European Union Aviation Safety Agency

Notice of Proposed Amendment 2019-02

Class D compartments

RMT.0070 (26.003)

EXECUTIVE SUMMARY

The objective of this NPA is to address the issue of potential uncontrollable fires in the Class D compartments of large aeroplanes used for commercial air transport (CAT). This includes any fires that result from thermal runaways of lithium batteries.

This NPA proposes, through an amendment of Part-26/CS-26, to require operators, whose in-service large aeroplanes used for CAT contain Class D cargo or baggage compartments, to apply to those aircraft:

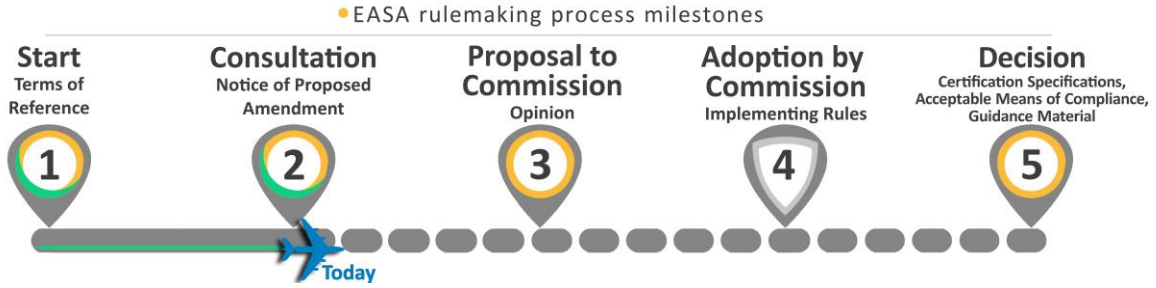
— the standards applicable to Class C compartments, if the aeroplanes are involved in the transport of passengers, or

— the standards applicable to either Class C or Class E compartments, if the aeroplanes are only involved in all-cargo operations.

If a regulation is introduced to amend Part-26 to require these changes, the resulting conversions of the Class D compartments would need to be performed within three years of the entry into force of that regulation.

The proposed changes are expected to increase safety by mitigating the risk of uncontrollable fires in Class D cargo or baggage compartments, and to improve harmonisation with the Federal Aviation Administration (FAA).

Action area:	Aircraft environment		
Affected rules:	Part-26, CS-26		
Affected stakeholders:	Air operators and POA holders		
Driver:	Safety	**Rulemaking group:**	No
Impact assessment:	Full	**Rulemaking Procedure:**	Standard



17.9.2010	**22.11.2013** (NPA 2013-23) **1.3.2019** (NPA 2019-02)	**2019/Q3**	**2021/Q2**	**2021/Q2**

Table of contents

1. About this NPA

1.1. How this NPA was developed

The European Union Aviation Safety Agency (EASA) developed this NPA in line with Regulation (EU) 2018/1139[1] ('Basic Regulation') and the Rulemaking Procedure[2]. This rulemaking activity is included in the European Plan for Aviation Safety (EPAS)[3] under rulemaking task (RMT).0070 (26.003). The text of this NPA has been developed by EASA and is hereby submitted to all interested parties[4] for consultation.

1.2. How to comment on this NPA

Please submit your comments using the automated **Comment-Response Tool (CRT)** available at **http://hub.easa.europa.eu/crt/**[5].

The deadline for submission of comments is **1 June 2019.**

1.3. The next steps

Following the closing of the public commenting period, EASA will review all the comments received.

Based on the comments received, EASA will consider the need for amendments to Commission Regulation (EU) 2015/640[6] and, if necessary, issue an opinion.

The opinion would be submitted to the European Commission, which will use it as a technical basis in order to take a decision on whether or not to amend the Regulation.

If the Commission decides that the Regulation should be amended, EASA will issue a decision that amends CS-26[7] and proposes certification specifications (CSs) and to comply with the amendments introduced into the Regulation.

The comments received on this NPA and the EASA responses to them will be reflected in a comment-response document (CRD). The CRD will be published and appended to any opinion or decision that is linked to this NPA.

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1 Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91 (OJ L 212, 22.8.2018, p. 1) (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1535612134845&uri= CELEX:32018R1139).

2 EASA is bound to follow a structured rulemaking process as required by Article 115(1) of Regulation (EU) 2018/1139. Such a process has been adopted by the EASA Management Board (MB) and is referred to as the 'Rulemaking Procedure'. See MB Decision No 18-2015 of 15 December 2015 replacing Decision 01/2012 concerning the procedure to be applied by EASA for the issuing of opinions, certification specifications and guidance material (http://www.easa.europa.eu/the-agency/management-board/decisions/easa-mb-decision-18-2015-rulemaking-procedure).

3 https://www.easa.europa.eu/document-library/general-publications?publication_type%5B%5D=2467

4 In accordance with Article 115 of Regulation (EU) 2018/1139 and Articles 6(3) and 7 of the Rulemaking Procedure.

5 In case of technical problems, please contact the CRT webmaster (crt@easa.europa.eu).

6 Commission Regulation (EU) 2015/640 of 23 April 2015 on additional airworthiness specifications for a given type of operations and amending Regulation (EU) No 965/2012 (OJ L 106, 24.4.2015, p. 18) (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid= 1537864675699&uri=CELEX:32015R0640).

7 Certification Specifications and Guidance Material for Additional airworthiness specifications for operations (CS-26).

2. In summary — why and what

2.1. Why we need to change the rules — issue/rationale

Almost 500 large aeroplanes fitted with Class D cargo or baggage compartments are currently registered in EASA Member States.

The risk of uncontrollable fires in this type of compartment was evaluated in NPA 2013-23[8], and the overall cost-benefit ratio of a mandatory conversion from a Class D compartment into a Class C or Class E compartment was considered at that time to be low enough not to propose a regulatory change (EUR 49.1 million in 2013 values for the industry, 0.07 accidents avoided and 5 lives saved).

In parallel, the carriage of lithium batteries in cargo or baggage compartments has increased over recent years, together with the identified risk of thermal runaways and the subsequent fires related to those batteries.

For this reason, EASA published Safety Information Bulletin (SIB) No. 2017-04R1[9] in December 2017 and decided to review the assessment performed in 2013 and the conclusion reached with NPA 2013-23.

This NPA presents the updated assessment made by EASA and its new proposal based on the conclusions of this assessment.

Note:

— A Class D cargo or baggage compartment is one in which a fire should be completely contained without endangering the safety of the aeroplane or the occupants and without being accessible to crew members. Such compartments depend on oxygen deprivation to prevent and suppress combustion, and on the capability of liners to resist flame penetration.

— A Class C cargo or baggage compartment is one equipped with a smoke or fire detector system and with a fire extinguishing or suppression system that is controllable from the cockpit.

— A Class E compartment is similar to a Class C compartment, but it is not equipped with a built-in fire extinguisher and is used only for the carriage of cargo.

Related safety issues

The following safety recommendations, addressed to the FAA by the National Transportation Safety Board (NTSB), are considered in the frame of this RMT: A-88-122[10], A-88-123 and A-97-056[11]. The NTSB recommended that the installation of smoke detection and fire suppression systems in all Class D cargo or baggage compartments should be mandated.

In response, and in order to remove the risk of uncontrollable fires in Class D compartments of already in-service aeroplanes, the FAA issued on 19 March 1998 the final rule FAR Part 121 Amdt 121-269. This Amendment introduced the following requirements:

[8] https://www.easa.europa.eu/sites/default/files/dfu/NPA%202013-23.pdf
[9] https://ad.easa.europa.eu/ad/2017-04R1
[10] https://www.ntsb.gov/safety/safety-recs/recletters/A88_121_128.pdf
[11] https://www.ntsb.gov/safety/safety-recs/recletters/A97_56_77.pdf

(a) Class D compartments in certain transport category aeroplanes already in service and used in transport of passengers must meet the fire or smoke detection and fire suppression standards for Class C compartments;

(b) Class D compartments in certain transport category aeroplanes already in service, and used only for the carriage of cargo, must meet the standards of either Class C compartments or the standards of Class E compartments.

2.2. What we want to achieve — objectives

The overall objectives of the EASA system are defined in Article 1 of . This proposal will contribute to the achievement of the overall objectives by addressing the issues outlined in Section 2.1.

The specific objective of this proposal is to mitigate the risk of a serious incident or accident caused by a fire that starts in a Class D compartment of a large aeroplane.

2.3. How we want to achieve it — overview of the proposals

It is proposed to introduce a requirement into Part-26 to state that (within three years of the amendment of the Regulation) all the in-service large aeroplanes that are used for CAT should have their Class D cargo or baggage compartments converted into:

(a) Class C compartments, if they are involved in the CAT of passengers, or

(b) either Class C or Class E compartments, if they are only involved in the CAT of cargo.

It is also proposed to amend CS-26 to provide specifications to be used to show compliance with the new requirement in Part-26.

2.4. What are the expected benefits and drawbacks of the proposals

The proposal is expected to increase both safety and harmonisation with the FAA.

The cost generated by the proposal would be financed for the most part by the operators of the affected aeroplanes.

The environmental impact is expected to be low to negligible.

No adverse social impact is expected.

3. Proposed amendments and rationale in detail

The text of the amendment is arranged to show deleted text, new or amended text as shown below:

— deleted text is ~~struck through~~;

— new or amended text is highlighted in blue;

— an ellipsis '[…]' indicates that the rest of the text is unchanged.

3.1. Draft regulation (amending Part-26)

PART-26

ADDITIONAL AIRWORTHINESS SPECIFICATIONS FOR OPERATIONS

(…)

SUBPART B
LARGE AEROPLANES

(…)

26.157 Conversion of Class D compartments

Operators of large aeroplanes used in CAT, type certified on or after 1 January 1958, shall ensure that, not later than [three years after the entry into force of this regulation]:

(a) for aeroplanes, the operation of which involves the transport of passengers, each Class D cargo or baggage compartment, regardless of its volume, complies with the specifications applicable to a Class C compartment; and

(b) for aeroplanes, the operation of which involves the transport of cargo only, each Class D cargo compartment, regardless of its volume, complies with the specifications applicable to either a Class C or a Class E compartment.

3.2. Draft certification specifications (amending CS-26)

(…)

Book 1
SUBPART B — LARGE AEROPLANES

(…)

CS 26.157 Conversion of Class D compartments

(a) Compliance with 26.157(a) of Part-26 can be demonstrated by showing compliance with CS 25.857(c) and CS 25.858 of CS-25.

(b) Compliance with 26.157(b) of Part-26 can be demonstrated by showing compliance with:

(1) either CS 25.857(c) and CS 25.858 of CS-25;

(2) or CS 25.857(e) of CS-25.

(…)

4. Impact assessment (IA)

4.1. What is the issue

4.1.1. Safety risk assessment

EASA is aware of numerous occurrences (27) of thermal runaways of lithium batteries that were reported by operators. These events took place on the ground and did not lead to any accidents.

Recent testing (refer to SIB No. 2017-04R1[12]) showed that if a thermal runaway event occurs in a large portable electronic device that is carried together with flammable material (e.g. hairspray) in an item of checked baggage, there would be a low probability that a Class D cargo or baggage compartment could contain the resulting fire, and a medium to low probability that a Class C compartment could contain it. The consequence of such a fire could therefore be catastrophic if it happened in flight in a Class D compartment. In a Class C or a Class E compartment, however, the earlier awareness of the start of the fire should help to mitigate its consequences.

The probability of a fire occurring in a Class D compartment, per departure, was estimated over the 1996-2015 period, based on:

(a) 27 known occurrences involving thermal runaways of lithium batteries in aviation environments (on board, in the airport facilities, etc.);

(b) 1 reported occurrence of a fire in an aeroplane equipped with a Class D compartment; and

(c) the worldwide CAT cycles in the corresponding period (516 292 182 CAT flights).

This combination results in an average probability of an uncontrolled fire event of 5.42×10^{-8} per departure.

4.1.2. Who is affected

Air operators of large aeroplanes equipped with Class D compartments are primarily affected by this issue. Design and production organisations (type certificate (TC) holders or supplemental type certificate (STC) holders) could be affected if they are requested to design and produce design changes to support operators in upgrading their Class D compartments.

Since September 2007 (when Amendment 3 of CS-25 was published), EASA has not accepted any applications for approvals of large aeroplane types whose designs have included Class D compartments.

The issue therefore affects large aeroplanes manufactured based on an approved design for which an application to EASA was made prior to the above-mentioned change to CS-25.

The number of large aeroplanes operated by EASA Member State operators that are equipped with Class D cargo or baggage compartments and are still in service (including temporary storage) is estimated to be 467 (as of November 2018). Around two-thirds of this fleet is composed of Airbus A320/A319 and Boeing 737 type aeroplanes.

12 https://ad.easa.europa.eu/ad/2017-04R1

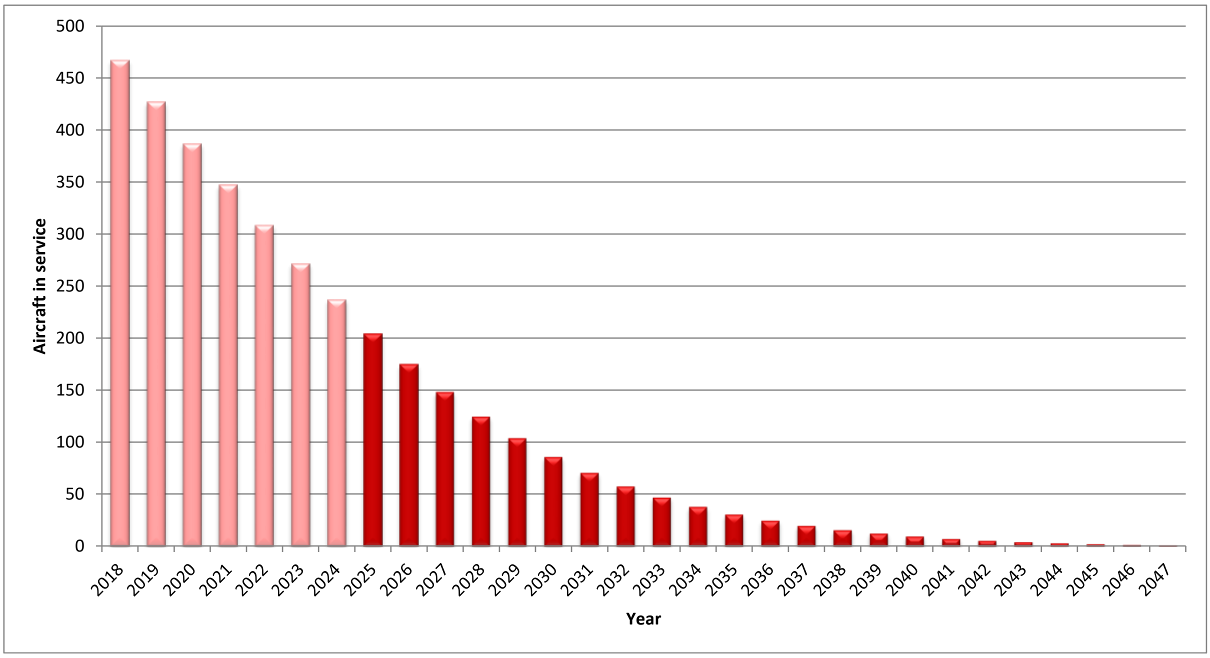
Table 1: Number of large aeroplanes with Class D cargo compartments[13]

Manufacturer	Type	Number of A/C
Airbus	A319/A320	158
Boeing	737	154
Embraer	ERJ-145	27
BAE Systems (Avro)	RJ	27
Boeing (McDonnell-Douglas)	MD-80	24
BAE Systems (Jetstream)	Jetstream 41	22
328 Support Services	Dornier 328	21
Fokker	Fokker 100	20
Embraer	EMB-120	6
Fokker	Fokker 70	5
BAE Systems (HS)	ATP	3
Grand Total		467

4.1.3. How could the issue/problem evolve

EASA has established a general retirement curve based on the age of aeroplanes. The retirement curve is based on a formula that, for each year, calculates the probability of retirement of an aeroplane, based on its age. The formula is based on historical data on the age of aeroplanes at the time when they were withdrawn from service.

Figure 1: the expected evolution of the number of in-service large aeroplanes, initially equipped with Class D cargo or baggage compartments, operated by EASA Member State operators[14].



13 Aircraft in service and in temporary storage, operated by EASA Member State operators on 2 November 2018.
14 Darker shades of red from 2025 show the period when Class D cargo compartments have to be converted.

Note: because there is currently no requirement in the EU legal framework that forbids operators to downgrade existing Class C or Class E compartments into Class D compartments, the size of the affected fleet may be greater than estimated.

4.2. What we want to achieve — objectives

The operational objective of this proposal is to improve the protection of occupants of large aeroplanes operated in CAT by reducing the probability of uncontrollable fires in their Class D cargo or baggage compartments.

4.3. How it could be achieved — options

The probability of containing a fire that results from the thermal runaway of a large portable electronic device in a Class C compartment is greater than in a Class D compartment. In addition, thanks to its installed smoke or fire detection systems, a Class C or E compartment would alert the pilots and provide them with earlier awareness of a fire in the cargo or baggage compartment. This awareness, if achieved, would lead to a reduction in the severity of such an event, and therefore to a reduced risk of an accident.

The options proposed are therefore — besides the option to not change the regulation (Option 0) — either a voluntary conversion (Option 1) or a mandatory conversion (Option 2) of the existing Class D compartments.

Table 2: Selected policy options

Option No	*Short title*	**Description**
0	Baseline option	No policy change (no change to the rules; risks remain as outlined in the issue analysis).
1	Voluntary conversion	Promote the voluntary conversion of Class D compartments to Class C or Class E compartments
2	Mandatory conversion (Part-26)	Require the conversion of Class D compartments into Class C or Class E compartments before a given date

Assuming that operators have to comply with the new rule by 1 January 2025, Table 7 shows the estimated number of large aeroplanes in service that would be fitted with Class D cargo or baggage compartments, and the risk of a catastrophic fire for the whole estimated service life of the remaining affected fleet.

Out of the 467 aeroplanes that were in service in 2018, it is expected that 263 will have been retired by the end of 2024. The last aeroplane of the remaining affected fleet of 204 aeroplanes will have been retired by 2047.

The current average aircraft age of 23.9 years (Table 6) is going to gradually increase to 48.5 years by 2047. The average annual flight hours and the average annual departures show strong correlations with the age of the aeroplanes (Table 4 and Table 5), and these correlations were taken into account when forecasting the future flight hours and departures.

4.4. Methodology and data

4.4.1. Methodology applied

Cost-effectiveness analysis was used to calculate the net cost associated with preventing one fatality. Cost-effectiveness analysis ranks regulatory options based on the 'cost per unit of effectiveness', i.e. the cost per fatality avoided.

In order to avoid a result that concentrates only on a single type of benefit (i.e. the number of fatalities avoided), the net cost of each option was calculated, taking into account the benefit of avoided aeroplane damage, as well as airport delays and diversions. The environmental impacts of additional CO_2 emissions were monetised and taken into account as part of the total net costs.

To make the results comparable, all monetary values are expressed in 2018 euros. For future costs and benefits, a standard discount rate of 4 % was applied, and past costs were inflated by the same rate. Discounted euro values are marked with the PV (present value) abbreviation in the columns to the right of the undiscounted figures.

The benefits are accrued during the period while the aircraft with updated cargo compartments are in service (2025–2047) and the installation costs are incurred in the last year of the transitionary period, which is 2024. Operating costs (extra fuel burn, maintenance, etc.) occur over the same period as the benefits (2025–2047).

4.4.2. Data collection

The current fleet of aircraft with Class D cargo or baggage compartments was estimated using information from FlightGlobal's Flight Fleets Analyzer. Detailed information was also provided by some aeroplane TC holders to identify the potentially affected aeroplanes, including the serial and line numbers of some types.

4.5. What are the impacts

4.5.1. Safety impact

Option 0

At the level of an individual aeroplane, the risk of an uncontrolled fire may increase over the years if no actions are taken, mainly due to the expansion of the transport of lithium batteries. At the level of the fleet of aeroplanes equipped with Class D compartments, although the size of the fleet should decrease over time, there is a possibility that this decrease may be slowed down if no measures are taken to prevent the conversion of Class C or Class E compartments into Class D compartments. The overall risk is therefore difficult to estimate, and it may even increase.

Option 1

Some operators may be more sensitive to voluntary actions than others. In particular, operators that face significant economic constraints may be less receptive to voluntarily converting their Class D compartments.

The promotion of voluntary actions by operators to convert Class D compartments could, however, provide a strong indication to operators that they should not convert Class C or Class E compartments into Class D compartments.

This option is therefore likely to bring a slightly greater positive safety impact than Option 0.

Option 2

Mandating the conversion of Class D compartments into Class C or Class E compartments would ensure that by the compliance date, all the affected aeroplanes would have been either converted or removed from service. It may also accelerate the retirement of affected aeroplanes, which are already quite old, and their replacement by newer (and hence safer) aeroplanes.

Option 2 would, in general, bring a greater positive safety impact than Option 1.

The related design changes are already available, therefore the compliance period could be relatively short.

4.5.2. Environmental impact

The conversion of a Class D compartment into a Class C or Class E cargo or baggage compartment has only a minor impact on the environment, since such a conversion would introduce only a slight weight increase for the aeroplane. The average weight increase per aeroplane is in the range of 20 to 100 kg. This weight increase would result in an associated greater consumption of fuel and additional gaseous emissions (Table 8 and Table 9), which would accumulate over the lifetime of the aeroplane. Since the affected aeroplanes and their flight hours represent a small and decreasing share of the total annual traffic from 2025 to 2047, the environmental impact is estimated to be low to negligible. As mentioned earlier, a mandated conversion may accelerate the retirement of affected aeroplanes and their replacement by newer and more environmentally friendly ones.

4.5.3. Social impact

Not applicable.

4.5.4. Economic impact

Whether it is voluntary or mandated, the conversion of Class D cargo or baggage compartments into either Class C or Class E compartments might lead to non-negligible costs for the operators who have to implement the changes. Depending on the possible transition period of the amending Regulation (which for this analysis is assumed to be three years, with a potential entry into force in 2021 and applicability in 2024), 204 out of 467 aeroplanes would need to be converted. (The other 263 aeroplanes are expected to have been retired from service by the end of 2024).

Since for most of the affected aeroplane types, the design changes are already available (as required for compliance with the FAA regulations), the cost of development of a modification is negligible for the aeroplane TC/STC holders. Most of the cost would therefore be on the operators who need to implement changes to their aeroplanes with Class D compartments or to replace the affected aeroplanes.

The cost of the conversion would be around EUR 90 000[15] for the upgrade kit and the installation per aeroplane. Because most operators would likely perform this conversion during a scheduled C-check, there would be no revenue lost due to time out of service.

[15] EUR 90 000 is based on the average of the range that the FAA used in 1998: 'Nominal equipment and installation unit (i.e. each airplane) costs range from $13 000 to $101 000 depending on the airplane model'.

Multiplying this cost for the 204 large aeroplanes estimated to be affected leads to a forecasted undiscounted cost for a fleet-wide retrofit of EUR 18.4 million. The 2018 present value of the retrofit using a 4 % discounting rate is EUR 14.5 million.

The discounted cost of the additional fuel burn at a EUR 2.40 per gallon price is EUR 1.4 million in the 2025–2047 period (Table 8). During the forecasted 1 million departures in the 2025-2047 period, 44 false alarms[16] may be expected, resulting in flight diversions with a cost of EUR 3 500 each, amounting to EUR 104 000 at the present value of additional costs. In the same period, the maintenance cost of the system (annual EUR 200 per aircraft for the replacement of the fire bottles every five years) is EUR 155 000 (PV) (Table 10).

The monetised benefits of avoiding a catastrophic accident include aeroplane and ground damage avoided and accident investigation costs saved. The average resale value of an aeroplane in the relevant fleet is EUR 3.1 million, based on data from Ascend. The cost of an accident investigation is estimated to be EUR 7.1 million according to the FAA values, and the avoided ground damage is EUR 0.5 million. These avoided costs were multiplied by the number of projected accidents in each year and then discounted to 2018 euro values (see Table 11). The total present value of the savings in the 2025-2047 period is EUR 389 000.

Question to stakeholders on economic impacts

Stakeholders are invited to provide quantified justifications regarding the possible economic impacts of the options proposed, or alternatively, to propose another justified solution to the issue, including the estimated EUR 90 000 cost of the upgrade kit and installation per aeroplane.

4.5.5. General Aviation and proportionality issues

The issue at stake concerns large aeroplanes that are operated for CAT. Hence, there is no impact on General Aviation.

No proportionality issue among the affected operators is expected.

4.6. Conclusion

4.6.1. Comparison of options

Option 0 would not bring any safety benefit.

Option 1 could result in a reduction in the risk of uncontrollable fires in the affected fleet to a certain extent.

However, Option 1 cannot exclude the possibility that certain operators might downgrade existing Class C or Class E compartments into Class D compartments. This could increase the size of the affected fleet, and therefore the risk of uncontrolled fires.

Option 2 would significantly mitigate the risk of uncontrollable fires in this type of compartment. If a thermal runaway of batteries occurred in one of these converted aeroplanes, it would then be better contained in a Class C or Class E compartment.

[16] Estimated 44 false alarms per 1 million departures (FAA sources).

Table 3 below summarises the cost of the mandatory conversion of a Class D compartment into a Class C or a Class E compartment.

These costs are compared with the costs established in 2013 and the current costs, in a scenario in which the additional risk generated by lithium batteries is not considered.

Table 3: Net cost per fatality prevented (2025–2047)[17]

Criteria	Quantified impact	2013 NPA	2018 (updated fleet, old accident rate)	2018 (updated fleet and accident rate)
	Number of aircraft to be retrofitted:	532	204	204
	Average number of PAX and crew on-board:	73	106	106
Safety	Accidents avoided:	0.07	0.02	0.05
	Fatalities prevented:	4.87	1.82	5.55
	Reduction in accident costs (A):	€ 525,850	€ 127,751	€ 388,852
Environment	Additional tonnes of fuel burn:	9,801	2,612	2,612
	Additional tonnes of CO2 emission:	30,972	3,572	3,572
	Shadow price of CO2 emission (B):	€ 2,674,076	€ 377,671	€ 377,671
Economic	Costs of installation (C):	€ 42,565,146	€ 14,526,075	€ 14,526,075
	Recurring costs (D):	€ 6,558,750	€ 1,621,097	€ 1,621,097
Cost effectiveness	Total net costs ([B + C + D] - A):	€ 51,272,122	€16,397,091	€16,135,990
	Net cost per fatality prevented:	**€ 10,518,523**	**€8,991,975**	**€2,907,134**

In the case of a mandatory conversion, the net cost per fatality prevented is lower in comparison with the previous assessment made in NPA 2013-23, although the risk is higher because of the issue of lithium batteries. This cost, which would be financed for the most part by operators, could be spread over a 3-year transition period.

Considering the additional risk generated by lithium batteries, EASA is currently of the opinion that the mandatory conversion of Class D compartments to Class C or Class E compartments is the best option to mitigate the potentially catastrophic consequences of an uncontrolled in-flight fire in a large aeroplane equipped with a Class D compartment.

Question to stakeholders

Stakeholders are also invited to provide any other quantitative information that they may find necessary to bring to the attention of EASA.

As a result, the relevant parts of the impact assessment might be adjusted on a case-by-case basis.

4.6.2. Sensitivity analysis

Because there is currently no requirement in the EU legal framework that forbids operators to downgrade existing Class C or Class E compartments into Class D compartments, the size of the affected fleet, and therefore the risk of uncontrolled fires, may be greater than estimated.

4.7. Monitoring and evaluation

The monitoring of the effects brought about by the proposed amendments to Part-26/CS-26 will consist of monitoring the trend in the number of large aeroplanes converted from Class D compartments into either Class C or Class E compartments before the end of the transition period.

[17] All monetised costs are expressed in 2018 present values applying a 4 % annual discount rate. Calculations are based on the relevant fleet operated by EASA Member State operators (see Table 1 and Figure 1).

In addition, the changes made to Part-26/CS-26 might be subject to interim/ongoing/ex post evaluation that will show the outcome that is obtained after the application of the new rules, taking into account the earlier predictions made in this impact assessment. The evaluation would provide evidence-based judgement of the extent to which the proposal has been relevant (given the needs and its objectives), effective and efficient, coherent, and has achieved added value for the EU. The decision as to whether an evaluation will be necessary should also be taken based on the results of the monitoring.

5. Proposed actions to support implementation

— Focused communication for advisory body meeting(s) (TeB, STeB)

(Advisory body members)

N/A

— Providing supporting clarifications in electronic communication tools EASA - NAAs (EUSurvey, SINAPSE or equivalent)

(Primarily targeted audience: the Competent Authority)

N/A

— EASA Circular

(Primarily targeted audience: the Competent Authority, Industry)

N/A

— Detailed explanation with clarification and indicated hints on the EASA web

(Industry, Competent Authority)

N/A

— Dedicated thematic workshop/session

(Industry, Competent Authority)

N/A

— Series of thematic events organised on the regional principle

(Industry, Competent Authority)

N/A

— Combination of the above selected means

(Industry, Competent Authority)

N/A

6. References

6.1. Affected regulations

Commission Regulation (EU) 2015/640 of 23 April 2015 on additional airworthiness specifications for a given type of operations and amending Regulation (EU) No 965/2012 (OJ L 106, 24.4.2015, p. 18) (https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1538170107669&uri=CELEX:32015R0640)

6.2. Affected decisions

ED Decision 2015/013/R of 8 May 2015 adopting Certification Specifications for additional airworthiness specifications for operations 'CS-26 — Issue 1'

(https://www.easa.europa.eu/document-library/agency-decisions/ed-decision-2015013r)

6.3. Other reference documents

— SIB No.: 2017-04R1 'Safety Precautions Regarding the Transport by Air of Portable Electronic Devices containing Lithium Batteries carried by Passengers' issued on 19 December 2017 (https://ad.easa.europa.eu/ad/2017-04R1)

— NPA 2013-23: Additional airworthiness specifications for operations: Fire hazard in Class D cargo compartments (https://www.easa.europa.eu/sites/default/files/dfu/NPA%202013-23.pdf)

7. Appendix 1: Retirement curves

How quickly will a new safety requirement mandated by Part-26 spread through the fleet?

The most important factor in the evolution of the fleet in this case is the rate of retirement of the aeroplanes. Using historical data on retirements, EASA has defined a third-degree polynomial curve that can be used to predict future retirements as a function of aircraft age.

The retirement curve shows the share of 'surviving' aircraft, in other words the percentage of the affected fleet that remains in service at any given age.

A review of the literature and a comprehensive analysis of the data (30 years) shows that retirement patterns have remained remarkably stable. Although projections based on past data should always be interpreted cautiously, there is no indication that these trends would change in the coming years or decades.

Applying the retirement curve requires the following steps:

— the current fleet is broken down into age categories;

— the current number of aircraft in each age category is projected back to year zero of the retirement curve (e.g. if we have 131 24-year old aircraft and we know that 53.6 % of those survive until the age of 24 years, then the original number of them was 131 ÷ 0.536 = 244);

— the retirement curve is applied to obtain the number of aircraft that remain in the fleet for the next year (if 48.1 % survive until the age of 25 years, then we get 244×0.481=117).

Calculating the difference between the two numbers (131–117=14) shows the number of aircraft that were retired.

8. Appendix 2: Tables

Table 4: Correlation between aircraft age and annual flight hours[18]

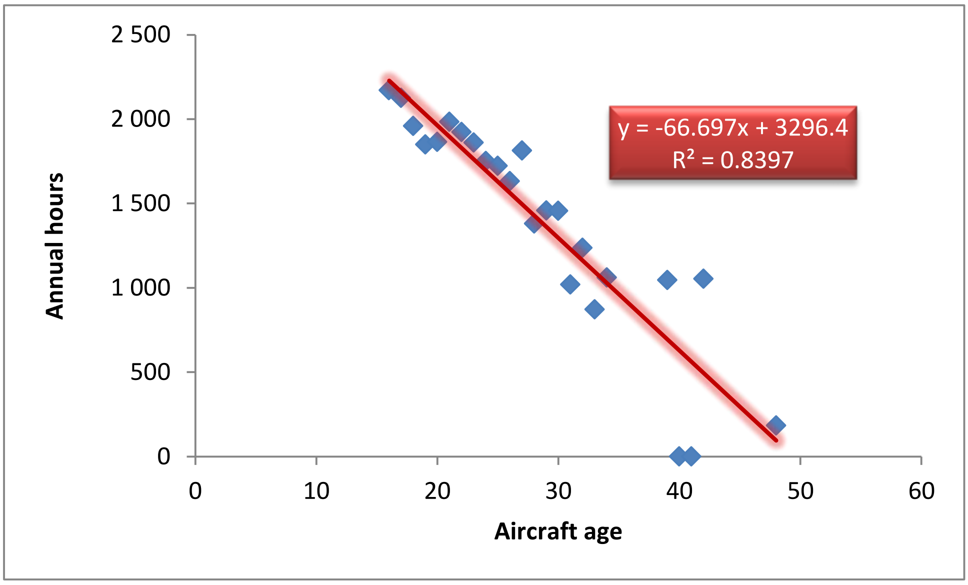
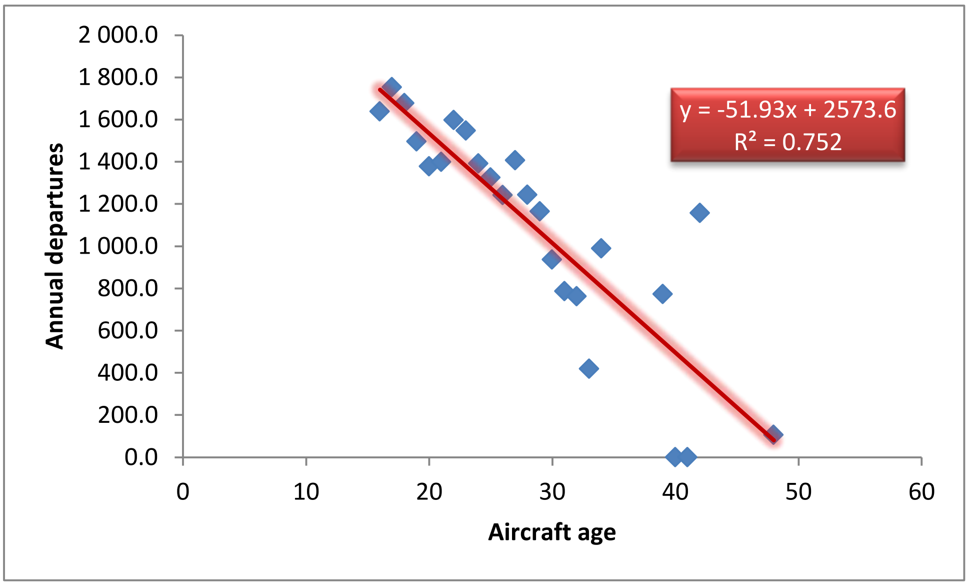


Table 5: Correlation between aircraft age and annual departures[19]



[18] Based on the total lifetime flight hours of the relevant fleet.
[19] Based on the total lifetime cycles of the relevant fleet.

Table 6: Aircraft registered in EASA Member States and equipped with a Class D compartment[20]

Manufacturer	Type	Number of A/C	Average age
328 Support Services	Dornier 328	21	25.2
Airbus	A319	61	37.1
Airbus	A320	97	20.6
BAE Systems (Avro)	RJ	27	20.7
BAE Systems (HS)	ATP	3	24.0
BAE Systems (Jetstream)	Jetstream 41	22	28.4
Boeing	737 (CFMI)	138	22.2
Boeing	737 (JT8D)	1	29.0
Boeing	737 NG	15	20.0
Boeing (McDonnell-Douglas)	MD-80	24	26.8
Embraer	EMB-120	6	22.9
Embraer	ERJ-145	27	24.2
Fokker	Fokker 100	20	28.6
Fokker	Fokker 70	5	22.2
Grand Total		467	23.9

[20] Aircraft in service and in temporary storage, operated by EASA Member State operators on 2 November 2018.

Table 7: Estimated evolution of the fleet and the risk with Class D compartments

Year	Aircraft with class D cargo comp.	Total departures	Accidents	Fatalities
2018	467	634,224	0.034	3.523
2019	427	560,968	0.030	3.116
2020	387	491,049	0.027	2.728
2021	347	425,196	0.023	2.362
2022	**309**	364,034	0.020	2.022
2023	272	308,052	0.017	1.711
2024	237	257,587	0.014	1.431
2025	204	212,806	0.012	1.182
2026	175	173,703	0.009	0.965
2027	148	140,108	0.008	0.778
2028	124	111,704	0.006	0.620
2029	104	88,058	0.005	0.489
2030	86	68,665	0.004	0.381
2031	70	52,980	0.003	0.294
2032	58	40,460	0.002	0.225
2033	47	30,586	0.002	0.170
2034	38	22,883	0.001	0.127
2035	31	16,936	0.001	0.094
2036	25	12,390	0.001	0.069
2037	20	8,951	0.000	0.050
2038	16	6,374	0.000	0.035
2039	12	4,465	0.000	0.025
2040	10	3,071	0.000	0.017
2041	7	2,071	0.000	0.012
2042	6	1,362	0.000	0.008
2043	4	865	0.000	0.005
2044	3	523	0.000	0.003
2045	2	293	0.000	0.002
2046	2	144	:	:
2047	1	56	:	:
2048	0	:	:	:
2049		:	:	:
∑2018–2047		4,040,567	0.2191	22.4
∑2025–2047		999,455	0.0542	5.6

Table 8: Shadow prices per tonne of CO_2 equivalent emitted (EUR)

Year of emission	Central guidance
2000-2009	22
2010-2019	26
2020-2029	32
2030-2039	40
2040-2049	55
2050-	83

Table 9: Cost of additional fuel burn and shadow prices of emission with climatic effect

Year	Aircraft with class D cargo comp.	Total flight hours	Additional fuel burn (US gallon)	Cost of additional fuel burn (undiscounted)	Cost of additional fuel burn (PV)	Additional CO2 emission (9.8kg/US gallon)	Shadow price of high altitude emission (per tonne)	HEATCO shadow price of greenhouse gas emission (undiscounted)	HEATCO shadow price of greenhouse gas emission (PV)
2018	467	810,354							
2019	427	716,628							
2020	387	627,188							
2021	347	542,969							
2022	**309**	464,763							
2023	272	393,197							
2024	237	328,696							
2025	204	271,474	179,549	€ 430,427	€ 327,089	1,760,325	€ 64	€ 112,661	€ 85,613
2026	175	221,520	146,511	€ 351,224	€ 256,636	1,436,410	€ 64	€ 91,930	€ 67,173
2027	148	178,614	118,133	€ 283,195	€ 198,969	1,158,188	€ 64	€ 74,124	€ 52,079
2028	124	142,346	94,146	€ 225,692	€ 152,469	923,016	€ 64	€ 59,073	€ 39,908
2029	104	112,164	74,184	€ 177,837	€ 115,520	727,305	€ 64	€ 46,547	€ 30,236
2030	86	87,416	57,816	€ 138,600	€ 86,569	566,835	€ 80	€ 45,347	€ 28,323
2031	70	67,410	44,584	€ 106,879	€ 64,189	437,105	€ 80	€ 34,968	€ 21,001
2032	58	51,446	34,025	€ 81,568	€ 47,103	333,590	€ 80	€ 26,687	€ 15,411
2033	47	38,860	25,702	€ 61,613	€ 34,212	251,982	€ 80	€ 20,159	€ 11,193
2034	38	29,047	19,211	€ 46,054	€ 24,589	188,350	€ 80	€ 15,068	€ 8,045
2035	31	21,474	14,203	€ 34,048	€ 17,479	139,245	€ 80	€ 11,140	€ 5,719
2036	25	15,691	10,378	€ 24,878	€ 12,280	101,743	€ 80	€ 8,139	€ 4,018
2037	20	11,318	7,486	€ 17,946	€ 8,518	73,393	€ 80	€ 5,871	€ 2,787
2038	16	8,045	5,321	€ 12,755	€ 5,821	52,164	€ 80	€ 4,173	€ 1,905
2039	12	5,623	3,719	€ 8,915	€ 3,912	36,460	€ 80	€ 2,917	€ 1,280
2040	10	3,858	2,552	€ 6,117	€ 2,581	25,017	€ 110	€ 2,752	€ 1,161
2041	7	2,594	1,716	€ 4,113	€ 1,669	16,820	€ 110	€ 1,850	€ 751
2042	6	1,700	1,124	€ 2,695	€ 1,051	11,020	€ 110	€ 1,212	€ 473
2043	4	1,074	710	€ 1,703	€ 639	6,963	€ 110	€ 766	€ 287
2044	3	644	426	€ 1,020	€ 368	4,173	€ 110	€ 459	€ 166
2045	2	355	235	€ 563	€ 195	2,303	€ 110	€ 253	€ 88
2046	2	171	113	€ 271	€ 91	1,110	€ 110	€ 122	€ 41
2047	1	63	42	€ 100	€ 32	410	€ 110	€ 45	€ 14
2048	0	:	:	:	:	:	:	:	:
2049		:	:	:	:	:	:	:	:
∑2018–2047		5,156,701	841,883	€ 2,018,213	€ 1,361,981	8,253,927		€ 566,265	€ 377,671
∑2025–2047		1,272,906	841,883	€ 2,018,213	€ 1,361,981	8,253,927		€ 566,265	€ 377,671

Table 10: Cost of false alarms and fire bottle replacement[21]

Year	Aircraft with class D cargo comp.	Total departures	False alarms resulting in diversions (44 per million departures)	Cost of diversions (undiscounted)	Cost of diversions (PV)	Fire bottle replacement cost (undiscounted)	Fire bottle replacement cost (PV)
2018	467	634,224					
2019	427	560,968					
2020	387	491,049					
2021	347	425,196					
2022	**309**	364,034					
2023	272	308,052					
2024	237	257,587					
2025	204	212,806	9	€ 32,772	€ 24,904	€ 40,845	€ 31,039
2026	175	173,703	8	€ 26,750	€ 19,546	€ 34,913	€ 25,511
2027	148	140,108	6	€ 21,577	€ 15,159	€ 29,574	€ 20,778
2028	124	111,704	5	€ 17,202	€ 11,621	€ 24,839	€ 16,780
2029	104	88,058	4	€ 13,561	€ 8,809	€ 20,701	€ 13,447
2030	86	68,665	3	€ 10,574	€ 6,605	€ 17,131	€ 10,700
2031	70	52,980	2	€ 8,159	€ 4,900	€ 14,078	€ 8,455
2032	58	40,460	2	€ 6,231	€ 3,598	€ 11,507	€ 6,645
2033	47	30,586	1	€ 4,710	€ 2,615	€ 9,362	€ 5,198
2034	38	22,883	1	€ 3,524	€ 1,881	€ 7,592	€ 4,054
2035	31	16,936	1	€ 2,608	€ 1,339	€ 6,137	€ 3,150
2036	25	12,390	1	€ 1,908	€ 942	€ 4,930	€ 2,434
2037	20	8,951	0	€ 1,379	€ 654	€ 3,944	€ 1,872
2038	16	6,374	0	€ 982	€ 448	€ 3,149	€ 1,437
2039	12	4,465	0	€ 688	€ 302	€ 2,476	€ 1,087
2040	10	3,071	0	€ 473	€ 200	€ 1,913	€ 807
2041	7	2,071	0	€ 319	€ 129	€ 1,447	€ 587
2042	6	1,362	0	€ 210	€ 82	€ 1,101	€ 430
2043	4	865	0	€ 133	€ 50	€ 833	€ 312
2044	3	523	0	€ 81	€ 29	€ 625	€ 225
2045	2	293	0	€ 45	€ 16	€ 458	€ 159
2046	2	144	0	€ 22	€ 7	€ 315	€ 105
2047	1	56	0	€ 9	€ 3	€ 197	€ 63
2048	0	:	:	:	:	:	:
2049		:	:	:	:	:	:
∑2018–2047		4,040,567	44	€ 153,916	€ 103,840	€ 238,067	€ 155,275
∑2025–2047		999,455	44	153,916	103,840	238,067	155,275

21 Present values (PV) are discounted values expressed in 2018 euros applying a 4 % discount rate.

Table 11: Benefits of accidents avoided[22]

Year	Aircraft with class D cargo comp.	Total departures	Accidents	Fatalities	Aircraft damages (undiscounted)	Aircraft damages (PV)	Investigation costs (undiscounted)	Investigation costs (PV)	Ground property damage (undiscounted)	Ground property damage (PV)
2018	467	634,224	0.034	3.523	€ 104,912	€ 104,912	€ 243,674	€ 243,674	€ 17,198	€ 17,198
2019	427	560,968	0.030	3.116	€ 92,794	€ 89,225	€ 215,528	€ 207,239	€ 15,211	€ 14,626
2020	387	491,049	0.027	2.728	€ 81,228	€ 75,100	€ 188,665	€ 174,431	€ 13,315	€ 12,311
2021	347	425,196	0.023	2.362	€ 70,335	€ 62,528	€ 163,364	€ 145,230	€ 11,530	€ 10,250
2022	**309**	364,034	0.020	2.022	€ 60,218	€ 51,474	€ 139,865	€ 119,557	€ 9,871	€ 8,438
2023	272	308,052	0.017	1.711	€ 50,957	€ 41,883	€ 118,356	€ 97,280	€ 8,353	€ 6,866
2024	237	257,587	0.014	1.431	€ 42,610	€ 33,675	€ 98,967	€ 78,215	€ 6,985	€ 5,520
2025	204	212,806	0.012	1.182	€ 35,202	€ 26,751	€ 81,762	€ 62,132	€ 5,771	€ 4,385
2026	175	173,703	0.009	0.965	€ 28,734	€ 20,995	€ 66,738	€ 48,765	€ 4,710	€ 3,442
2027	148	140,108	0.008	0.778	€ 23,176	€ 16,283	€ 53,831	€ 37,821	€ 3,799	€ 2,669
2028	124	111,704	0.006	0.620	€ 18,478	€ 12,483	€ 42,917	€ 28,994	€ 3,029	€ 2,046
2029	104	88,058	0.005	0.489	€ 14,566	€ 9,462	€ 33,833	€ 21,977	€ 2,388	€ 1,551
2030	86	68,665	0.004	0.381	€ 11,358	€ 7,094	€ 26,382	€ 16,478	€ 1,862	€ 1,163
2031	70	52,980	0.003	0.294	€ 8,764	€ 5,263	€ 20,355	€ 12,225	€ 1,437	€ 863
2032	58	40,460	0.002	0.225	€ 6,693	€ 3,865	€ 15,545	€ 8,977	€ 1,097	€ 634
2033	47	30,586	0.002	0.170	€ 5,059	€ 2,809	€ 11,751	€ 6,525	€ 829	€ 461
2034	38	22,883	0.001	0.127	€ 3,785	€ 2,021	€ 8,792	€ 4,694	€ 621	€ 331
2035	31	16,936	0.001	0.094	€ 2,801	€ 1,438	€ 6,507	€ 3,340	€ 459	€ 236
2036	25	12,390	0.001	0.069	€ 2,050	€ 1,012	€ 4,760	€ 2,350	€ 336	€ 166
2037	20	8,951	0.000	0.050	€ 1,481	€ 703	€ 3,439	€ 1,632	€ 243	€ 115
2038	16	6,374	0.000	0.035	€ 1,054	€ 481	€ 2,449	€ 1,118	€ 173	€ 79
2039	12	4,465	0.000	0.025	€ 739	€ 324	€ 1,715	€ 753	€ 121	€ 53
2040	10	3,071	0.000	0.017	€ 508	€ 214	€ 1,180	€ 498	€ 83	€ 35
2041	7	2,071	0.000	0.012	€ 343	€ 139	€ 796	€ 323	€ 56	€ 23
2042	6	1,362	0.000	0.008	€ 225	€ 88	€ 523	€ 204	€ 37	€ 14
2043	4	865	0.000	0.005	€ 143	€ 54	€ 333	€ 125	€ 23	€ 9
2044	3	523	0.000	0.003	€ 87	€ 31	€ 201	€ 72	€ 14	€ 5
2045	2	293	0.000	0.002	€ 48	€ 17	€ 112	€ 39	€ 8	€ 3
2046	2	144	:	:	:	:	:	:	:	:
2047	1	56	:	:	:	:	:	:	:	:
2048	0	:	:	:	:	:	:	:	:	:
2049		:	:	:	:	:	:	:	:	:
∑2018–2047		4,040,567	0.2191	22.4	€ 668,349	€ 570,326	€ 1,552,339	€ 1,324,667	€ 109,560	€ 93,492
∑2025–2047		999,455	0.0542	5.6	€ 165,295	€ 111,528	€ 383,921	€ 259,041	€ 27,096	€ 18,282

22 Present values (PV) are discounted values expressed in 2018 euros applying a 4 % discount rate.