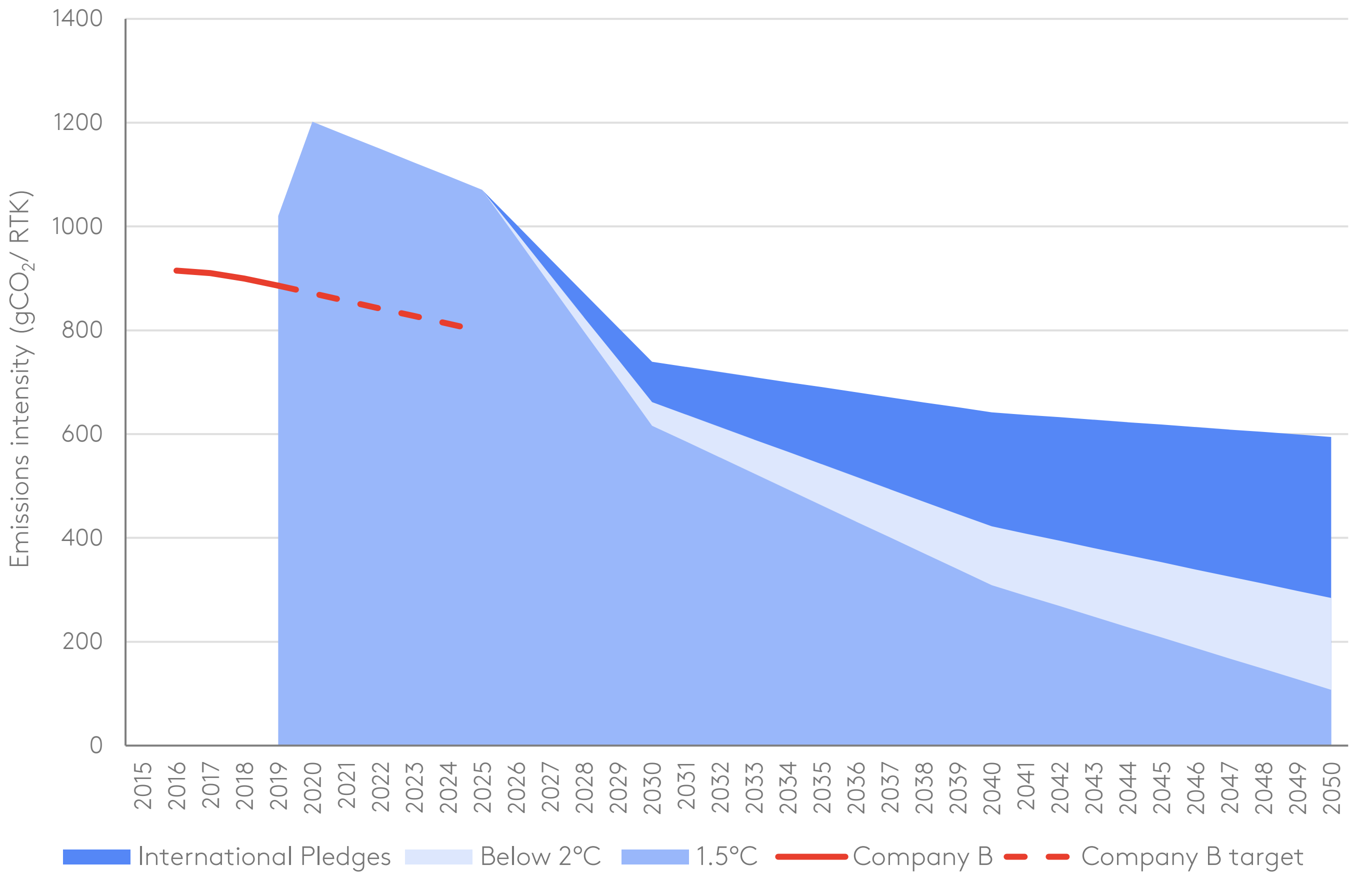
Company B: recalculation of carbon intensity using separately disclosed passenger and freight data

Company B provides separate carbon intensity figures for passenger and freight operations. These are not in a form suitable to use in our assessment. However, Company B also provides separate data for flight emissions, passenger kilometres and freight tonnes kilometres, which can be used by TPI to calculate carbon intensity in terms of RTKs. For example, Company B's total CO_2 emissions from flight operations (excluding those operated by third parties) were 32,301,249 tonnes in 2019, passenger kilometres were 277,462 million RPKs (also excluding third party flights) and freight tonne kilometres were 10,118 million tonne kilometres (excluding third party flights). Thus, total revenue tonne kilometres for 2019 are calculated as ((277,462 x 0.095) + 10,118) = 36,478 million RTKs and the carbon intensity is calculated as (32,301,249 / 36,478) = 886 tonnes per million RTKs, equivalent to 886 gCO_2/RTK.

Company B provides a carbon intensity target to reduce CO_2 emissions per RTK by 25% by 2025 compared with 2006 values. Company B also states that by 2019, 67% of the target had been achieved. Thus, Company B's carbon intensity in 2019 was (67% x 25%) = 16.75% lower than that in 2006, implying the 2006 intensity was (886/(1 - 16.75%)) = 1,064 gCO_2/RTK and the target for 2025 is (1,064 x (1- 25%)) = 798 gCO_2 per RTK.

Company B provides two further emissions targets; a medium-term target to cap net absolute emission at 2020 levels and a longer-term target to reduce net absolute emissions by 50% by 2050, relative to 2005 levels. As noted above, the TPI benchmark does not take account of emissions reductions from carbon offsetting and therefore these targets are not used in assessing the Company B's Carbon Performance.

Figure 4.2. Carbon Performance of Company B compared with sector benchmarks



5. Discussion

This note has described the methodology followed by TPI in carrying out its Carbon Performance assessment of companies, with a particular focus on airlines.

The Carbon Performance assessment is designed to be robust yet easy to understand and use. There are inevitably many nuances surrounding each company's individual performance, how it relates to the benchmarks, and why. Investors may wish to dig deeper into companies' assessments in their engagements with them to better understand these.

5.1. General issues

The assessment follows the Sectoral Decarbonisation Approach (SDA), which involves comparing companies' emissions intensity with sector-specific benchmark emissions intensities that are consistent with international targets (e.g. the sum of International Pledges).

TPI uses IEA modelling to calculate the benchmark pathways. TPI Centre mainly uses the modelling of the IEA to calculate the airlines emissions intensity benchmarks. While such economy-energy models offer a number of advantages, they are also subject to limitations. In particular, model projections often turn out to be wrong. The comparison between companies and the benchmark pathways might then be inaccurate. However, there is no way to escape the need to make a projection of the future in forward-looking exercises like this. The IEA updates its modelling every two years with the aim of improving the accuracy of its projections and TPI plans to update its benchmark pathways accordingly.

We use companies' self-reported emissions and activity data to derive emissions intensity pathways. Therefore, companies' pathways are only as accurate as the underlying disclosures.

Estimating the recent, current, and especially the future emissions intensity of companies involves a number of assumptions. Therefore, it is important to bear in mind that, in some cases, the emissions path drawn for each company is an estimate made by TPI, based on information disclosed by companies, rather than the companies' own estimate or target. In other cases, the information disclosed by companies is sufficient on its own to completely characterise the emissions intensity pathway.

5.2. Issues specific to airlines

In the context of the SDA, TPI's approach to assessing the Carbon Performance of the airline industry is to focus on the CO_2 emissions from jet fuel combustion, as this is where the majority of the industry's lifecycle emissions are concentrated.

Benchmarking the performance of airlines can be achieved using integrated modelling of the transportation sector. TPI uses the IEA's modelling (combined with freight forecasts from ICAO). A significant source of variation between the low-carbon scenarios of different transportation modelling groups is the share of the burden that is placed on avoiding air transportation and shifting modes of transportation, as opposed to improving fuel efficiency and increasing the use of low-carbon fuels [16]. TPI indirectly reflects the different projections of air transport activity by using three different IEA scenario narratives (e.g. more stringent policy assumptions in the 1.5°C and Below 2°C scenarios leading to lower aviation activity projections than in the International Pledges scenario). Nevertheless, uncertainty about actual future airline activity remains high.

TPI benchmarks airlines between now and 2050. The three benchmark pathways do not diverge very much in the next few years due to the specific features of the industry, as well as the impact of the COVID-19 pandemic. These include the long life of aircraft, the high cost of infrastructure and the existing cost differential between conventional and alternative low-carbon jet fuels, which together mean that technological developments are slow to be reflected in lower carbon intensities for the industry.

In terms of emission targets, companies generally set them on absolute net emissions, which rely on airlines purchasing emissions reductions from other sectors through the carbon offset market.

However, TPI benchmarks are derived from the IEA's modelling work, which uses the approach of allocating **gross** carbon budgets to each sector in a cost-effective way.

IEA projects that, after taking into account emissions reductions from other sectors, airlines will still have to reduce their gross emissions significantly. Although in principle offsetting is a means to reduce emissions cost-effectively, we do not currently take into account airlines' net emissions targets, because it is unclear how much their gross emissions will fall and this is the key piece of information required for benchmarking.

To provide investors with more information about their long-term emissions reduction plans, airlines could augment their net targets with gross targets, or with an alternative, suitably firm indication of what proportion of a net target will be met by own emissions reductions as opposed to offsetting. Nonetheless, in future assessments, TPI will look to establish how airlines' net targets compare with comparable benchmarks. This would provide an additional measure of companies' Carbon Performance. To do this, it would be necessary to convert airlines' targets expressed in terms of absolute CO_2 emissions into carbon intensity targets, expressed in terms of CO_2 per RTK. This would require information, such as:

- Details of what proportion of an airline's net emissions will be capped at 2020 levels under the target. If the target is based on CORSIA then it will relate solely to an airline's international flight emissions. In addition, CORSIA excludes emissions from certain international routes, to or from countries that have not signed up to participate in CORSIA.
- An estimate of the growth in emissions (beyond 2020) that are not included in the target above (that is, from domestic and excluded international flights).
- An estimate of the growth in passenger and freight activity for each airline beyond 2020.

Currently, much of this information is not publicly available, but with the introduction of CORSIA and its monitoring, reporting and verification requirements, effective from next year, we would expect that information disclosure will improve in the future.

Finally, a distinguishing feature of the airline sector is that its climate-change impact is greater than the effects of its carbon emissions. The non-CO_2 radiative forcing effects of aircraft flying at altitude are substantial and may be of similar magnitude to the CO_2 impacts, although there is uncertainty over the size [14] [17]. As a result, TPI's assessment focuses solely on the Carbon Performance of airlines. ICAO recognises the need for an up-to-date scientific assessment of the full climate effect of aviation [17]. Without this, the airline sector's contribution to climate change is likely underestimated.

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