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Project

Analysis of Flight Routes and Hints for Passengers

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Abstract

Purpose – This project calculates "Trip Emission Ecolabels" (TEE) based on fuel performance, equivalent CO2, local noise level and local air pollution with NOx. As such, flight routes to different destinations (domestic, short-, middle- and long-distance) can be compared. Passengers obtain hints for selecting a flight option for minimum environmental impact.
Methodology – The TEEs for flight connections are calculated with an Excel tool. Considered are the distance of the flight and aircraft performance parameters from a database depending on aircraft and engine model and cabin layout.
Findings – Flight booking engines consider today at best CO2 emissions, but not the whole environmental impact of a flight. The fastest, shortest or cheapest flight may not be the flight with the least environmental impact. For an evaluation of the trip, both the flight routing and the aircraft environmental performance per passenger is important.
Research Limitations – The available data for turboprop engines does not contain information about nitrogen oxides (NOx) emitted by the engine. Therefore, turboprop aircraft are not taken into account in this report. Due to the many available flight connections and combinations, this report can only work with selected examples.
Practical Implications – The applied method allows calculating and comparing the environmental impact of a trip with a combination of different stopovers and aircraft. Today, flight options have to be extracted from flight booking engines and have to be processed offline. In the future these calculations can be offered to passengers directly by flight booking engines. Furthermore, also airlines could calculate and decide on the aircraft, engine, cabin layout and routing, to offer environmentally beneficial flight connections.
Social Implications – The environmental impact of different trips can be made more transparent and can therefore be discussed in public.
Originality – This project is an addition to previous research and the first one to use the existing TEE method to this extent.

HAW HAMBURG

DEPARTMENT OF AUTOMOTIVE AND AERONAUTICAL ENGINEERING

Analysis of Flight Routes and Hints for Passengers

Task for a Project

Background

The environmental awareness of travelers has grown bigger in the last decade, and flight booking engines have responded, showing a CO2 emission value as part of their search results. To allow passengers a better choice among offered aircraft for a flight, an Ecolabel for Aircraft was developed by Haß and Scholz in the year 2015. Based on the Ecolabel for Aircraft, Hurtecant under the supervision of Scholz developed two methods for a Trip Emission Ecolabels, because a passenger often cannot easily recognize the flight connection with least environmental impact.

Task

Task of this project is to apply the best of the two existing Trip Emission Ecolabels to a variety of flight connections, to discuss the findings and to give hints for passengers, when it comes to selecting a flight option. Following subtasks have to be considered:

- Review the previous research and decide, which Trip Emission Ecolabels should be used.
- Find interesting routes for the application of the Trip Emission Ecolabel.
- Calculate and print Ecolabels for Aircraft for missing aircraft, engine and cabin combinations.
- Calculate and print Trip Emission Ecolabels for interesting flight connections, found with a flight booking engine.
- Draw up an overview and discuss the findings.

The report has to be written in English based on German or international standards on report writing.

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List of Symbols

A	Local Air Pollution $[\frac{g}{kN}]$
A_{max}	LAP, max $[\frac{g}{kN}]$ (normalization constant from statistics)
A_{min}	LAP, min $[\frac{g}{kN}]$ (normalization constant from statistics)
E_{CO_2}	CO_2-equivalent emission $\left[\frac{\frac{kg}{km}}{seat}\right]$
$E_{CO_2,max}$	CO_2, max $\left[\frac{\frac{kg}{km}}{seat}\right]$ (normalization constant from statistics)
$E_{CO_2,min}$	CO_2, min $\left[\frac{\frac{kg}{km}}{seat}\right]$ (normalization constant from statistics)
f_{max}	fuel, max $\left[\frac{\frac{kg}{km}}{seat}\right]$ (normalization constant from statistics)
f_{min}	fuel, min $\left[\frac{\frac{kg}{km}}{seat}\right]$ (normalization constant from statistics)
I	Indicator [var.]
N_{local}	Local Noise Level $\left[\frac{EPNdB}{EPNdB}\right]$
$N_{local,max,jet}$	LNL, max, jet $\left[\frac{EPNdB}{EPNdB}\right]$ (normalization constant from statistics)
$N_{local,min,jet}$	LNL, min, jet $\left[\frac{EPNdB}{EPNdB}\right]$ (normalization constant from statistics)
$n_{flights}$	Number of flights [-]
n_{seats}	Number of seats [-]
O	Overall Rating [-]
P_f	Fuel performance $\left[\frac{\frac{kg}{km}}{seat}\right]$
R	Distance between airports [km]
r	Ratio of indicator of TEE and reference flight [-]
$S_{Env.}$	Environmental Rating [-]

Indizes

avg	Average value
EC	Economy Class
general	Value for whole aircraft in sum
norm.	normalized value
ref	Value of reference flight
TEE	Trip Emission Ecolabel
total	Sum of whole trip

List of Abbreviations

A/C	Aircraft
CO_2	Carbon Dioxide
EC	Economy Class
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ISO	International Organization for Standardization
LAP	Local Air Pollution
LNL	Local Noise Level
NO_x	Nitrogen Oxide
TEE	Trip Emission Ecolabel

List of Aircraft, Airport and Airline Codes

ICAO Aircraft Codes

A319	Airbus A319
A320	Airbus A320
A20N	Airbus A320 neo
A321	Airbus A321
A21N	Airbus A321 neo
A333	Airbus A330-300
A339	Airbus A330-900
A359	Airbus A350-900
A35K	Airbus A350-1000
A388	Airbus A380-800
AT72	ATR 72
BCS1	Airbus A220-100 (before: Bombardier CS100)
BCS3	Airbus A220-300 (before: Bombardier CS300)
B712	Boeing 717-200
B738	Boeing 737-800
B38M	Boeing 737 MAX 8
B39M	Boeing 737 MAX 9
B748	Boeing 747-8

B753	Boeing 757-300
B763	Boeing 767-300(ER)
B772	Boeing 777-200(ER)
B77W	Boeing 777-300ER
B788	Boeing 787-8
B789	Boeing 787-9
B78X	Boeing 787-10
CRJX	Bombardier CRJ1000
E175	Embraer E175
E190	Embraer E190
E295	Embraer E195-E2

IATA Airport Codes

ADB	Adnan Menderes Airport, Izmir, Turkey
AMS	Amsterdam Airport Schiphol, Amsterdam, Netherlands
ATL	Hartsfield–Jackson Atlanta International Airport, Atlanta, USA
AUA	Queen Beatrix International Airport, Oranjestad, Aruba
AYT	Antalya Airport, Antalya, Turkey
BAH	Bahrain International Airport, Manama, Bahrain
BCN	Barcelona–El Prat Airport, Barcelona, Spain
BKK	Suvarnabhumi Airport, Bangkok, Thailand
BON	Flamingo International Airport, Kralendijk, Bonaire
CAI	Cairo International Airport, Cairo, Egypt
CDG	Charles de Gaulle Airport, Paris, France
CGN	Cologne Bonn Airport, Cologne / Bonn, Germany
CMB	Bandaranaike International Airport, Colombo, Sri Lanka
DFW	Dallas/Fort Worth International Airport, Dallas / Fort Worth, USA
DOH	Hamad International Airport, Doha, Qatar
DTW	Detroit Metropolitan Wayne County Airport, Detroit, USA
DUB	Dublin Airport, Dublin, Ireland
DUS	Düsseldorf Airport, Düsseldorf, Germany
DXB	Dubai International Airport, Dubai, United Arab Emirates
EWR	Newark Liberty International Airport, New Jersey, USA
FRA	Frankfurt Airport, Frankfurt, Germany
FUE	Fuerteventura Airport, Fuerteventura, Spain
HAM	Hamburg Airport, Hamburg, Germany
HEL	Helsinki-Vantaa Airport, Helsinki, Finland

HKG	Hong Kong International Airport, Hong Kong, China
HRG	Hurghada International Airport, Hurghada, Egypt
IAD	Washington Dulles International Airport, Washington D.C., USA
IAH	George Bush Intercontinental Airport, Houston, USA
IST	Istanbul New Airport (before: Atatürk International Airport), Istanbul, Turkey
JFK	John F. Kennedy International Airport, New York City, USA
KEF	Keflavík International Airport, Reykjavik, Iceland
KUL	Kuala Lumpur International Airport, Kuala Lumpur, Malaysia
LHR	Heathrow Airport, London, UK
LIS	Lisbon Portela Airport, Lisbon, Portugal
LPA	Gran Canaria Airport, Gran Canaria, Spain
MAD	Adolfo Suárez Madrid–Barajas Airport, Madrid, Spain
MEX	Mexico City International Airport, Mexico City, Mexico
MIA	Miami International Airport, Miami, USA
MUC	Munich Airport, Munich, Germany
PMI	Palma de Mallorca Airport, Palma de Mallorca, Spain
RIX	Riga International Airport, Riga, Latvia
SAW	Sabiha Gökçen International Airport, Istanbul, Turkey
VGO	Vigo–Peinador Airport, Vigo, Spain
VIE	Vienna International Airport, Vienna, Austria
VLC	Valencia Airport, Valencia, Spain
ZRH	Zurich Airport, Zürich, Switzerland

IATA Airline Codes

4Y	Eurowings Discover
AA	American Airlines
AF	Air France
AM	Aeromexico
AY	Finnair
BA	British Airways
CX	Cathay Pacific Airways
DE	Condor
DL	Delta Air Lines
EI	Aer Lingus
EK	Emirates
EW	Eurowings
FI	Icelandair
FR	Ryanair
IB	Iberia

KL	KLM
LH	Lufthansa
LX	SWISS
OS	Austrian Airlines
PC	Pegasus Airlines
TG	Thai Airways
TK	Turkish Airlines
TP	TAP Portugal
UA	United Airlines
UX	Air Europa
VY	Vueling
WK	Edelweiss Air
XQ	SunExpress

Definitions

Airline hub

> *An airline hub or hub airport is an airport used by one or more airlines to concentrate passenger traffic and flight operations. Hubs serve as transfer (or stop-over) points to help get passengers to their final destination. It is part of the hub-and-spoke system. An airline may operate flights from several non-hub (spoke) cities to the hub airport, and passengers traveling between spoke cities connect through the hub. This paradigm creates economies of scale that allow an airline to serve (via an intermediate connection) city-pairs that could otherwise not be economically served on a non-stop basis.* (Wikipedia 2022a)

Cabin layout

The term *cabin layout* is used in this paper to describe a design of the aircraft cabin regarding to the number of seats of a travel class and the space these seats occupy.

CO_2-equivalent emission

CO_2 and non-CO_2 emissions are merged and expressed as one metric that matches the environmental impact of the same amount of CO_2 (Van Endert 2017).

Domestic flight

"A domestic flight is a form of commercial flight within civil aviation where the departure and the arrival take place in the same country" (Wikipedia 2022d).

Ecolabel

The word *ecolabel* is defined by the United States Environmental Protection Agency as:

> *Ecolabels are marks placed on product packaging or in e-catalogs that can help consumers and institutional purchasers quickly and easily identify those products that meet specific environmental performance criteria and are therefore deemed "environmentally preferable". Ecolabels can be owned or managed by government agencies, nonprofit environmental advocacy organizations, or private sector entities.*
>
> *Ecolabels can be single-attribute, meaning they focus on a single lifecycle stage (i.e. the use phase) of a product/service or a single environmental issue (i.e. VOC emissions). They can also be multi-attribute, meaning they focus on the entire lifecycle (manufacture, use, maintenance, disposal) of a product/service and address many different environmental issues (i.e. energy use, chemical use, recycling, and more).* (EPA 2022)

In this paper the word *ecolabel* will be used due to its established meaning in an equivalent way to describe its purpose. In the current stage of the development the use of the "Trip Emission Ecolabel" is voluntarily and not monitored or owned by any government or agency.

Emission

The Cambridge Dictionary defines the word *emission*, among other things, as "an amount of something, especially a gas that harms the environment, that is sent out into the air" (Cambridge Dictionary 2022c). In this paper, beside harmful gases, like carbon dioxide and nitrogen oxides, also noise is considered as emission.

Fuel performance

The term *fuel performance* is used as an indicator of burnt fuel per distance and passenger seat or the total amount of burnt fuel for a flight per passenger seat.

Layover

> *In scheduled transportation, a layover (also waypoint way station, or connection) is a point where a vehicle stops, with passengers possibly changing vehicles.*
> *…*
> *For air travel, where layovers are longer, passengers will exit the vehicle and wait in the terminal, often to board another vehicle traveling elsewhere.* (Wikipedia 2022b)

Leg

"A section or stage of a journey or process" (Oxford Dictionary 2022c). In this paper used to describe a flight from start until landing.

Long-haul flights

Due to a definition of EUROCONTROL, *long-haul flights* are "… routes longer than 4000 km" (EUROCONTROL 2011, p. 21). Due to a definition of the IATA, *long-haul flights* are flights longer than 6 hours. (IATA 2020, p. 96)

Medium-haul flights

Due to a definition of EUROCONTROL, *medium-haul flights* are "… routes between 1500 and 4000 km" (EUROCONTROL 2011, p. 21). Due to a definition of the IATA, *medium-haul flights* are flights between 3 and 6 hours. (IATA 2020, p. 96)

Short-haul flights

Due to a definition of EUROCONTROL, *short-haul flights* are "… routes shorter than 1500 km" (EUROCONTROL 2011, p. 21) Due to a definition of the IATA, *short-haul flights* are flights up to 3 hours. (IATA 2020, p. 96)

Stopover

> *A stopover is a longer form of layover, allowing time to leave the transport system for sightseeing or overnight accommodation.* (Wikipedia 2022b)

The word *stopover* is often used in the meaning of *layover*.

Trip

The Cambridge Dictionary defines the word trip, among other things, as "… the act of traveling from one place to another" (Cambridge Dictionary 2022b). In this paper the word trip is used for non-stop and multi-stop flights from origin to destination.

1 Introduction

1.1 Motivation

Energy labels for different electronical devices are very common these days, an equivalent labelling for aircraft or flight connections is not. Some very cheap connections can be found at low-cost carriers but will increase the ecological footprint of the trip by flying via unreasonable layovers.

A long time the price of a trip was the dominating criterion, but the ecological awareness of travelers grew bigger and bigger. To meet the new upcoming requirements of passengers, an ecolabel must be published to satisfy these claims of more transparency about the environmental impact of flights and flight connections.

This project will compare a variety of flight connections and point out some deficiencies which can be discussed by using the method of the "Trip Emission Ecolabel". In contrast to electronical devices, where a better efficiency can save money, the most efficient flight will not always be the cheapest.

By implementing this more accurate tool to calculate the environmental impact of a trip into flight search and booking engines, the passengers can get a better idea of their ecological footprint by a specific trip or decide which flight connection to choose.

Furthermore, airlines could use this tool to reconsider their decisions on their routes or aircraft models for an eco-friendlier connection of origin and destination, because the most fuel-efficient flight is not always the one with the overall best environmental impact.

1.2 Title Terminology

Analysis
The Cambridge Dictionary defines the word *analysis*, among other things, as "the process of studying or examining something in an organized way to learn more about it, or a particular study of something" (Cambridge Dictionary 2022d) and describes the method of work in this paper.

Flight
The Cambridge Dictionary defines the word *flight*, among other things, as "a journey in an aircraft" (Cambridge Dictionary 2022).

Routes
The Cambridge Dictionary defines the word *route*, among others things, as "a particular way or direction between places" (Cambridge Dictionary 2022e) and is used in this paper as the way between origin and destination.

Hint
The Oxford Dictionary defines the word *hint*, among other things, as a "… small piece of practical information or advice" (Oxford Dictionary 2022a) and is used in this paper in that way.

Passengers
The Oxford Dictionary defines the word *passenger*, among other things, as a "… traveller on a public or private conveyance other than the driver, pilot, or crew" (Oxford Dictionary 2022b) and is used in this paper in that way.

1.3 Objectives

The first two objectives of this project are, to examine and publish a variety of *Trip Emission Ecolabels* resulting of the application of the existing Excel calculation tools and giving hints for passengers to leaven the selection of a flight, or a multi-stop flight connection in relation to ecological impact, price and flight time, after an examination of the results.

The third objective is, to raise the passengers' awareness of the ecological impact of flights and a not always intuitive correlation of price, flight time and environmental effect.

1.4 Previous Research

This project is based on previous research of MacDonald (2012), Haß (2015), Van Endert (2017), Sokour (2018), Velasco (2020) and Hurtecant (2021).

MacDonald first developed a 'Flight Evaluator' to grade flight connections, because the cheapest flight is not always the fastest and not always the one with the least environmental impact. Haß was the first who adopted this grading and developed a detailed *Ecolabel for Aircraft* that had an appearance of a well-established Energy-Label. After the first design of the *Ecolabel for Aircraft*, Van Endert further developed this ecolabel and the tools for its calculation. Furthermore, she gave explanations to the ecolabel and the calculation tools. The Excel calculation tool for the ecolabel was improved by Sokour and Bähr due to automation of the Excel sheets and they provided a user guide for it.

Velasco reviewed the previous done research and suggested new designs for the ecolabel, he also considered all forms of transportation for an evaluation of the environmental impact of travelling.

The last update of the ecolabel was done by Hurtecant and new tools named *Trip Emission Calculator* were created to compare flight connections with more than one flight and more than one aircraft model. Those two tools result in two different *Trip Emission Ecolabels*.

1.5 Structure of the Work

This project consists of 8 chapters. The structure of this work is as follows:

Chapter 2	In this chapter the previous research on the subject of ecolabels for aircraft and flight connections are reviewed.
Chapter 3	The process of finding routes and information about flight connections for the application of the given tools is described in this chapter.
Chapter 4	In this chapter the work of adding missing aircraft information to the given database and calculating new "Ecolabels for Aircraft" is described.
Chapter 5	This chapter gives information about how the "Trip Emission Ecolabel" is calculated and describes the previous acquired concepts of calculation.
Chapter 6	This chapter provides sought-out results of the comparison of calculated flight connections.
Chapter 7	This chapter provides the discussion on the findings of this project.
Chapter 8	This chapter provides summery and conclusions of this project, furthermore, hints for passengers are given when it comes to selecting a flight option.
Chapter 9	This chapter contains recommendations to future work on this subject.
Appendix A	Contains all routes and flight connections calculated in this project.
Appendix B	Contains a list of all new aircraft combinations added to the database.
Appendix C	Contains all prints of "Ecolabels for Aircraft" calculated for this project.
Appendix D	Contains all prints of "Trip Emission Ecolabels" calculated for this project.
Appendix E	Contains more detailed tables of the sought-out results presented in Chapter 6.

2 Literature Review

2.1 Master Thesis of MacDonald

In his master thesis, MacDonald (2012, sec. 6.1) states, that ticket prices and the environmental impact often do not correlate. Beyond that, MacDonald explains that often the cheapest travel option is a flight connection with great detours.

To assess flight options based on cost, flight time and efficiency, and to confirm the previous statements, MacDonald developed a tool called *'Flight Evaluator'* and confirmed his arguments (MacDonald 2012, sec. 6.3).

2.2 Bachelor Thesis of Haß

In 2015 in a bachelor thesis (Haß 2015), the *Ecolabel for Aircraft* was first defined, and the author specified "the most relevant environmental impacts of aviation and the causative emissions of aircraft".

To determine the environmental impact of aircraft, the emission of carbon dioxide (CO_2), nitrogen oxides (NO_x), [fuel consumption, author's note] and noise pollution are considered. The comparison of the calculated results and use of normalizing factors allows a comparison of different aircraft models and cabin layouts. These results are rated [like in an Energy Label, author's note], can be compared and give a general indication of the environmental performance of every aircraft. (Haß 2015, Abstract)

In his bachelor thesis, Haß (2015, sec. 7.2) states, that the used emission data are not certified to the time the thesis was written. Another adjustment that was suggested, is the implementation of the cruise altitude.

2.3 Master Thesis of Van Endert

The master thesis (Van Endert 2017) deals with the further development and explanation of the *Ecolabel for Aircraft* [first developed by Haß, author's note] and the tools for the generation (Van Endert 2017, sec. 1.3). Van Endert also optimized the metrics of the tool and changed the design referring to an EU Energy Label, which simplified the dealing with this label for passengers.

Van Endert also implemented the cruise altitude, [recommended by Haß in his bachelor thesis, author's note], to calculate the CO_2-equivalent (Van Endert 2017, sec. 4.4.2 and 5.1.5).

The final recommendation of Van Endert includes, that the noise parameter of jets and turboprops need to be merged to develop one rating scale and ease the comparison of both types of aircraft (Van Endert 2017, sec. 7.2).

2.4 Project of Sokour and Bähr

In a project in 2018 (Sokour 2018) both authors improved the Excel calculation tool [of Van Endert, author's note] for the *Ecolabel for Aircraft* by automating the transfer of required data out of data sheets into the designated cells of the calculation tool. In this way, a better comparison of aircraft with different engines or cabin layouts was possible. Also, a print function was added. (Sokour 2018, Abstract)

Beyond that, Sokour and Bähr created *Ecolabels* for the most popular aircraft and wrote a *User Guide* for the software (Sokour 2017). Overall, the automation of the existing Excel calculation tool improved the handling of this tool.

2.5 Bachelor Thesis of Velasco

In his bachelor thesis, Velasco (2020) reviews the approaches of *Haß* and *Van Endert* to develop an *Ecolabel for Aircraft* and shows several flaws to these approaches. Velasco makes some suggestions to a new design of the ecolabel.

In his elaboration Velasco does not only refer to the *Ecolabel for Aircraft*, but he also considers all forms of transportation and evaluated the environmental awareness in passenger aviation in general.

Velasco recommends in his thesis, that the usage of the tools to create ecolabels are not yet user-friendly and need implementation in booking or search engines. Velasco also states that the information distributed by the exiting tools only consider flight connections and no other forms of transportation (Velasco 2020, sec. 9.2).

2.6 Master Thesis of Hurtecant

A master thesis in 2021 (Hurtecant 2021) should update the design of the *Ecolabel for Aircraft* to follow ISO standards and the results of the calculation should be presented in an easy way to be understood by passengers. Moreover, not only an ecolabel to compare aircraft and therefore direct flights, other tools should compare the environmental impact when the destination is reached with more than one leg (Hurtecant 2021, Task).

Hurtecant discusses and shows the previous ecolabels and developed a new design of the ecolabel to fit ISO standards (Hurtecant 2021, sec.6). A user interface was added to the calculation tool for *Ecolabel for Aircraft* to provide an easier input of new aircraft into the database (Hurtecant 2021, sec. 7.1.2)

To compare flights with lay- or stopovers, Hurtecant developed three concepts of tools to calculate multi-leg trips (Hurtecant 2021, sec. 7.2).

Hurtecant seized the recommendation of *Van Endert* and modified the calculation of noise ratings of jets and turboprops in order to make jets and turboprops comparable (Hurtecant 2021, sec. 9.1).

The recommendations of Hurtecant state beside other, that the air pollution of turboprops still cannot be calculated due to lack of publicly available data and the rating of CO_2-equivalent is uncertain yet and needs further research. The final advice Hurtecant gave in his thesis, is to automate the tools to make it easier for passengers to use. (Hurtecant 2021, sec. 10)

3 Routes for the Application

3.1 Finding Routes and Flight Connections

In this project the Hamburg Airport is picked as the departure airport for all considered destinations, because there are many flights taking place at Hamburg and many possible flight connections with and without layovers.

To find popular destinations from Hamburg Airport, the webpage of the airport was consulted and as mentioned in Hamburg Airport (2021) the most popular destination in 2020 was Munich. This destination is considered as an example of a domestic or short-haul flight. In the list of the top 10 destinations also Palma de Mallorca (place #7 and place #2 for summer holidays) and Antalya (place #9 in the year 2019) are mentioned. These two destinations will be examples for medium-haul flights.

For a greater variety in evaluated destinations and flight connections the flight search engine of Google was consulted. All 100 selected routes and connections that were used to create a *Trip Emission Ecolabel* are shown in Table A.1 in the appendix.

3.2 Flight Search Engine

The flight search engine, which can be found on Google (2022), provides additional information of price, estimated flight time, layovers, operating airline, planned aircraft model, flight number, the estimated CO_2-Emission for one passenger and the additional or saved emission over a common flight. An example of a search result for a flight connection is shown in Figure 3.1.

3.3 Evaluating the Information of the Flight Connections

To evaluate the correctness of the information provided by the flight search engine and to gather additional information, another online tool was used. The flight and aircraft online search tool, which can be found at Flightradar24 (2022), shows future and past information of a certain flight number as shown as an example in Figure 3.2.

Flightradar24 gives an information of the aircraft model used in past flights. The free version of the online tool provides information of the last 7 days and some planned flights in the future. Flights of one flight number, or one route, are not always done by the same aircraft, especially not in bigger airlines with a big and diverse fleet. If a flight is operated by different aircraft models, the most used model was selected. To get a cabin layout for the flight, the last used aircraft of the selected model and its registration number was considered as an example.

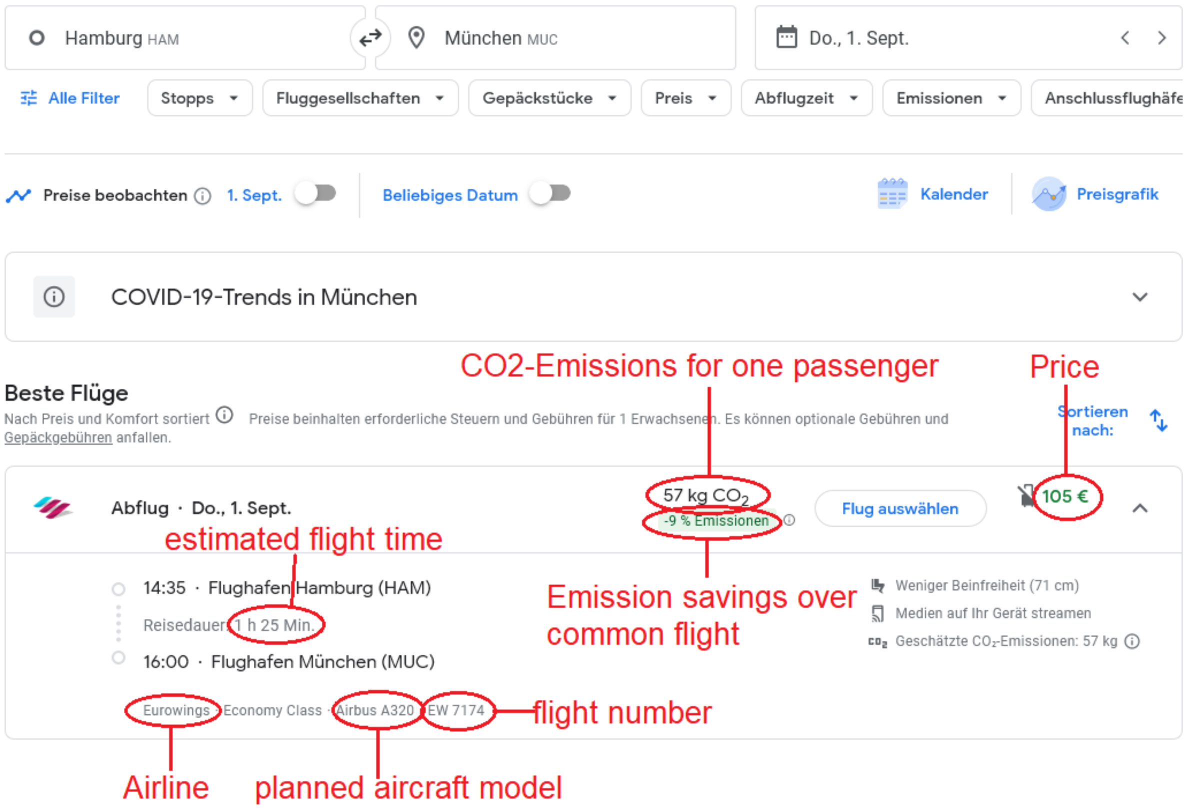

Figure 3.1 Example of a searched flight connection with Google Flights (modified from Google 2022)

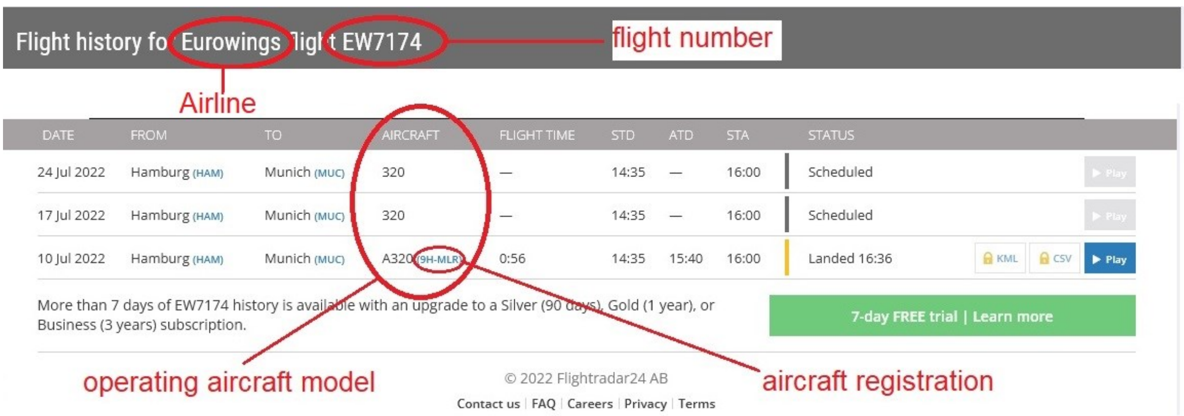

Figure 3.2 Example of additional information given by Flightradar24 (modified from Flightradar24 2022)

4 Generating New Ecolabels

4.1 Research of the Aircraft Information

After gathering all information of the flight connection, the information about the operating aircraft of these flight connections must be researched. Generally speaking, the research was done like described in Van Endert (2017, sec. 5.1.1). The website seatguru.com gave information of cabin layouts and from the website airfleets.net, or the website of the airline, the provided information about the engines were used.

Airbus A350-900 (359) Layout 2

Seating details Seat map key

	Pitch/ Bed Length	Width	Seating details
Business	64 / 78	20	36 flat bed seats
	Pitch	Width	Seating details
Premium Economy	38	18	21 recliner seats
Economy	31	17	262 standard seats

Figure 4.1 Seating details of Airbus A350-900 of Lufthansa from SeatGuru (2022)

Airbus A350 - MSN 74 - D-AIXA
Airline Lufthansa
Status : Active
Registration : D-AIXA

Lufthansa

Airline Lufthansa
Country : Germany
Date : 1954 -
Codes: LH DLH GEC
Callsign : Lufthansa
Web site : http://www.lufthansa.de

General information & flightlog

Serial number	74
Type	350-941
First flight date	29/11/2016
Test registration	F-WZNC
Plane age	5.6 years
Seat configuration	C48 W21 Y224
Hex code	3C6701

Engines 2 x RR Trent XWB

Flights recorded
LH639 DXB->MUC 21/01/22
LH1461 FRA->LAX 26/06/21
LH430 FRA->ORD 04/12/20
See details - Add a flight

Figure 4.2 General information about an aircraft from Airfleets (2022)

In Figure 4.1 an example of the provided information from seatguru.com is shown. In this example an Airbus A350-900 operated by Lufthansa is chosen. Lufthansa had two layouts for their cabin of an A350-900. In this case Layout 2 was chosen and the website gives information about the number of seats in each travel class, the seat pitch and the width of the seats.

Figure 4.2 shows an example of the given information from airfleets.net. The searched information from this website is the installed engine type. In this example of an Airbus A350-900 from Lufthansa with the registration D-AIXA two engines of the type Rolls-Royce Trent XWB (RR Trent XWB) are installed.

4.2 Adding New Aircraft Combinations to the Database

Once the information of the aircraft are gathered, they can be added to the database of the Ecolabel Tool like described in Hurtecant (2021, sec. 7.1.2). Following an ecolabel of the new combination can be generated. A list of new added combinations can be found in Table B.1 in the appendix. Figure 4.1 shows an example of an *Ecolabel for Aircraft*. The chosen aircraft for this example is an Airbus A320 from Lauda Europe with 180 seats and installed V2527-A5 engines. This specific aircraft has an *Overall Rating* of 7,12 and is graded with B. The score of the *Overall Rating* is defined from the worst possible score of 0 and a grade G and the best possible score of 10 and the grade A (Hurtecant 2021, sec. 5.6). Additionally given and rated information are the *Fuel Performance* (Hurtecant 2021, sec. 5.2.6), the *CO_2 Equivalent Emissions* (Hurtecant 2021, sec.5.4.7), the *Local Noise Level* (Hurtecant 2021, sec. 5.5.3), the *Local Air Pollution* (Hurtecant 2021, sec. 5.3.3) and a more detailed information about the *Fuel Performance* broken up into the travel classes (Hurtecant 2021, sec. 5.2.8).

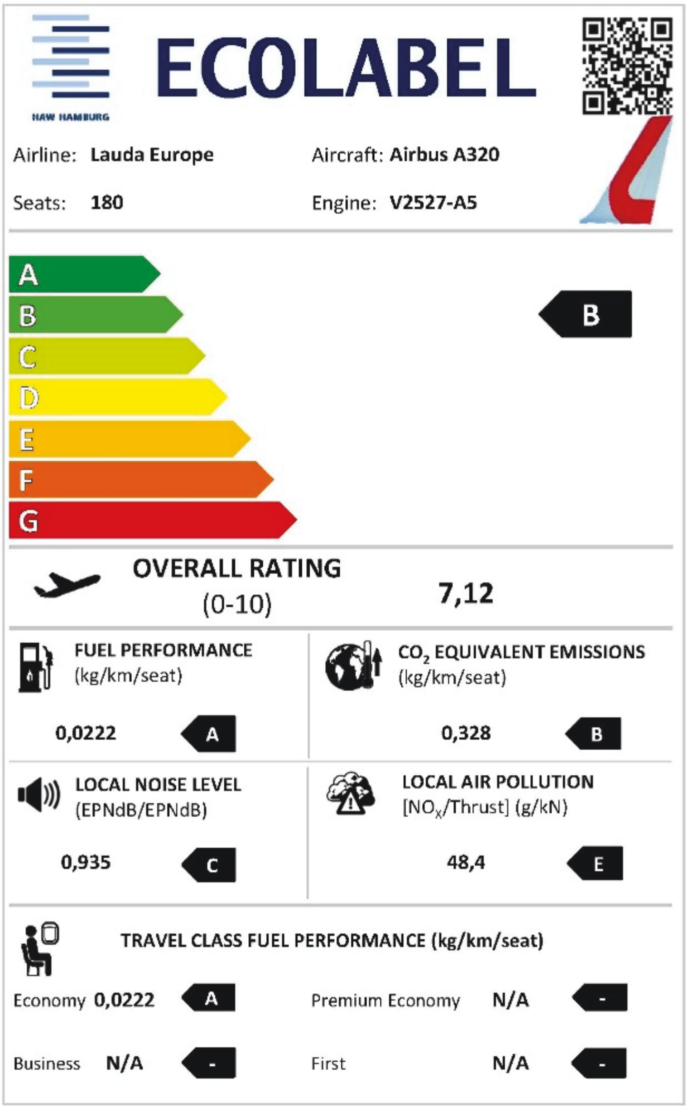

Figure 4.3 Ecolabel for Aircraft, example of an A320 of Lauda Europe

5 Generating Trip Emission Ecolabels

5.1 Explanation of the Previous Acquired Calculators

To calculate the ratings of a *Trip Emission Ecolabel* Hurtecant supplied two concepts of *Trip Emission Calculators*. The first concept, described by Hurtecant, results in an ecolabel as previous known from Van Endert but gives average values, whilst taking the leg-distance into account, of the operated aircraft on this multi-stop connection (Hurtecant 2021, sec. 7.2.1). The second concept also takes the total flown distance into account and results in a new design. This design gives values about the absolute impact of the flight connection and compares it to a reference non-stop flight of a Boeing 737-800 with a distance of 2400 km (Hurtecant 2021, sec. 7.2.2).

5.1.1 First Concept of Hurtecant

To get an ecolabel for a connection with stop-/layovers, two or more *Ecolabel for Aircraft* need to be combined. To combine those ecolabels and their calculated values, average values will be formed for the new combined ecolabel as following:

$$P_{f,avg} = \frac{P_{f,1} \cdot R_1 + P_{f,2} \cdot R_2 + \cdots + P_{f,n} \cdot R_n}{R_1 + R_2 + \cdots + R_n} \tag{5.1}$$

In Equation (5.1) the average fuel performance ($P_{f,avg}$) is calculated, this equation applies for the general fuel performance of the aircraft and to the travel class fuel performances. The multiplication of fuel performances of the operated aircraft ($P_{f,1}$; $P_{f,2}$; … ; $P_{f,n}$) and the related flown distances between the airports (R_1 ; R_2 ; … ; R_n) are added and divided by the total flown distance between the airports.

$$E_{CO_2,avg} = \frac{E_{CO_2,1} \cdot R_1 + E_{CO_2,2} \cdot R_2 + \cdots + E_{CO_2,n} \cdot R_n}{R_1 + R_2 + \cdots + R_n} \tag{5.2}$$

Equation (5.2) is used to calculate the average CO_2 equivalent emission ($E_{CO_2,avg}$). For the calculation, the CO_2 equivalent emissions of the operated aircraft ($E_{CO_2,1}$; $E_{CO_2,2}$; … ; $E_{CO_2,n}$) and the related flown distances between the airports (R_1 ; R_2 ; … ; R_n) are added and divided by the total flown distance between the airports.

$$N_{local,avg} = \frac{N_{local,1} + N_{local,2} + \cdots + N_{local,n}}{n_{flights}} \tag{5.3}$$

To calculated the average Local Noise Level ($N_{local,avg}$) the Local Noise Levels of the operated aircrafts ($N_{local,1}$; $N_{local,2}$; ... ; $N_{local,n}$) are added and divided by the total number of flights ($n_{flights}$) as seen in Equation (5.3).

$$A_{avg} = \frac{A_1+A_2+\cdots+A_n}{n_{flights}} \tag{5.4}$$

In Equation (5.4) is shown how the average Local Air Pollution (A_{avg}) is calculated. The Local Air Pollution of the operated aircraft (A_1 ; A_2 ; ... ; A_n) are added and divided by the total number of flights ($n_{flights}$).

To make the *Overall Rating* combinable, the above calculated values need to be normalized with a rating scale. The used rating scales and statistical constants for normalization (f_{min} ; f_{max} ; $E_{CO2,min}$; $E_{CO2,max}$; A_{min} ; A_{max} ; $N_{local,min,jet}$; $N_{local,max,jet}$) are described in Hurtecant (2021, ch. 5). The normalization of the values is shown below:

$$P_{f,norm.} = \frac{P_{f,,avg,general}-f_{min}}{f_{max}-f_{min}} \tag{5.5}$$

Equation (5.5) shows the normalization of the fuel performance ($P_{f,norm.}$). From the average fuel performance ($P_{f,avg,general}$) the constant of the statistical minimum value of fuel performance (f_{min}) is subtracted and divided by the subtraction of the constant of the statistical maximum value of fuel performance (f_{max}) and f_{min}.

$$E_{CO_2,norm.} = \frac{E_{CO_2,avg}-E_{CO_2,min}}{E_{CO_2,max}-E_{CO_2,min}} \tag{5.6}$$

To get the normalized CO_2 equivalent emission ($E_{CO_2,norm.}$), Equation (5.6) shows, that the statistical minimum value of CO_2 equivalent emission ($E_{CO_2,min}$) is substracted from the average CO_2 equivalent emission ($E_{CO_2,avg}$) and divided by the subtraction of statistical maximum value of CO_2 equivalent emission ($E_{CO_2,max}$) and $E_{CO_2,min}$.

$$N_{local,norm.} = \frac{N_{local,avg}-N_{local,min,jet}}{N_{local,max,jet}-N_{local,min,jet}} \tag{5.7}$$

The normalized Local Noise Level ($N_{local,norm.}$) is calculated by Equation (5.7). To get the result, the statistical minimum value of the Local Noise Level for jets ($N_{local,min,jet}$) is subtracted from the average Local Noise Level ($N_{local,avg}$) and divided by the subtraction of the statistical maximum value of the Local Noise Level for jets ($N_{local,max,jet}$) and $N_{local,min,jet}$.

$$A_{norm.} = \frac{A_{avg}-A_{min}}{A_{max}-A_{min}} \tag{5.8}$$

Equation (5.8) is used to get the normalized value of the Local Air Pollution ($A_{norm.}$). In this equation the statistical minimum value of the Local Air Pollution (A_{min}) is subtracted from the average Local Air Pollution (A_{avg}) and divided by the subtraction of the statistical maximum value of the Local Air Pollution (A_{max}) and A_{min}.

$$O = (1 - \left(0{,}2 \cdot P_{f,norm.} + 0{,}4 \cdot E_{CO_2,norm.} + 0{,}2 \cdot N_{local,norm.} + 0{,}2 \cdot A_{norm.}\right) \cdot 10 \quad (5.9)$$

Equation (5.9) shows how the *Overall Rating* (O) is calculated. The results of Equations (5.5) – (5.8) are considered and weighted with factors that describe the environmental impact of the assigned emission. The weighing factors are described in Hurtecant (2021, sec. 5.6).

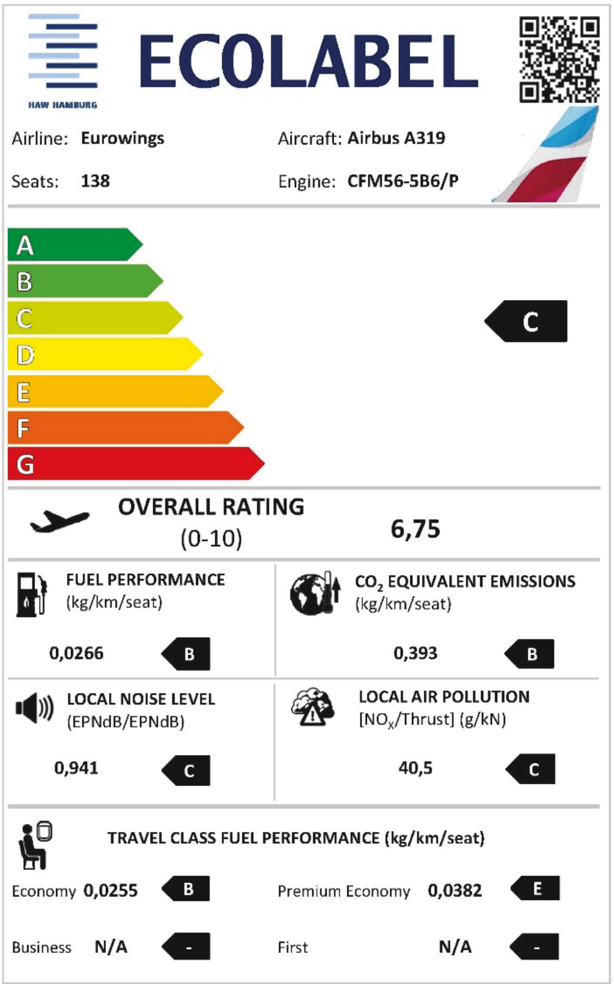

Figure 5.1 Ecolabel of an Airbus A319 from Eurowings

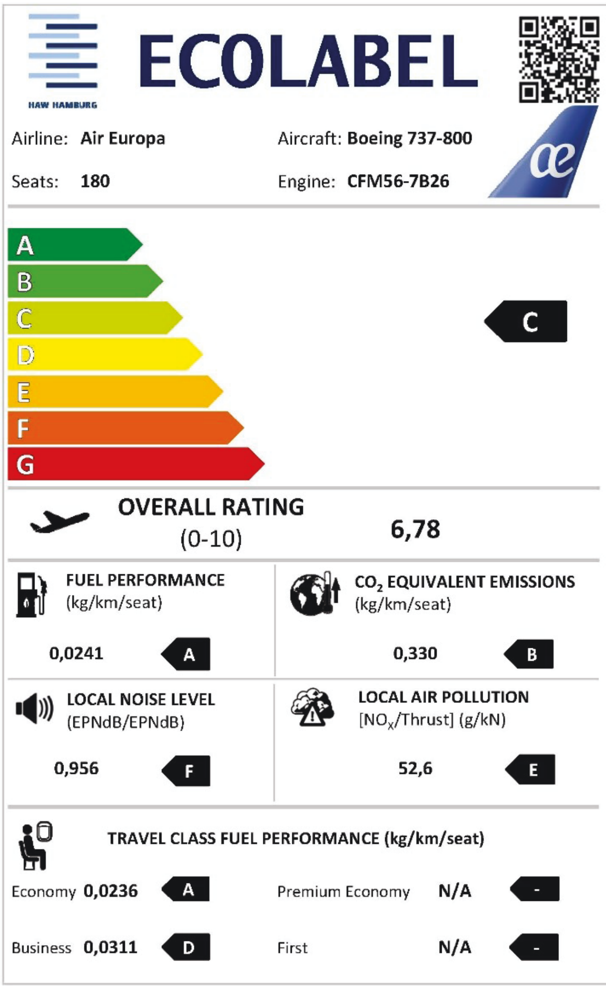

Figure 5.2 Ecolabel of a Boeing 737-800 from Air Europa

A flight from Hamburg to Palma de Mallorca with a layover in Valencia is used as an example for the above-described calculations. The first leg to Valnecia is a flight with Eurowings in an Airbus A319, the ecolabel of this aircraft is shown in Figure 5.1, the second leg is a flight with Air Europa in a Boeing 737-800, the ecolabel of this aircraft is shown in Figure 5.2.

Once the Equations (5.1) – (5.9) are applied to the example, the following results are received:

From Equation (5.1) with: $P_{f,1,\mathrm{general}} = 0{,}0266\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $P_{f,2,\mathrm{general}} = 0{,}0241\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $R_1 = 1761\ \mathrm{km}$; $R_2 = 277\ \mathrm{km}$

$$P_{f,avg,general} = \frac{P_{f,1,\mathrm{general}} \cdot R_1 + P_{f,2,\mathrm{general}} \cdot R_2 + \cdots + P_{f,n,general} \cdot R_n}{R_1 + R_2 + \cdots + R_n}$$

$$P_{f,avg,general} = \frac{0{,}0266 \cdot 1761 + 0{,}0241 \cdot 277}{1761 + 277} \cdot \frac{\frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}} \cdot \mathrm{km}}{\mathrm{km}}$$

$$P_{f,avg,general} = 0{,}0262\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}} \tag{5.10}$$

From Equation (5.1) with: $P_{f,1,\mathrm{EC}} = 0{,}0255\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $P_{f,2,\mathrm{EC}} = 0{,}0236\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $R_1 = 1761\ \mathrm{km}$; $R_2 = 277\ \mathrm{km}$

$$P_{f,avg,EC} = \frac{P_{f,1,\mathrm{EC}} \cdot R_1 + P_{f,2,\mathrm{EC}} \cdot R_2 + \cdots + P_{f,n,EC} \cdot R_n}{R_1 + R_2 + \cdots + R_n}$$

$$P_{f,avg,EC} = \frac{0{,}0255 \cdot 1761 + 0{,}0236 \cdot 277}{1761 + 277} \cdot \frac{\frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}} \cdot \mathrm{km}}{\mathrm{km}}$$

$$P_{f,avg,EC} = 0{,}0252\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}} \tag{5.11}$$

From Equation (5.2) with: $E_{CO_2,1} = 0{,}393\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $E_{CO_2,2} = 0{,}330\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $R_1 = 1761\ \mathrm{km}$; $R_2 = 277\ \mathrm{km}$

$$E_{CO_2,avg} = \frac{E_{CO_2,1} \cdot R_1 + E_{CO_2,2} \cdot R_2 + \cdots + E_{CO_2,n} \cdot R_n}{R_1 + R_2 + \cdots + R_n}$$

$$E_{CO_2,avg} = \frac{0{,}393 \cdot 1761 + 0{,}330 \cdot 277}{1761 + 277} \cdot \frac{\frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}} \cdot \mathrm{km}}{\mathrm{km}}$$

$$E_{CO_2,avg} = 0{,}383\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}} \tag{5.12}$$

From Equation (5.3) with: $N_{local,1} = 0{,}941\ \frac{\text{EPNdB}}{\text{EPNdB}}$; $N_{local,2} = 0{,}956\ \frac{\text{EPNdB}}{\text{EPNdB}}$; $n_{flights} = 2$

$$N_{local,avg} = \frac{N_{local,1} + N_{local,2} + \cdots + N_{local,n}}{n_{flights}}$$

$$N_{local,avg} = \frac{0{,}941 + 0{,}956}{2} \cdot \frac{\frac{\text{EPNdB}}{\text{EPNdB}}}{1}$$

$$N_{local,avg} = 0{,}949\ \frac{\text{EPNdB}}{\text{EPNdB}} \tag{5.13}$$

From Equation (5.4) with: $A_1 = 40{,}5\,\frac{\text{g}}{\text{kN}}$; $A_2 = 52{,}6\,\frac{\text{g}}{\text{kN}}$; $n_{flights} = 2$

$$A_{avg} = \frac{A_1 + A_2 + \cdots + A_n}{n_{flights}}$$

$$A_{avg} = \frac{40{,}5 + 52{,}6}{2} \cdot \frac{\frac{\text{g}}{\text{kN}}}{1}$$

$$A_{avg} = 46{,}55\ \frac{\text{g}}{\text{kN}} \tag{5.14}$$

From Equation (5.5) with: $P_{f,avg,general} = 0{,}0262\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $f_{min} = 0{,}0131\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $f_{max} = 0{,}0798\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$

$$P_{f,norm.} = \frac{P_{f,,avg,general} - f_{min}}{f_{max} - f_{min}}$$

$$P_{f,norm.} = \frac{0{,}0262 - 0{,}0131}{0{,}0798 - 0{,}0131} \cdot \frac{\frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}}{\frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}}$$

$$P_{f,norm.} = 0{,}1967 \tag{5.15}$$

From Equation (5.6) with: $E_{CO_2,avg} = 0{,}383\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $E_{CO_2,min} = 0{,}0543\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $E_{CO_2,max} = 1{,}1066\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$

$$E_{CO_2,norm.} = \frac{E_{CO_2,avg} - E_{CO_2,min}}{E_{CO_2,max} - E_{CO_2,min}}$$

$$E_{CO_2,norm.} = \frac{0{,}383 - 0{,}0543}{1{,}1066 - 0{,}0543} \cdot \frac{\frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}}{\frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}}$$

$$E_{CO_2,norm.} = 0{,}313 \tag{5.16}$$

From Equation (5.7) with: $N_{local,avg} = 0{,}949\ \frac{\text{EPNdB}}{\text{EPNdB}}$; $N_{local,min,jet} = 0{,}81753\ \frac{\text{EPNdB}}{\text{EPNdB}}$; $N_{local,max,jet} = 1{,}00042\ \frac{\text{EPNdB}}{\text{EPNdB}}$

$$N_{local,norm.} = \frac{N_{local,avg} - N_{local,min,jet}}{N_{local,max,jet} - N_{local,min,jet}}$$

$$N_{local,norm.} = \frac{0{,}949 - 0{,}81753}{1{,}00042 - 0{,}81753} \cdot \frac{\frac{\text{EPNdB}}{\text{EPNdB}}}{\frac{\text{EPNdB}}{\text{EPNdB}}}$$

$$N_{local,norm.} = 0{,}716 \tag{5.17}$$

From Equation (5.8) with: $A_{avg} = 46{,}55\ \frac{\text{g}}{\text{kN}}$; $A_{min} = 20{,}4348\ \frac{\text{g}}{\text{kN}}$; $A_{max} = 214{,}2387\ \frac{\text{g}}{\text{kN}}$

$$A_{norm.} = \frac{A_{avg} - A_{min}}{A_{max} - A_{min}}$$

$$A_{norm.} = \frac{46{,}55 - 20{,}4348}{214{,}2387 - 20{,}4348} \cdot \frac{\frac{\text{g}}{\text{kN}}}{\frac{\text{g}}{\text{kN}}}$$

$$A_{norm.} = 0{,}135 \tag{5.18}$$

From Equation (5.9) with: $P_{f,norm.} = 0{,}1967$; $E_{CO_2,norm.} = 0{,}313$; $N_{local,norm.} = 0{,}716$; $A_{norm.} = 0{,}135$

$$O = (1 - \left(0{,}2 \cdot P_{f,norm.} + 0{,}4 \cdot E_{CO_2,norm.} + 0{,}2 \cdot N_{local,norm.} + 0{,}2 \cdot A_{norm.}\right) \cdot 10$$
$$O = (1 - (0{,}2 \cdot 0{,}1967 + 0{,}4 \cdot 0{,}313 + 0{,}2 \cdot 0{,}716 + 0{,}2 \cdot 0{,}135) \cdot 10$$
$$O = 6{,}65 \tag{5.19}$$

The results of Equations (5.10) – (5.14) and (5.19) can be found on the first concept of the *Trip Emission Ecolabel* as shown in Figure 5.3.

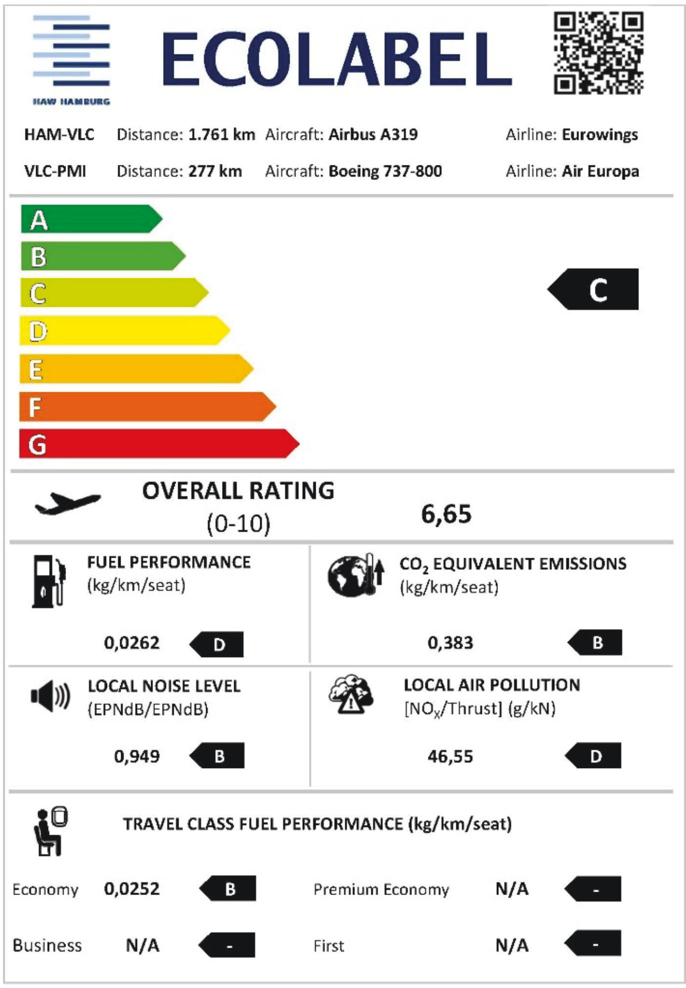

Figure 5.3 Trip Emission Ecolabel of the calculated example

As it can be seen in comparison of Figures 5.1 and 5.2 to Figure 5.3, the *Overall Rating* of the combined flight is slightly worse than the two separate *Overall Ratings* of the aircraft. This is not due to the additional landing, but due to the interaction of different cabin layouts and the values of the two original aircraft. The Local Noise Levels and the Local Air Pollutions are not added due to an additional landing as seen in Equation (5.3) and (5.4). The higher the value of the rating the better, additionally grade A is best and grade G is worst.

5.1.2 Second Concept of Hurtecant

For the second concept of Hurtecant, the values of the *Ecolabels for Aircraft* are used to calculate the absolute impact of the flights and compare the connection to a reference flight as following:

$$P_{f,total} = P_{f,1} \cdot R_1 + P_{f,2} \cdot R_2 + \cdots + P_{f,n} \cdot R_n \quad (5.20)$$

Equation (5.20) calculates the total amount of burnt fuel per seat ($P_{f,total}$) by adding the multiplication of the fuel performances of the operated aircraft ($P_{f,1}$; $P_{f,2}$; … ; $P_{f,n}$) and the related flown distances (R_1 ; R_2 ; … ; R_n). This equation applies for the general fuel per seat of the aircraft and to the travel class fuel per seat.

$$E_{CO_2,total} = E_{CO_2,1} \cdot R_1 + E_{CO_2,2} \cdot R_2 + \cdots + E_{CO_2,n} \cdot R_n \quad (5.21)$$

Equation (5.21) is used to calculate the total amount of CO_2 equivalent emission ($E_{CO_2,total}$) per seat into the atmosphere by adding the multiplication of CO_2 equivalent emission of the operated aircraft ($E_{CO_2,1}$; $E_{CO_2,2}$; … ; $E_{CO_2,n}$) and the related flown distances (R_1 ; R_2 ; … ; R_n).

$$N_{local,total} = N_{local,1} + N_{local,2} + \cdots + N_{local,n} \quad (5.22)$$

Equation (5.22) shows the calculation of the total amount of Local Noise Level ($N_{local,total}$) emitted. To calculate this value the Local Noise Levels of the operated aircraft ($N_{local,1}$; $N_{local,2}$; … ; $N_{local,n}$) are added up.

$$A_{total} = \frac{A_1 \cdot T_1}{n_{seats,1}} + \frac{A_2 \cdot T_2}{n_{seats,2}} + \cdots + \frac{A_n \cdot T_n}{n_{seats,n}} \quad (5.23)$$

Equation (5.23) calculates the total amount of Local Air Pollution (A_{total}) by summarizing the multiplication of Local Air Pollutions (A_1 ; A_2 ; … ; A_n) and the overall thrust (T_1 ; T_2 ;

… ; T_n) and divided by the number of seats of the operated aircraft ($n_{seats,1}$; $n_{seats,2}$; … ; $n_{seats,n}$).

To make the above calculated results easier to compare, they are converted into ratios in comparison of the reference flight as shown in Equations (5.24) – (5.28):

$$r = \frac{I_{TEE}}{I_{ref}} \tag{5.24}$$

$$r_{P_f} = \frac{P_{f,total,general}}{P_{f,ref}} \tag{5.25}$$

$$r_{E_{CO_2}} = \frac{E_{CO_2,total}}{E_{CO_2,ref}} \tag{5.26}$$

$$r_{L_{noise}} = \frac{L_{noise,total}}{L_{noise,ref}} \tag{5.27}$$

$$r_A = \frac{A_{total}}{A_{ref}} \tag{5.28}$$

To calculate the *Environmental Rating* ($S_{Env.}$) the ratios are multiplied with weighing factors according to the environmental impact of the emission as shown in Equation (5.29). The factors are defined like the ones in Section 5.1.1 and described in Hurtecant (2021, sec. 5.6).

$$S_{Env.} = 0{,}2 \cdot r_{P_f} + 0{,}4 \cdot r_{E_{CO_2}} + 0{,}2 \cdot r_{L_{noise}} + 0{,}2 \cdot r_A \tag{5.29}$$

As an example, for the calculations of the second concept, the same flight connection of Section 5.1.1 and Figures 5.1 and 5.2 is used.

From Equation (5.20) with: $P_{f,1,\text{general}} = 0{,}02661\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $P_{f,2,\text{general}} = 0{,}02412\ \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $R_1 = 1761\ \text{km}$; $R_2 = 277\ \text{km}$

$$P_{f,total,general} = P_{f,1} \cdot R_1 + P_{f,2} \cdot R_2 + \cdots + P_{f,n,general} \cdot R_n$$

$$P_{f,total,general} = (0{,}02661 \cdot 1761 + 0{,}02412 \cdot 277) \cdot \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}} \cdot \text{km}$$
$$P_{f,total,general} = 56{,}1\ \frac{\text{kg}}{\text{seat}} \tag{5.30}$$

From Equation (5.20) with: $P_{f,1,\mathrm{EC}} = 0{,}0255\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $P_{f,2,\mathrm{EC}} = 0{,}0236\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $R_1 = 1761$ km ; $R_2 = 277$ km

$$P_{f,total,EC} = P_{f,1,\mathrm{EC}} \cdot R_1 + P_{f,2,\mathrm{EC}} \cdot R_2 + \cdots + P_{f,n,EC} \cdot R_n$$

$$P_{f,total,EC} = (0{,}0255 \cdot 1761 + 0{,}0236 \cdot 277) \cdot \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}} \cdot \mathrm{km}$$

$$P_{f,total,EC} = 53{,}9\ \frac{\mathrm{kg}}{\mathrm{seat}} \tag{5.31}$$

From Equation (5.21) with: $E_{CO_2,1} = 0{,}3933\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $E_{CO_2,2} = 0{,}3300\ \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}}$; $R_1 = 1761$ km ; $R_2 = 277$ km

$$E_{CO_2,total} = E_{CO_2,1} \cdot R_1 + E_{CO_2,2} \cdot R_2 + \cdots + E_{CO_2,n} \cdot R_n$$

$$E_{CO_2,total} = (0{,}3933 \cdot 1761 + 0{,}3300 \cdot 277) \cdot \frac{\frac{\mathrm{kg}}{\mathrm{km}}}{\mathrm{seat}} \cdot \mathrm{km}$$

$$E_{CO_2,total} = 820{,}3\ \frac{\mathrm{kg}}{\mathrm{seat}} \tag{5.32}$$

From Equation (5.22) with: $N_{local,1} = 0{,}9408\ \frac{\mathrm{EPNdB}}{\mathrm{EPNdB}}$; $N_{local,2} = 0{,}9560\ \frac{\mathrm{EPNdB}}{\mathrm{EPNdB}}$

$$N_{local,total} = N_{local,1} + N_{local,2} + \cdots + N_{local,n}$$

$$N_{local,total} = (0{,}9408 + 0{,}9560) \cdot \frac{\mathrm{EPNdB}}{\mathrm{EPNdB}}$$

$$N_{local,total} = 1{,}897\ \frac{\mathrm{EPNdB}}{\mathrm{EPNdB}} \tag{5.33}$$

From Equation (5.23) with: $A_1 = 40{,}49\ \frac{\mathrm{g}}{\mathrm{kN}}$; $A_2 = 52{,}56\ \frac{\mathrm{g}}{\mathrm{kN}}$; $T_1 = 2 \cdot 104{,}53$ kN ; $T_2 = 2 \cdot 116{,}99$ kN ; $n_{seats,1} = 138$; $n_{seats,2} = 180$

$$A_{total} = \frac{A_1 \cdot T_1}{n_{seats,1}} + \frac{A_2 \cdot T_2}{n_{seats,2}} + \cdots + \frac{A_n \cdot T_n}{n_{seats,n}}$$

$$A_{total} = \left(\frac{40{,}49 \cdot 2 \cdot 104{,}53}{138} + \frac{52{,}56 \cdot 2 \cdot 116{,}99}{180}\right) \cdot \frac{\frac{\text{g}}{\text{kN}} \cdot \text{kN}}{\text{seat}}$$

$$A_{total} = 129{,}7\ \frac{\text{g}}{\text{seat}} \tag{5.34}$$

From Equation (5.25) with: $P_{f,total,general} = 56{,}1\ \frac{\text{kg}}{\text{seat}}$; $P_{f,ref} = 66{,}4\ \frac{\text{kg}}{\text{seat}}$

$$r_{P_f} = \frac{P_{f,total,general}}{P_{f,ref}}$$

$$r_{P_f} = \frac{56{,}1}{66{,}4} \cdot \frac{\frac{\text{kg}}{\text{seat}}}{\frac{\text{kg}}{\text{seat}}}$$

$$r_{P_f} = 0{,}84 \tag{5.35}$$

From Equation (5.26) with: $E_{CO_2,total} = 820{,}3\ \frac{\text{kg}}{\text{seat}}$; $E_{CO_2,ref} = 909{,}0\ \frac{\text{kg}}{\text{seat}}$

$$r_{E_{CO_2}} = \frac{E_{CO_2,total}}{E_{CO_2,ref}}$$

$$r_{E_{CO_2}} = \frac{820{,}3}{909{,}0} \cdot \frac{\frac{\text{kg}}{\text{seat}}}{\frac{\text{kg}}{\text{seat}}}$$

$$r_{E_{CO_2}} = 0{,}90 \tag{5.36}$$

From Equation (5.27) with: $L_{noise,total} = 1{,}897\ \frac{\text{EPNdB}}{\text{EPNdB}}$; $L_{noise,ref} = 0{,}954\ \frac{\text{EPNdB}}{\text{EPNdB}}$

$$r_{L_{noise}} = \frac{L_{noise,total}}{L_{noise,ref}}$$

$$r_{L_{noise}} = \frac{1{,}897}{0{,}954} \cdot \frac{\frac{\text{EPNdB}}{\text{EPNdB}}}{\frac{\text{EPNdB}}{\text{EPNdB}}}$$

$$r_{L_{noise}} = 1{,}99$$

(5.37)

From Equation (5.28) with: $A_{total} = 129{,}7 \frac{\text{g}}{\text{seat}}$; $A_{ref} = 49{,}9 \frac{\text{g}}{\text{seat}}$

$$r_A = \frac{A_{total}}{A_{ref}}$$

$$r_A = \frac{129{,}7}{49{,}9} \cdot \frac{\frac{\text{g}}{\text{seat}}}{\frac{\text{g}}{\text{seat}}}$$

$$r_A = 2{,}60$$

(5.38)

From Equation (5.29) with: $r_{P_f} = 0{,}84$; $r_{E_{CO_2}} = 0{,}90$; $r_{L_{noise}} = 1{,}99$; $r_A = 2{,}60$

$$S_{Env.} = 0{,}2 \cdot r_{P_f} + 0{,}4 \cdot r_{E_{CO_2}} + 0{,}2 \cdot r_{L_{noise}} + 0{,}2 \cdot r_A$$
$$S_{Env.} = 0{,}2 \cdot 0{,}84 + 0{,}4 \cdot 0{,}90 + 0{,}2 \cdot 1{,}99 + 0{,}2 \cdot 2{,}60$$
$$S_{Env.} = 1{,}45$$

(5.39)

The calculated results of Equations (5.30) – (5.34) and (5.39) are shown at the *Trip Emission Ecolabel* of the second concept in Figure 5.4, also the results of the ratios from Equations (5.35) – (5.38) are given in brackets behind the value. For the *Environmental Rating*, in contrast to the *Overall Rating*, a lower value is better.

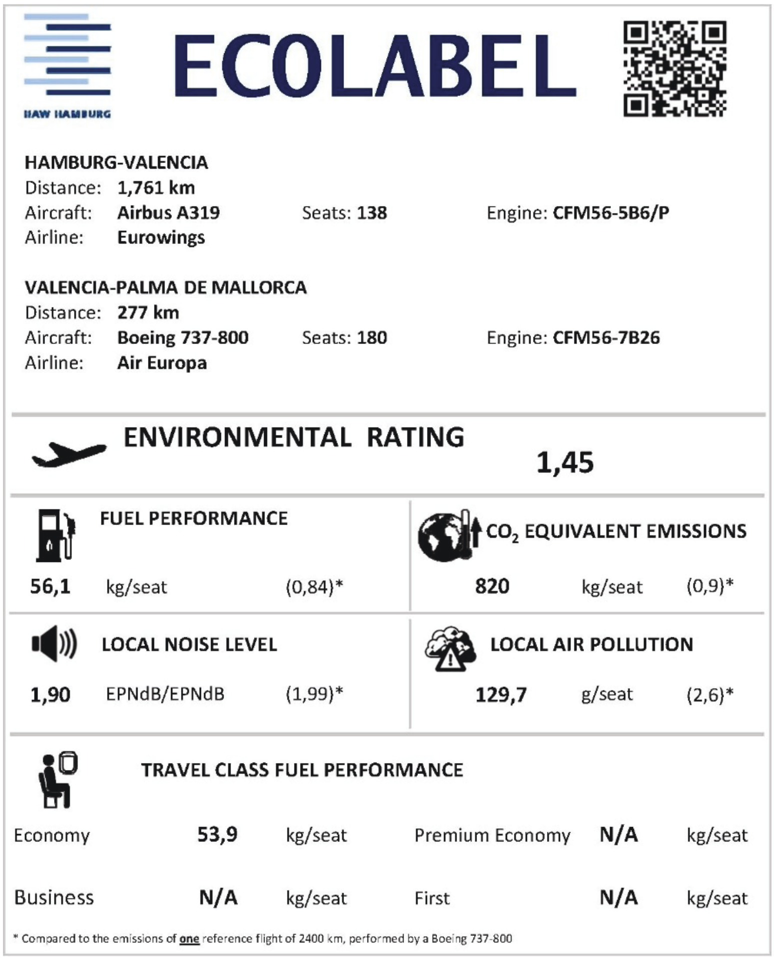

Figure 5.4 Trip Emission Ecolabel of the calculated example

5.2 Evaluation of the Two Trip Emission Ecolabels

To reveal some shortcomings of the first concept, described in Section 5.1.1, another example was calculated. The result of the first calculation, done like in Section 5.1.1, is shown in Figure 5.5. Calculated is a flight connection of Vueling with a layover in Barcelona and both flights executed by an Airbus A320. Figure 5.6 shows an *Ecolabel for Aircraft*, in this case an Airbus A320 of Lauda Europe, as a direct flight.

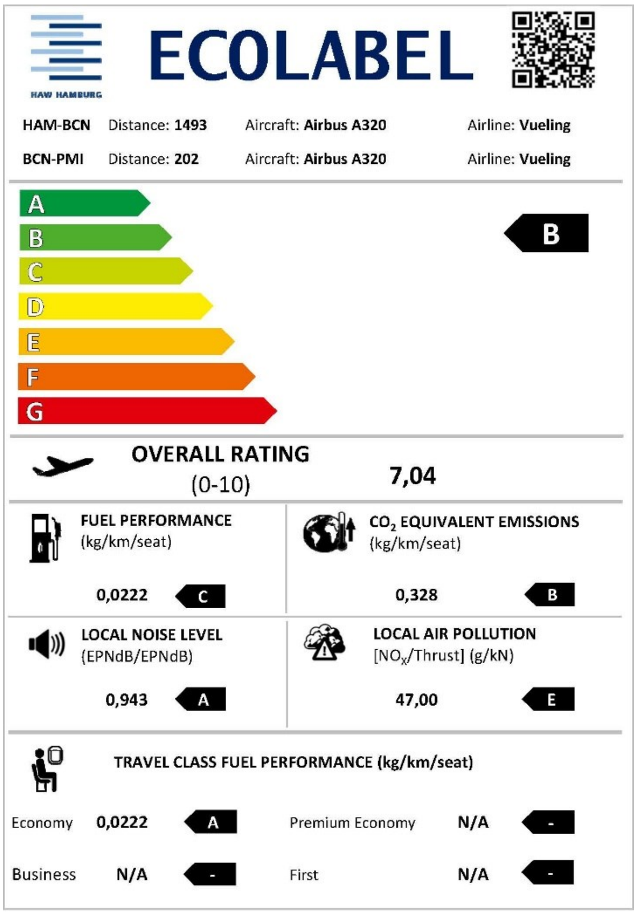

Figure 5.5 Trip Emission Ecolabel from Hamburg to Palma de Mallorca with layover in Barcelona operated by Vueling

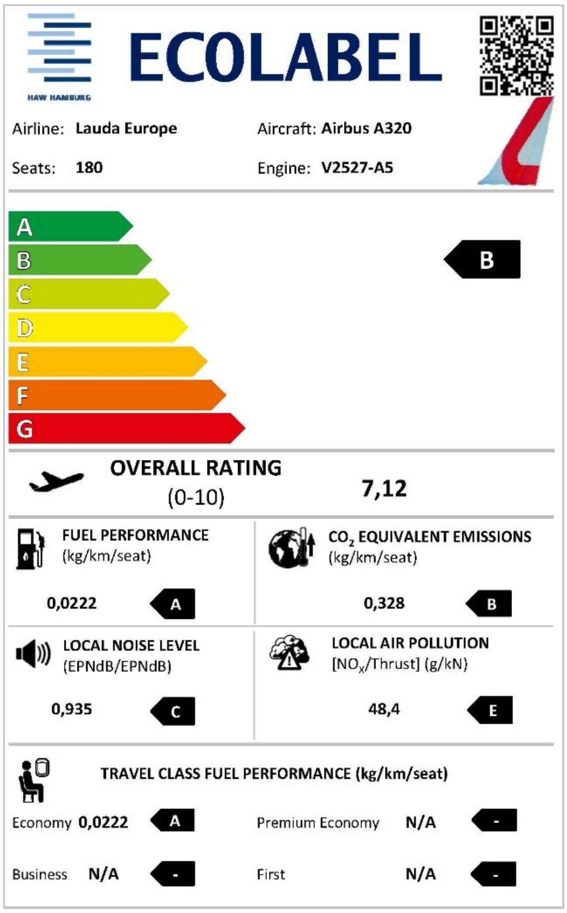

Figure 5.6 Ecolabel for Airbus A320 from Lauda Europe as direct flight from Hamburg to Palma de Mallorca

The minor difference in the ratings of Figures 5.5 and 5.6 is due to a minor difference in the installed engines of both connections, not the fact that in case of Figure 5.5 an additional landing is performed.

Figures 5.7 and 5.8 show the same connections as above, but know calculated with the second concept, as described in Section 5.1.2. As seen in comparison of Figures 5.7 and 5.8 a well notable difference in the ratings is given with the second concept due to the summation of the Local Air Pollution and the summation of the Local Noise Level.

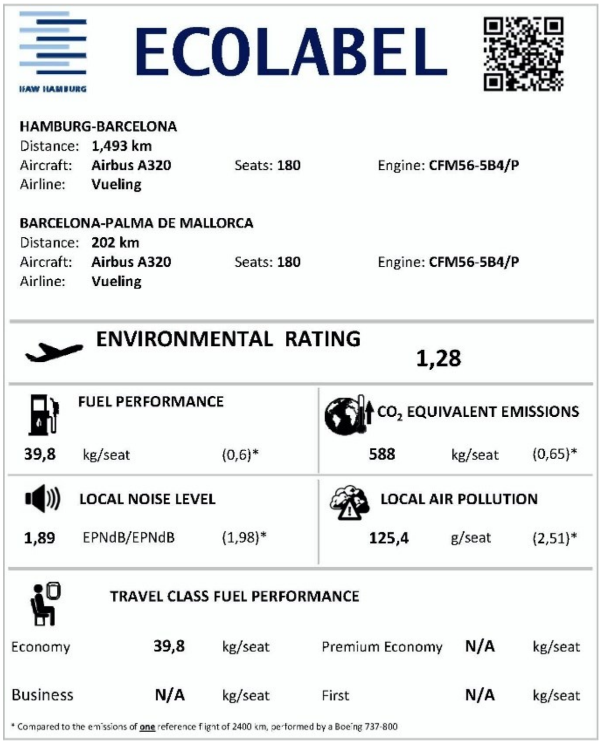

Figure 5.7 Trip Emission Ecolabel from Hamburg to Palma de Mallorca with layover in Barcelona operated by Vueling

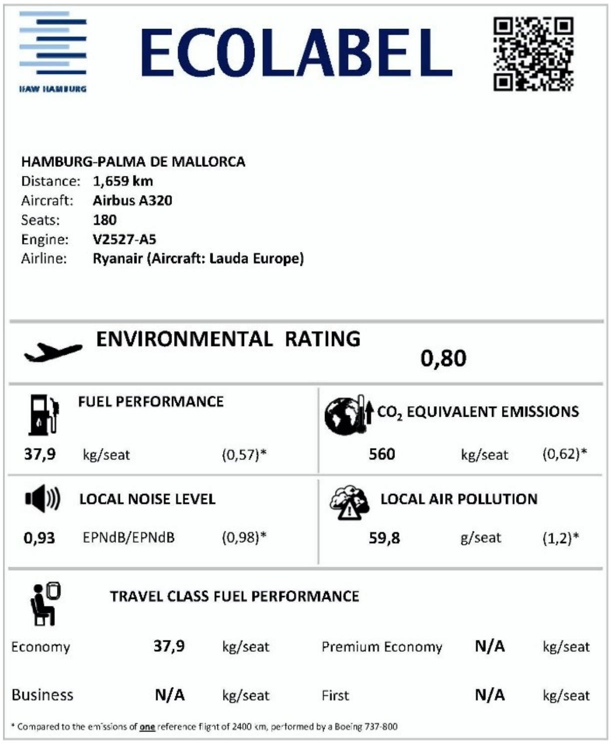

Figure 5.8 Trip Emission Ecolabel as direct flight from Hamburg to Palma de Mallorca operated by Ryanair with an aircraft from Lauda Europe

Due to the mentioned shortcomings of the first concept and it additionally does not give helpful results when a flight connection deviates a lot from the direct route and distorts the comparison with other connections, for this project the second concept was chosen. Because the values and the ratings of the second concept are compared to the same reference flight, the rating can be considered normalized and is comparable for all calculated flight connections from an origin airport to the destination airport. The second concept also has the benefit, that the absolute environmental impact is given with the values and a passenger gets a better idea of how the environment is affected by the flights or chosen connections.

6 Comparison of Flight Connections

In this chapter not all 100 during this project calculated connections will be discussed, even the calculated connections are not all available connections. Due to the massive amount of possible flight connections a selection was done to represent reasonable and interesting flight connections. Due to the rapid change of ticket prices, the ticket prices in this project are results of a search with a flight planned 2,5 months in the future. All ticket prices are generated for the same date of flight to be comparable. The tables in this chapter are shortened for better legibility and a better overview. More detailed tables of the flight connections can be found in Appendix E. All calculated *Trip Emission Ecolabels* for this project can be found in Appendix D.

6.1 Domestic Flight from Hamburg to Munich

Table 6.1 Comparison of flights from Hamburg to Munich

No.	Airlines	Stopover	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	EW	-	64	01:25	600	0,60
03	LH	-	83	01:20	600	0,65
05	EW - LH	DUS	254	02:20	827	1,17
08	EW	DUS	149	02:15	827	0,97
09	LH	FRA	181	02:05	712	1,23

Table 6.1 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Munich, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the Trip Emission Ecolabel. The detailed table can be found at Table E.1 in the appendix.

Figure 6.1 shows the routes of the evaluated flight connections from Hamburg to Munich.

Figures 6.2 – 6.5 show the results of Table 6.1 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

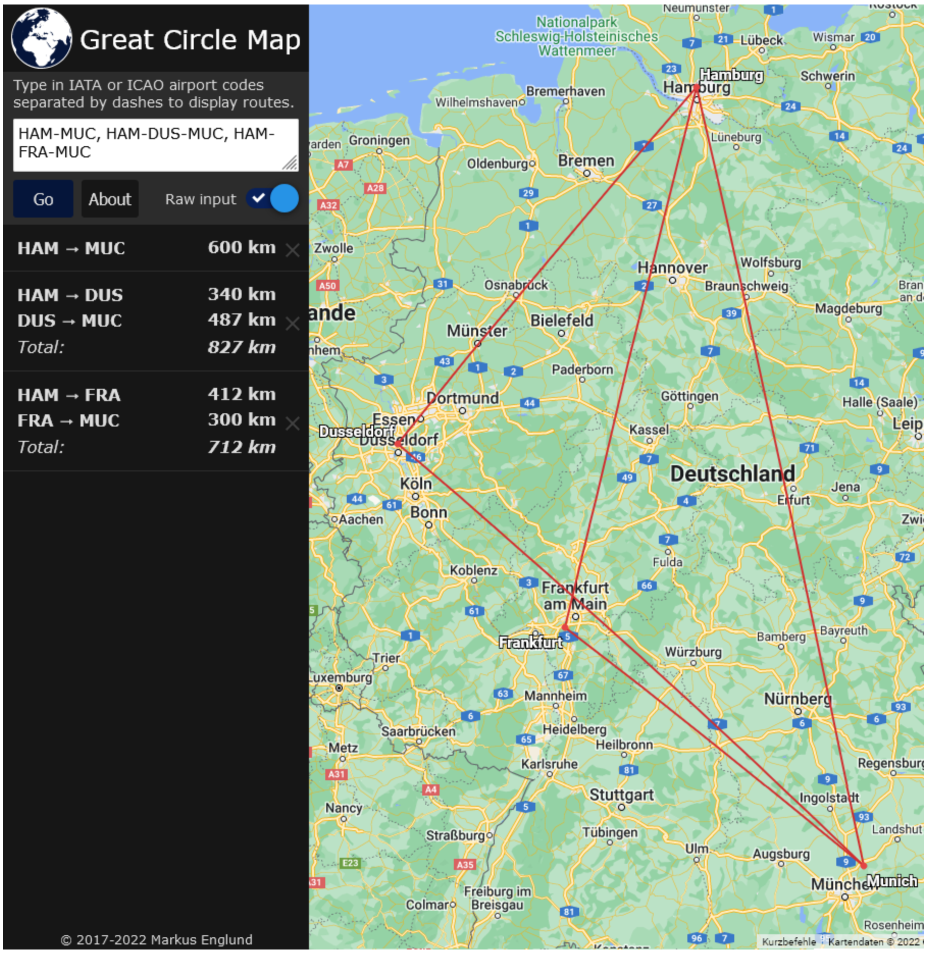

Figure 6.1 Flight connections from Hamburg to Munich (greatcirclemap.com)

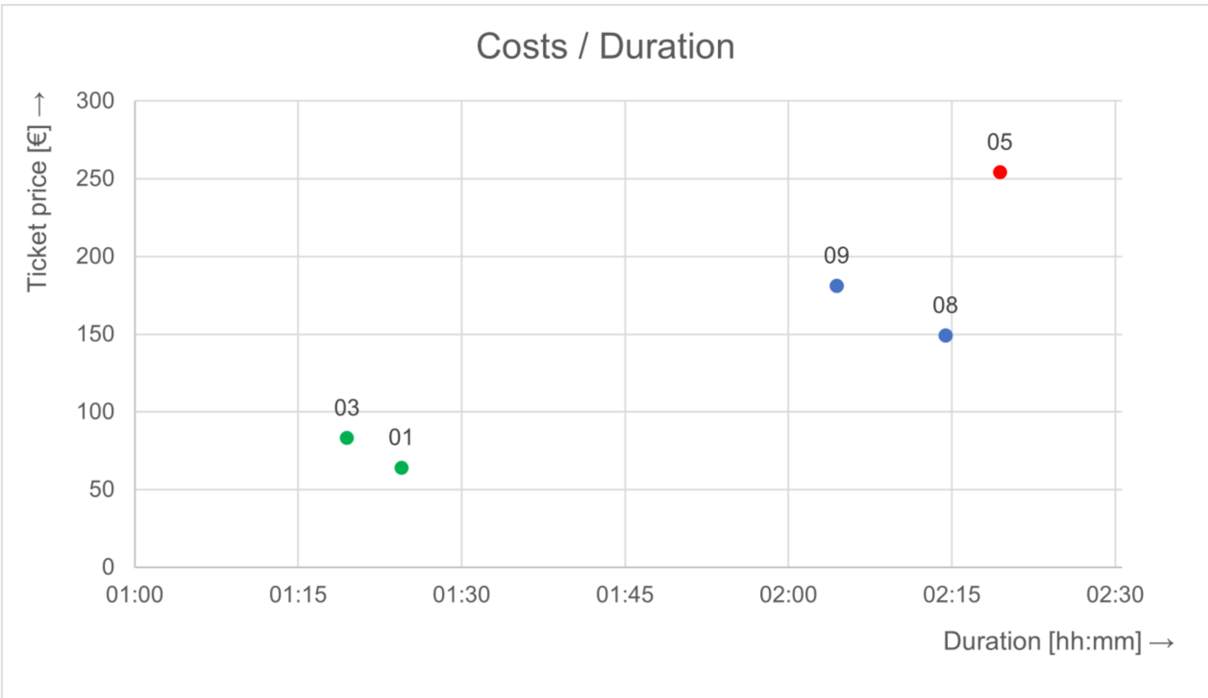

Figure 6.2 Distribution of costs over duration of the flights from Hamburg to Munich

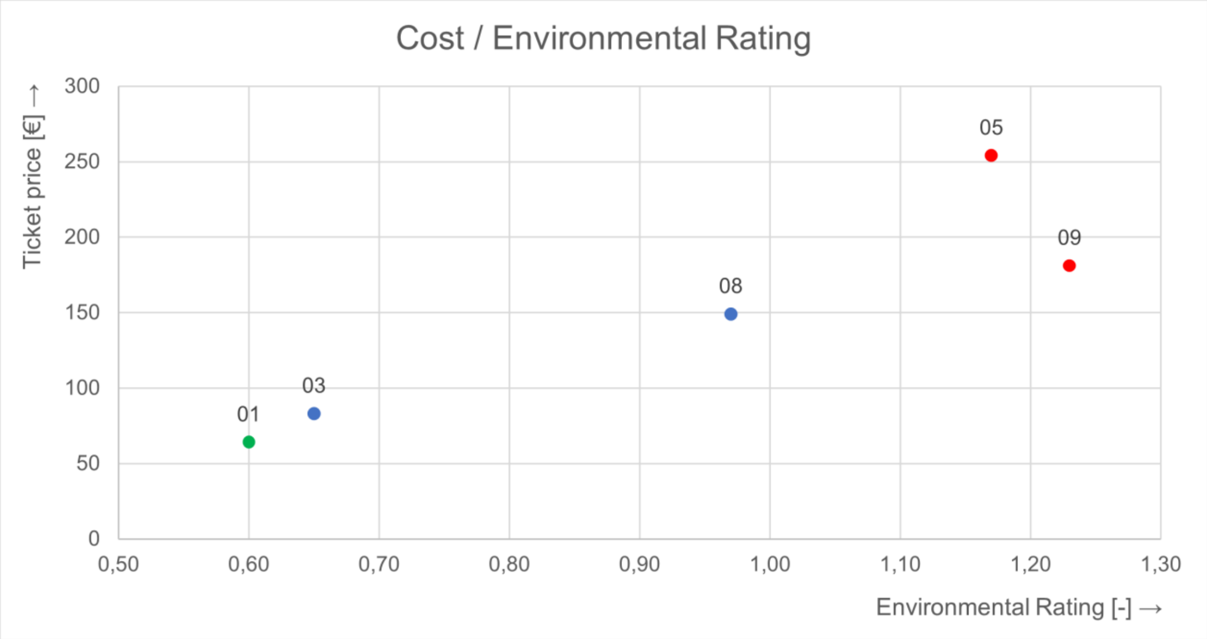

Figure 6.3 Distribution of costs over Environmental Rating of the flights from Hamburg to Munich

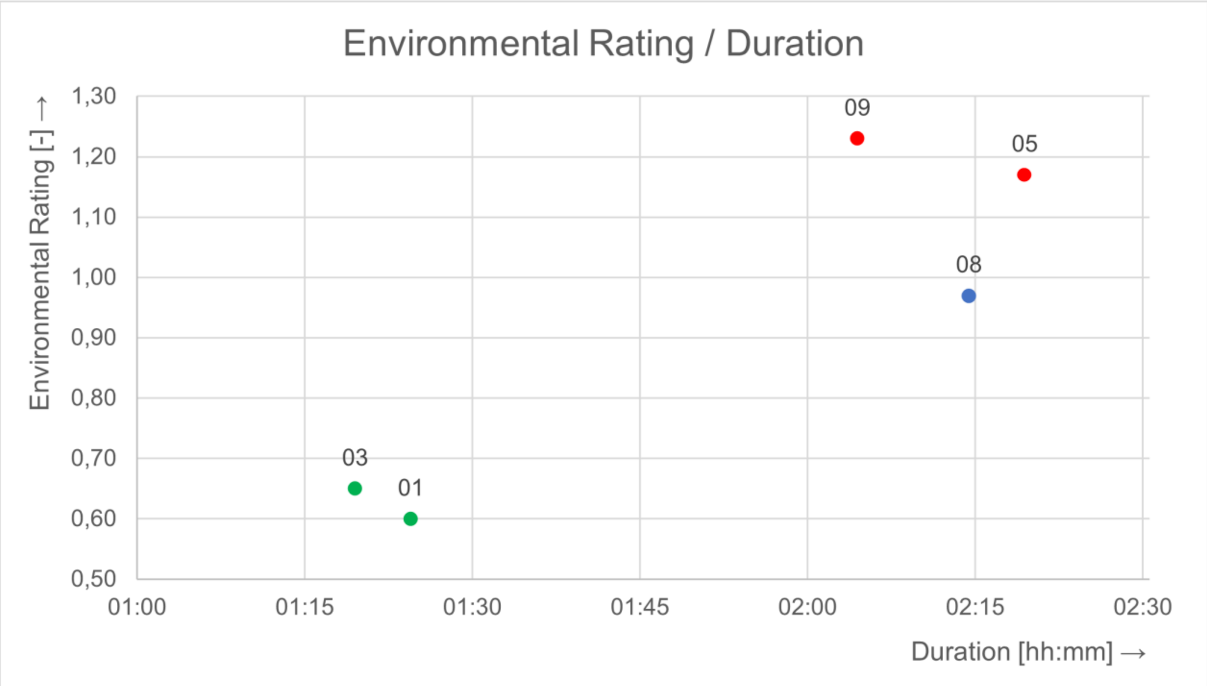

Figure 6.4 Distribution of the Environmental Rating over duration of the flights from Hamburg to Munich

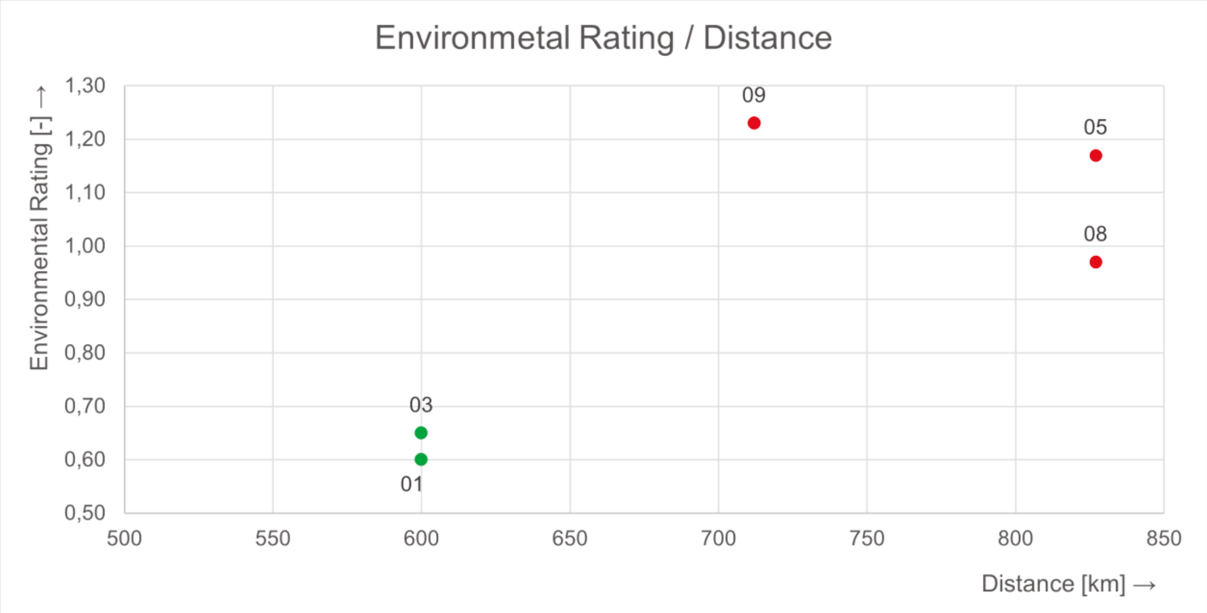

Figure 6.5 Distribution of the Environmental Rating over distance of the flights from Hamburg to Munich

6.2 Medium-Haul Flight from Hamburg to Palma de Mallorca

Table 6.2 Comparison of flights from Hamburg to Palma de Mallorca

No.	Airlines	Stopover	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	FR	-	83	02:35	1.659	0,82
03	DE	-	169	02:45	1.659	1,08
04	FR	-	134	02:35	1.659	0,80
07	EW	-	184	02:45	1.659	0,88
08	EW - UX	BCN	185	03:20	1.695	1,32
09	VY	BCN	200	03:30	1.695	1,28

Table 6.2 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Palma de Mallorca, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.2 in the appendix.

Figure 6.6 shows the routes of the evaluated flight connections from Hamburg to Palma de Mallorca.

Figures 6.7 – 6.10 show the results of Table 6.2 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

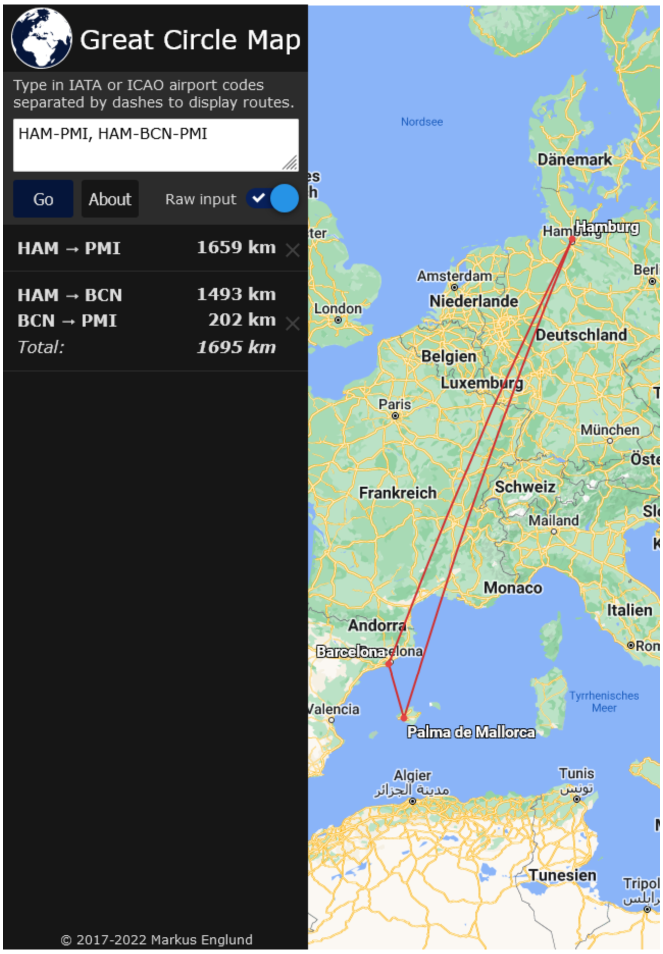

Figure 6.6 Flight connections from Hamburg to Mallorca (greatcirclemap.com)

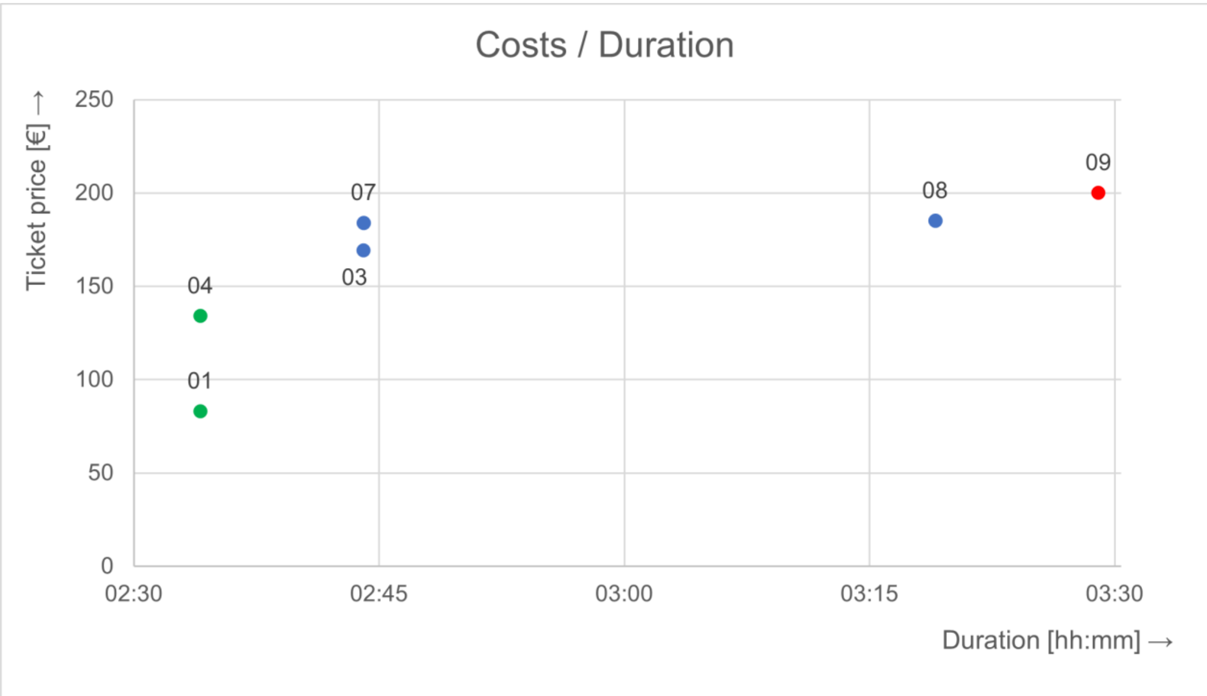

Figure 6.7 Distribution of costs over duration of the flights from Hamburg to Palma de Mallorca

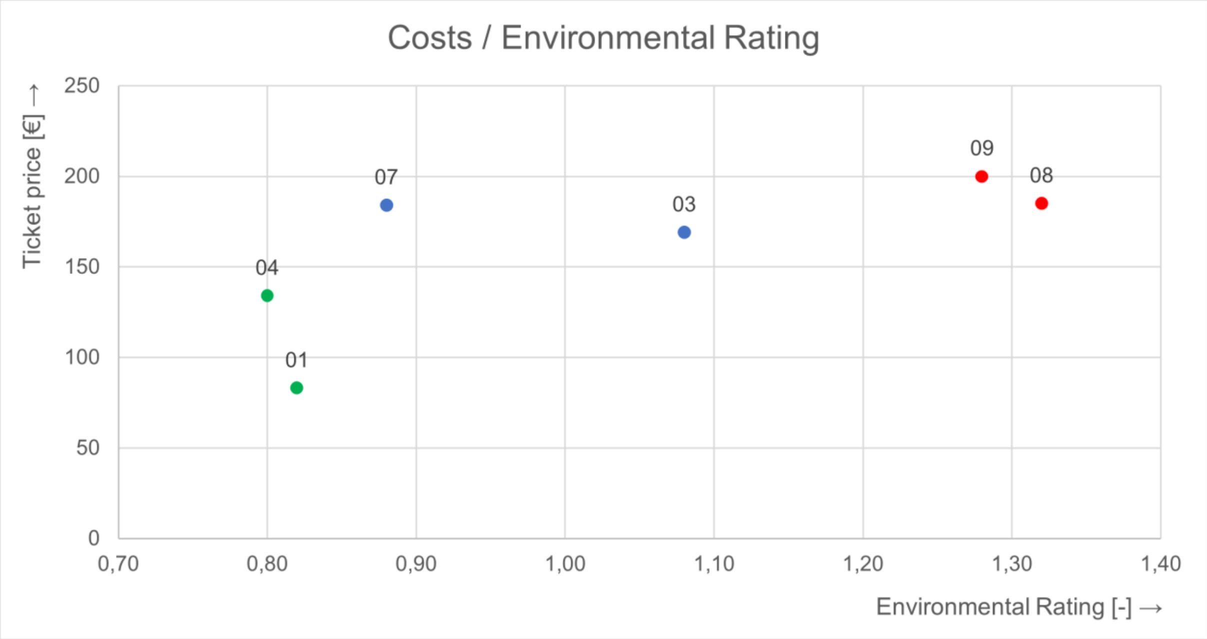

Figure 6.8 Distribution of costs over Environmental Rating of the flights from Hamburg to Palma de Mallorca

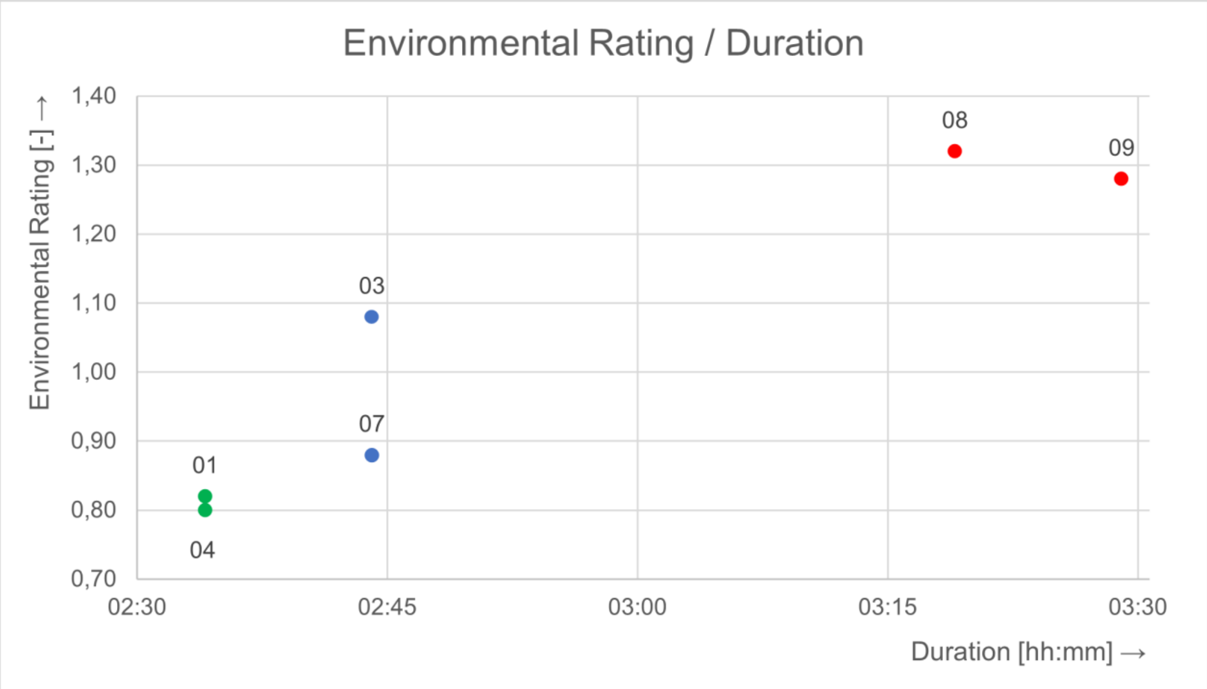

Figure 6.9 Distribution of the Environmental Rating over duration of the flights from Hamburg to Palma de Mallorca

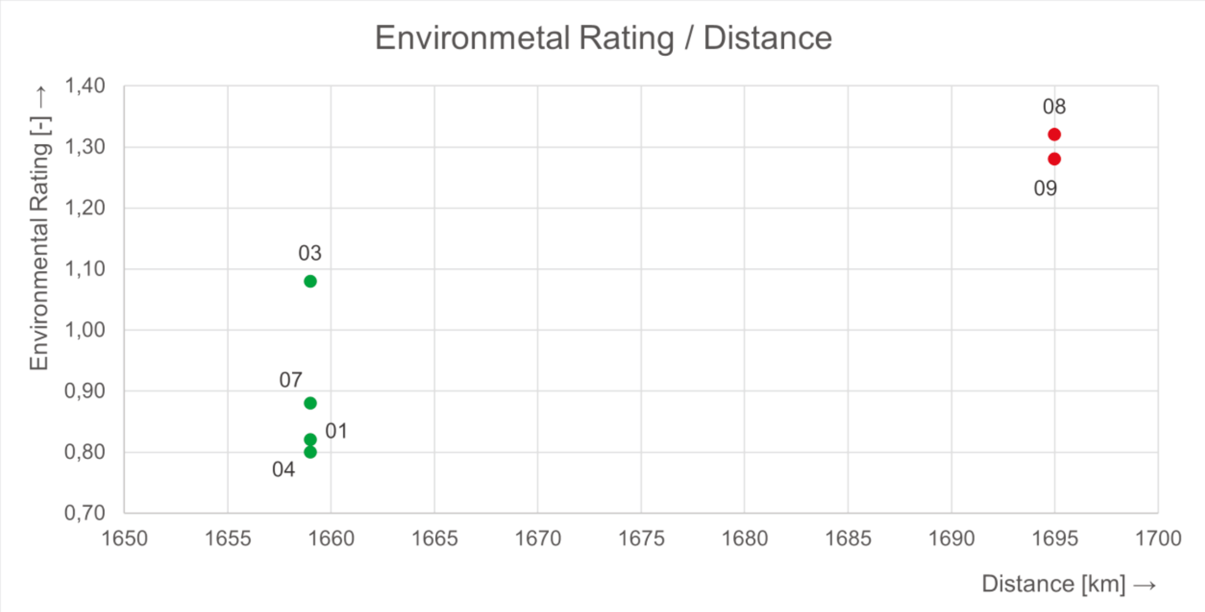

Figure 6.10 Distribution of the Environmental Rating over distance of the flights from Hamburg to Palma de Mallorca

6.3 Medium-Haul Flight from Hamburg to Gran Canaria

Table 6.3 Comparison of flights from Hamburg to Gran Canaria

No.	Airlines	Stopover 1	Stopover 2	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	LH - 4Y	FRA	-	227	05:45	3.597	1,77
02	IB	MAD	-	235	05:45	3.545	1,63
05	LX - WK	ZRH	-	191	05:50	3.695	1,66
06	KL - UX	AMS	MAD	181	06:40	3.604	4,50
07	TP	LIS	-	201	05:50	3.536	2,07
08	EW - WK	ZRH	-	207	05:50	3.695	1,75

Table 6.3 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Gran Canaria, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.3 in the appendix.

Figure 6.11 shows the routes of the evaluated flight connections from Hamburg to Gran Canaria.

Figures 6.12 – 6.15 show the results of Table 6.3 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

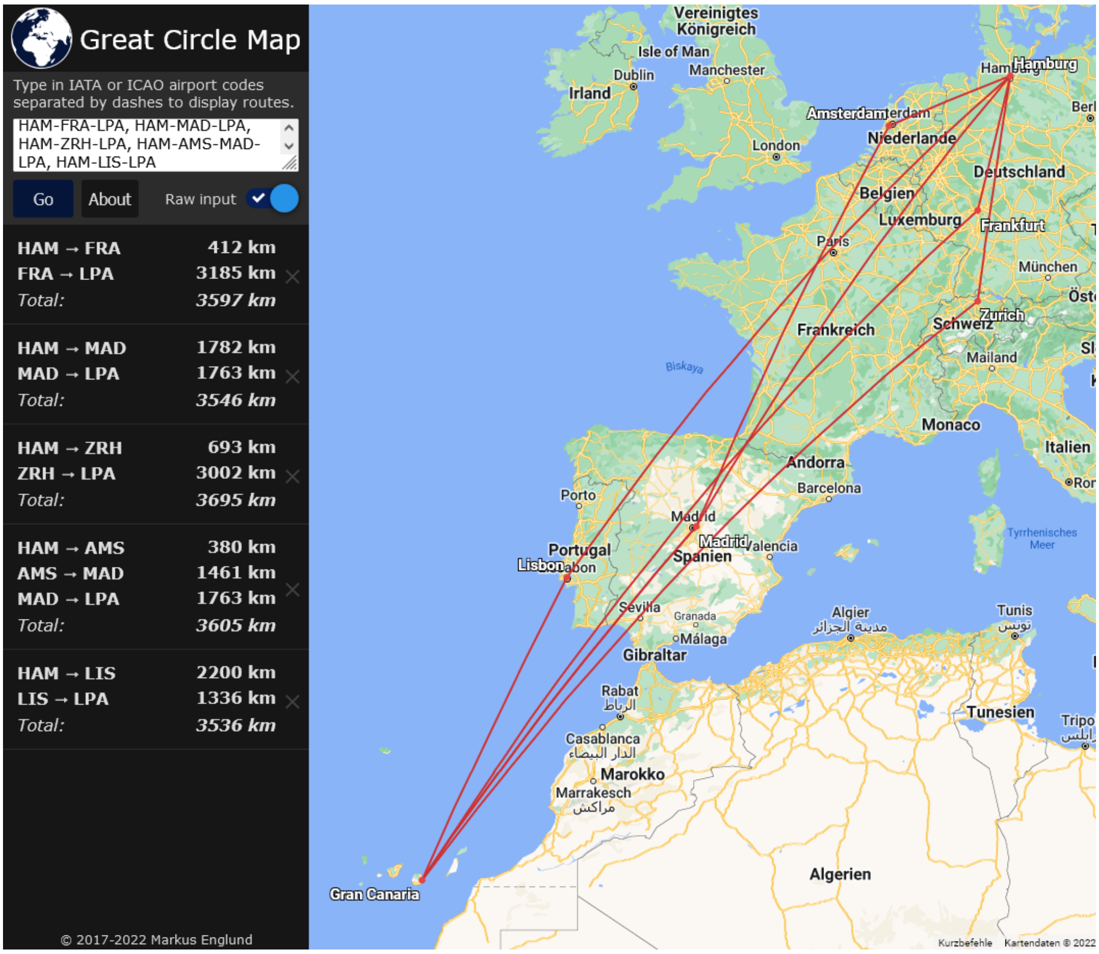

Figure 6.11 Flight connections from Hamburg to Gran Canaria (greatcirclemap.com)

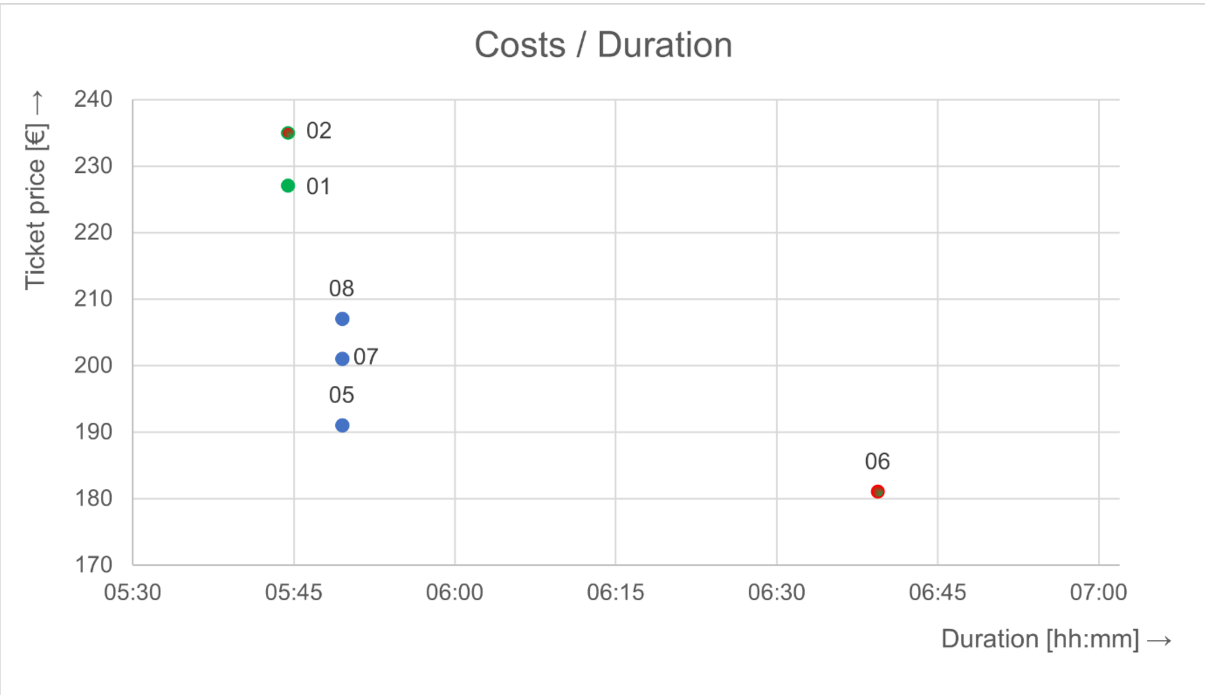

Figure 6.12 Distribution of costs over duration of the flights from Hamburg to Gran Canaria

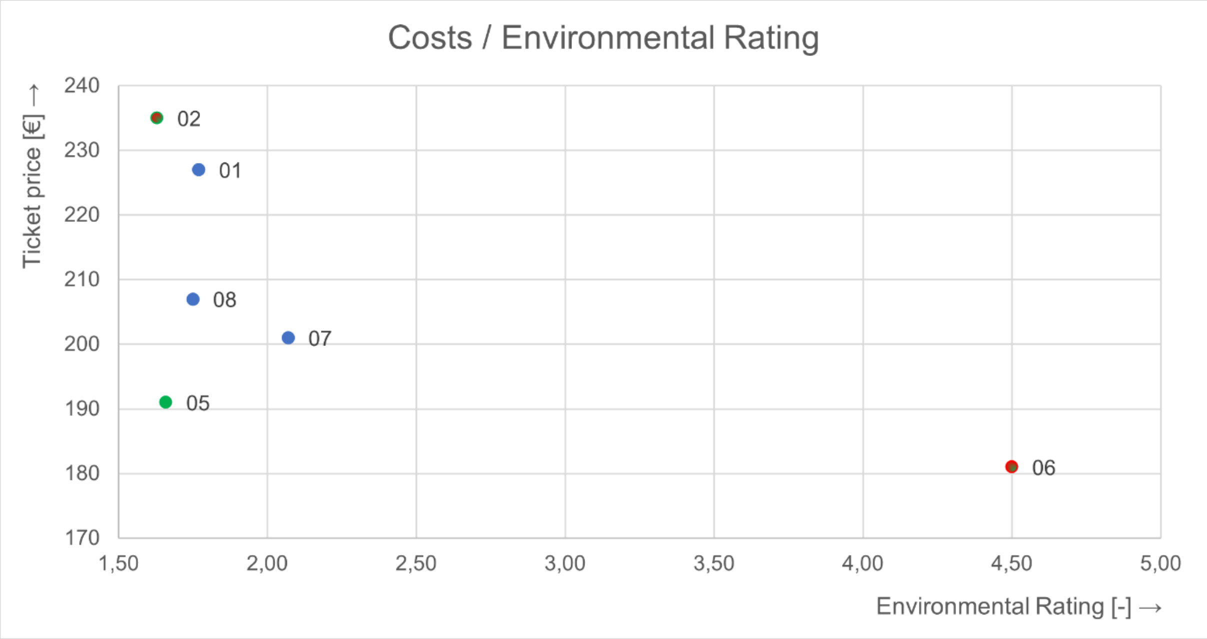

Figure 6.13 Distribution of costs over Environmental Rating of the flights from Hamburg to Gran Canaria

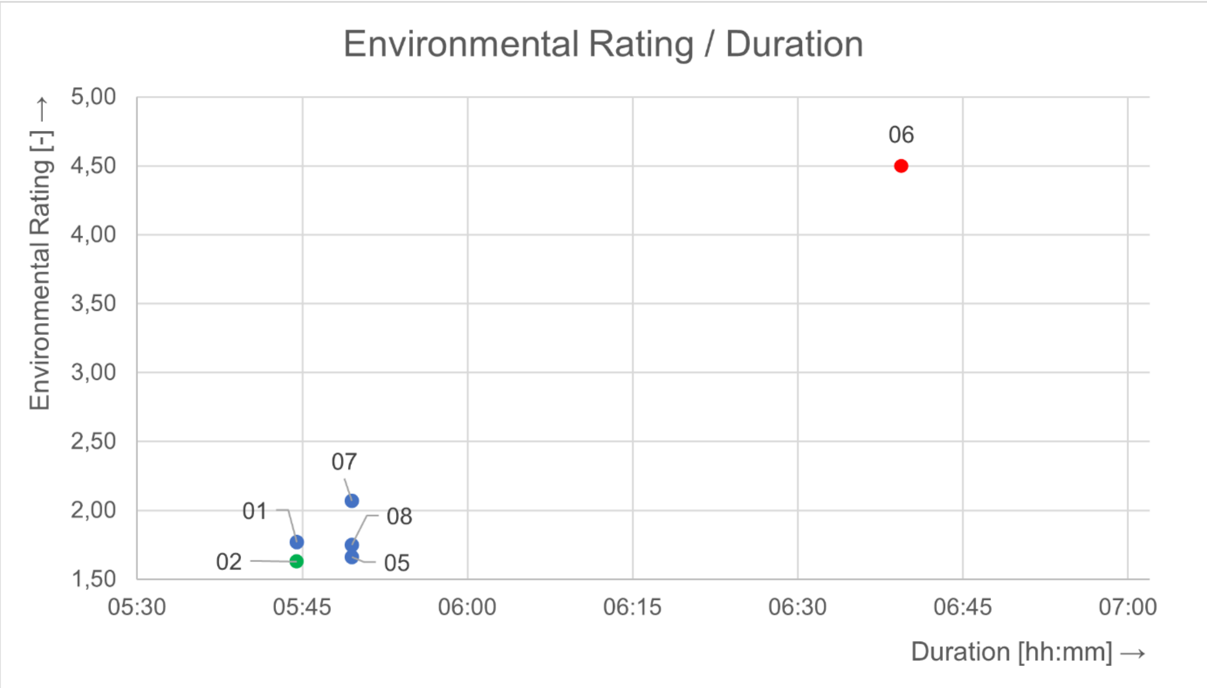

Figure 6.14 Distribution of the Environmental Rating over duration of the flights from Hamburg to Gran Canaria

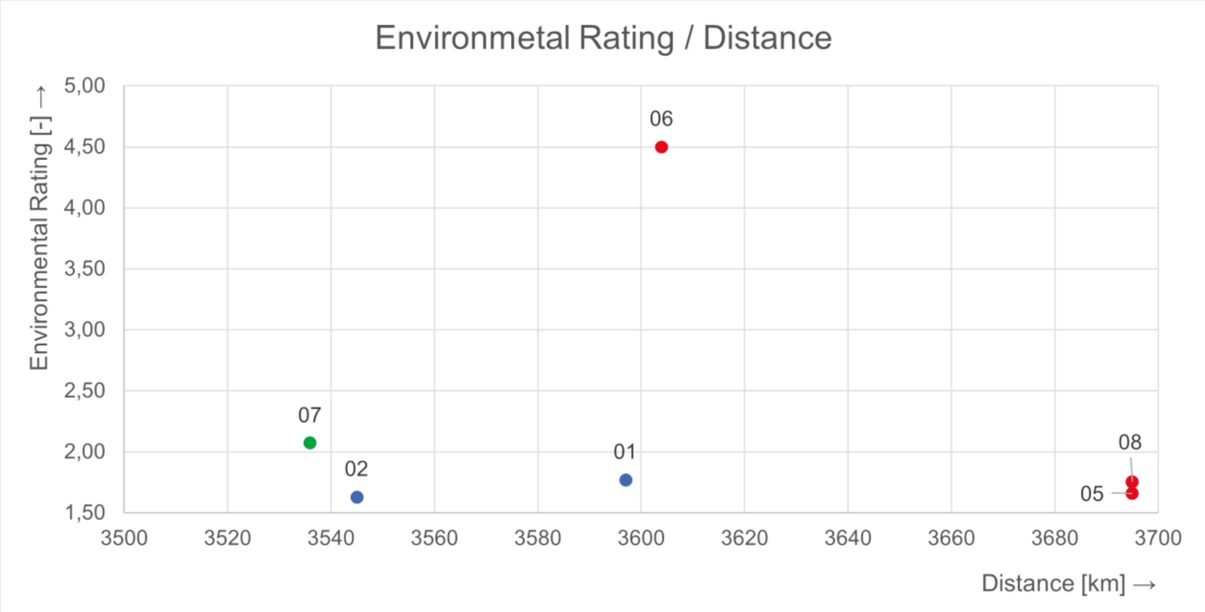

Figure 6.15 Distribution of the Environmental Rating over distance of the flights from Hamburg to Gran Canaria

6.4 Medium-Haul Flight from Hamburg to Antalya

Table 6.4 Comparison of flights from Hamburg to Antalya

No.	Airlines	Stopover	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
02	XQ	-	110	03:35	2.456	0,98
03	TK	-	140	03:35	2.456	1,18
04	TK - PC	SAW	125	04:25	2.486	1,47
07	TK	IST	151	04:40	2.474	1,87
09	TK	IST	157	04:25	2.474	1,96
10	LH - XQ	MUC	188	04:20	2.603	1,57

Table 6.4 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Antalya, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.4 in the appendix.

Figure 6.16 shows the routes of the evaluated flight connections from Hamburg to Antalya.

Figures 6.17 – 6.20 show the results of Table 6.4 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

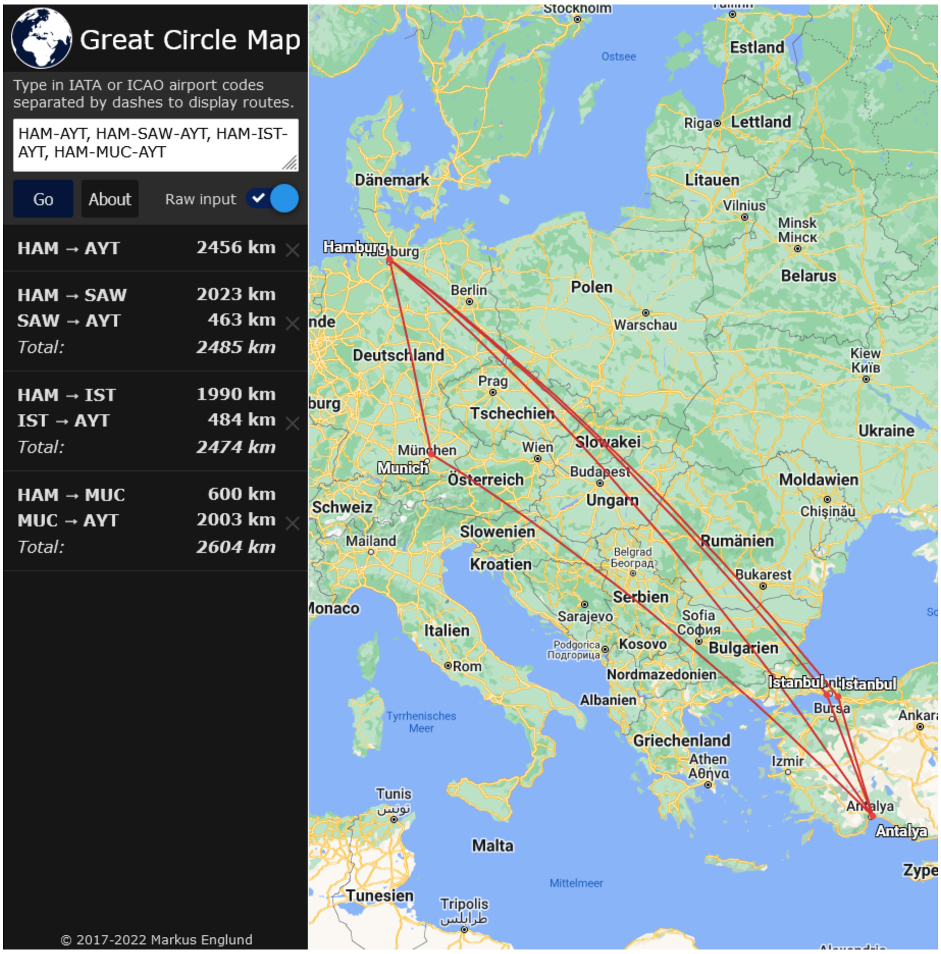

Figure 6.16 Flight connections from Hamburg to Antalya (greatcirclemap.com)

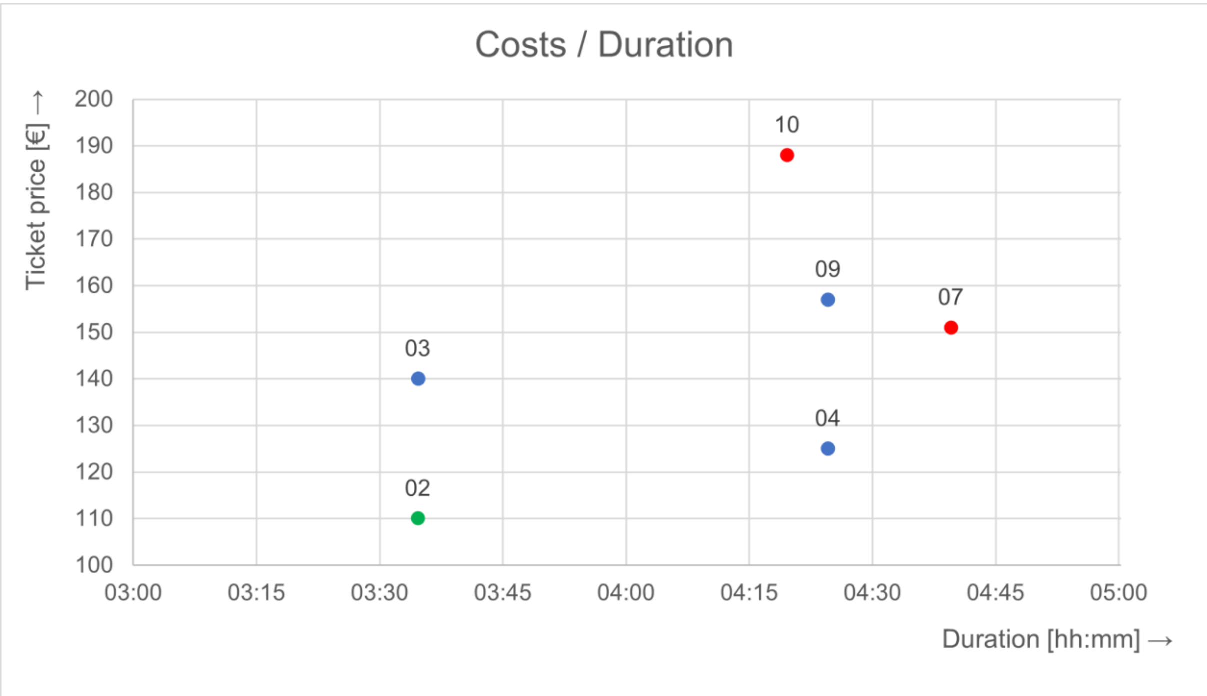

Figure 6.17 Distribution of costs over duration of the flights from Hamburg to Antalya

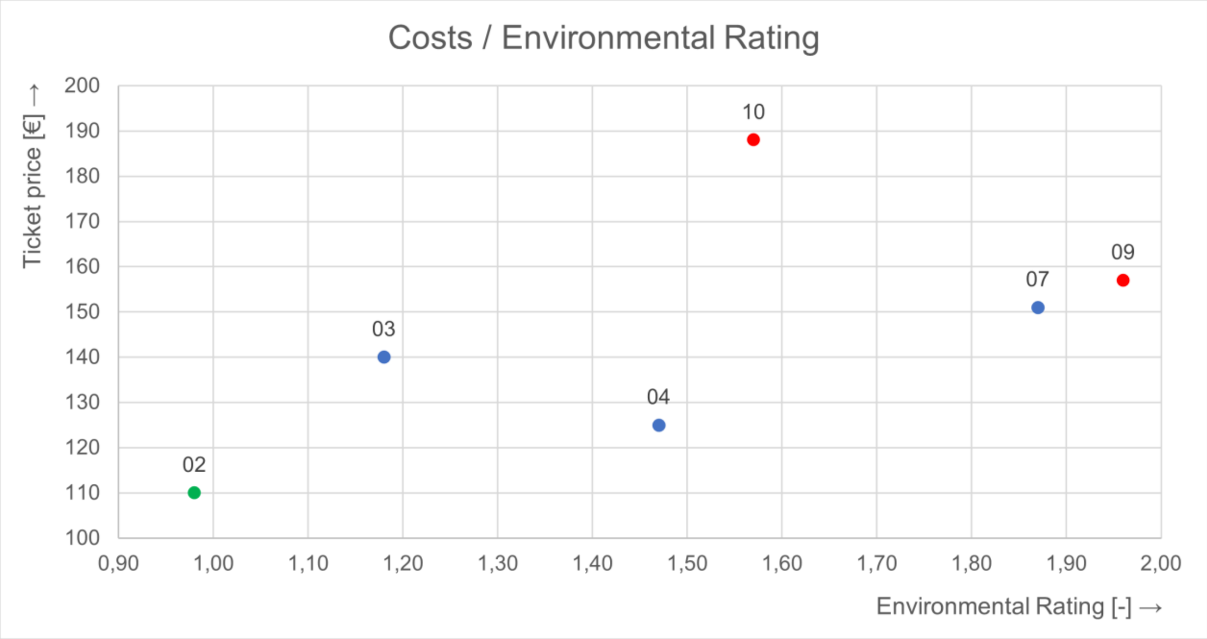

Figure 6.18 Distribution of costs over Environmental Rating of the flights from Hamburg to Antalya

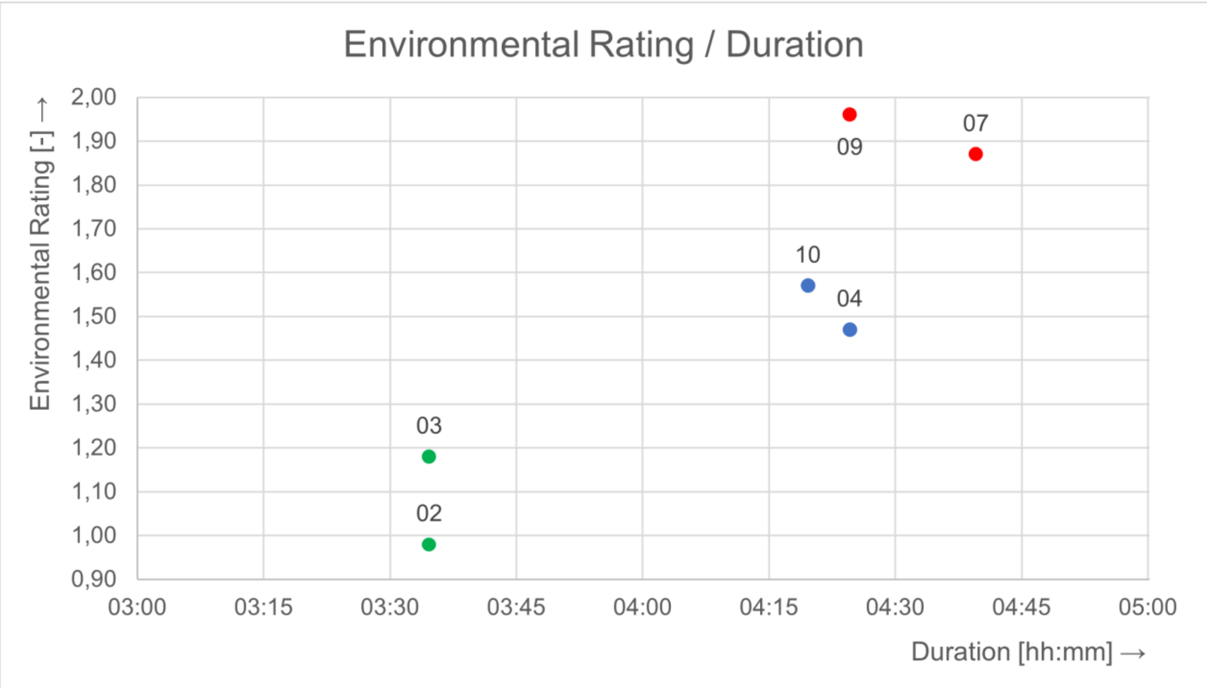

Figure 6.19 Distribution of the Environmental Rating over duration of the flights from Hamburg to Antalya

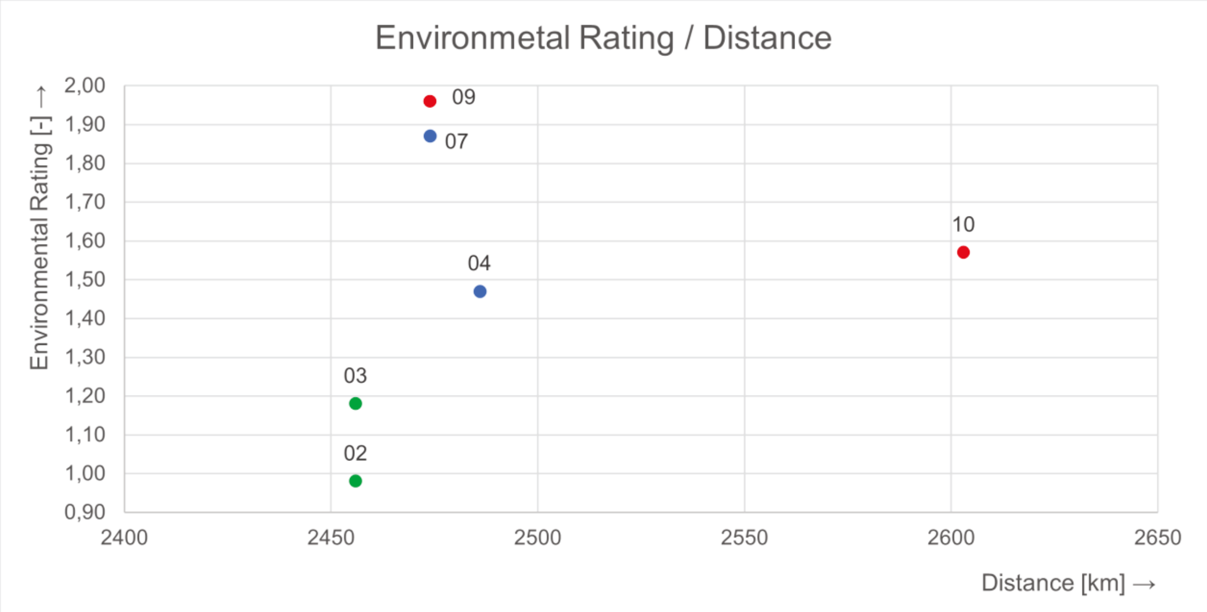

Figure 6.20 Distribution of the Environmental Rating over distance of the flights from Hamburg to Antalya

6.5 Long-Haul Flight from Hamburg to New York

Table 6.5 Comparison of flights from Hamburg to New York

No.	Airlines	Stopover	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	LH - DE	FRA	469	09:55	6.618	2,51
02	FI	KEF	503	09:30	6.345	2,64
05	EI	DUB	676	09:50	6.214	2,56
06	FI	KEF	503	09:30	6.359	2,64
08	KL	AMS	716	09:10	6.264	2,58
09	LH	FRA	1.245	09:40	6.640	2,51

Table 6.5 shows the results of the most reasonable flight connections calculated in this project from Hamburg to New York, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.5 in the appendix.

Figure 6.21 shows the routes of the evaluated flight connections from Hamburg to New York.

Figures 6.22 – 6.25 show the results of Table 6.5 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

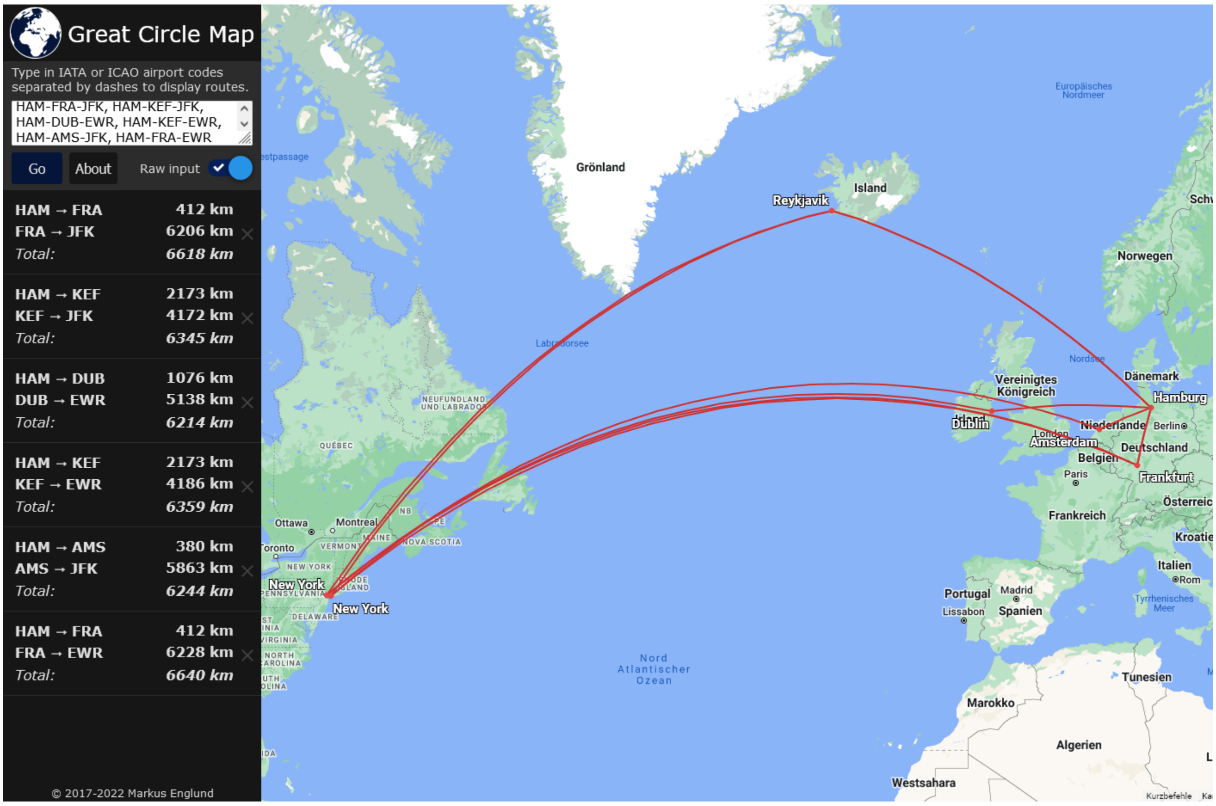

Figure 6.21 Flight connections from Hamburg to New York (greatcirclemap.com)

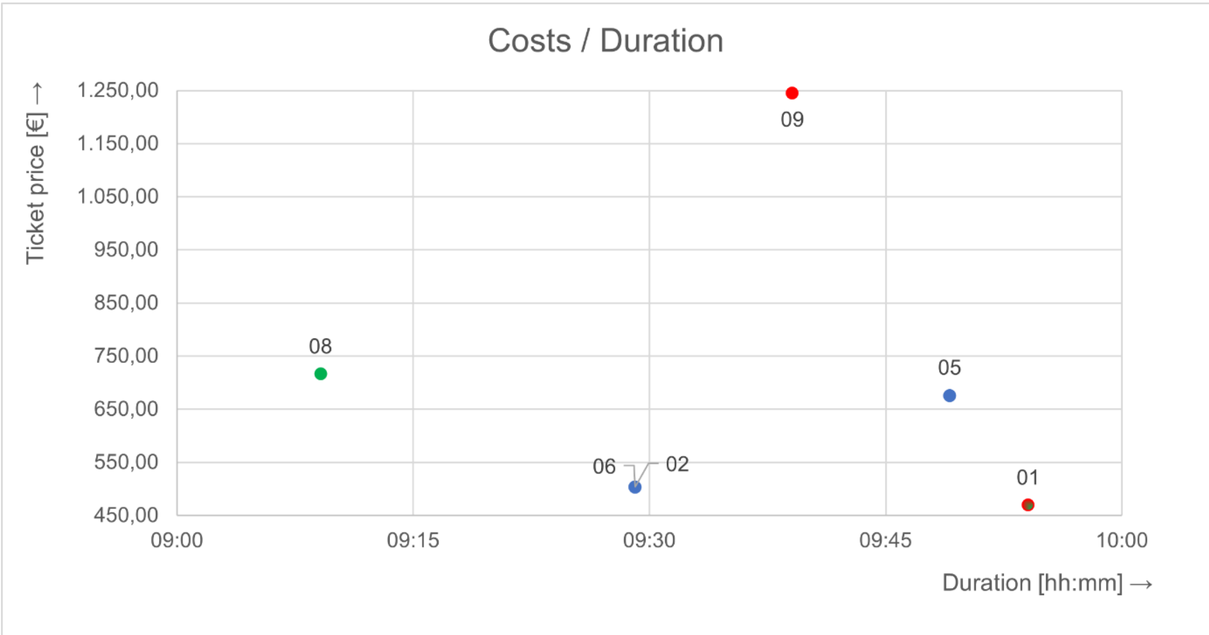

Figure 6.22 Distribution of costs over duration of the flights from Hamburg to New York

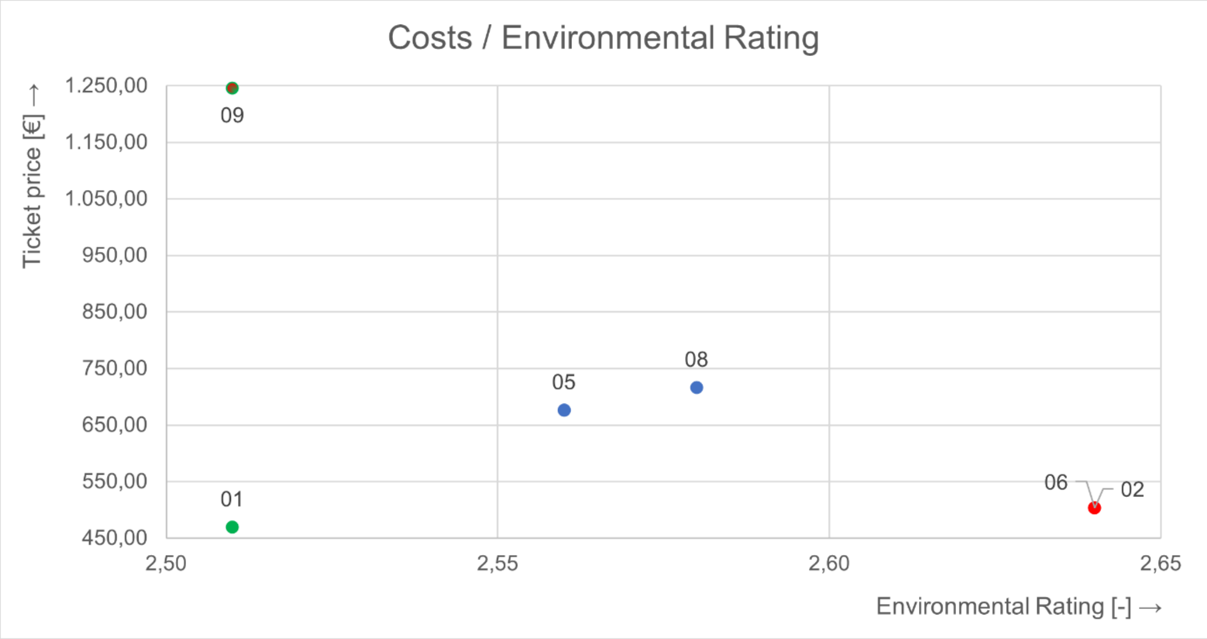

Figure 6.23 Distribution of costs over Environmental Rating of the flights from Hamburg to New York

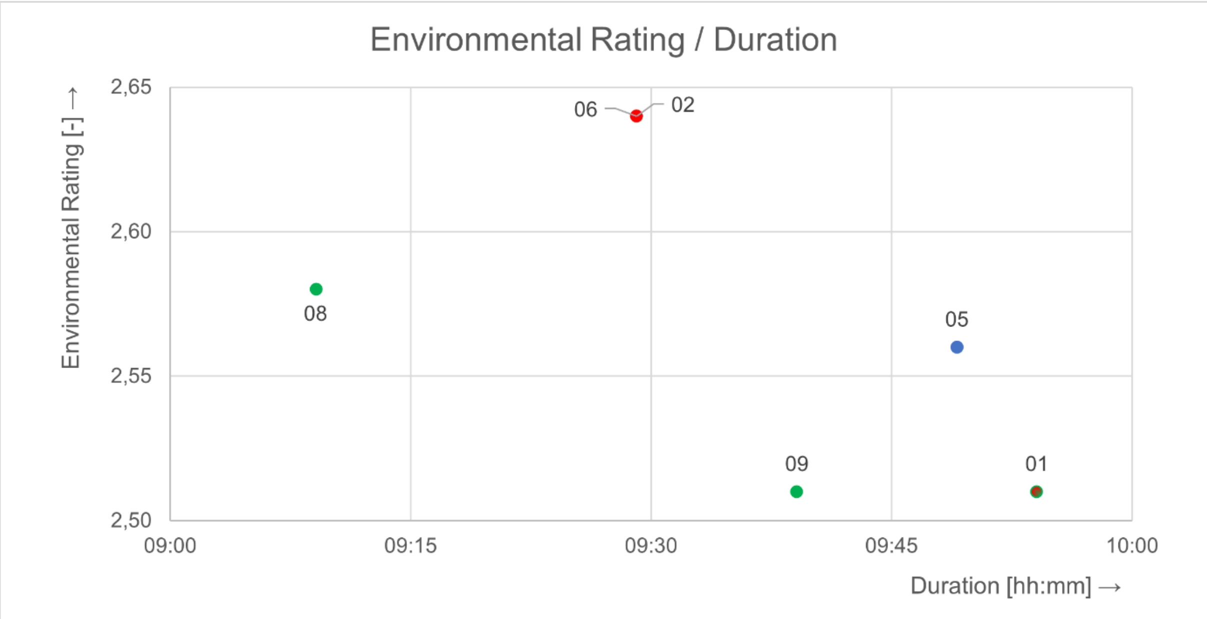

Figure 6.24 Distribution of the Environmental Rating over duration of the flights from Hamburg to New York

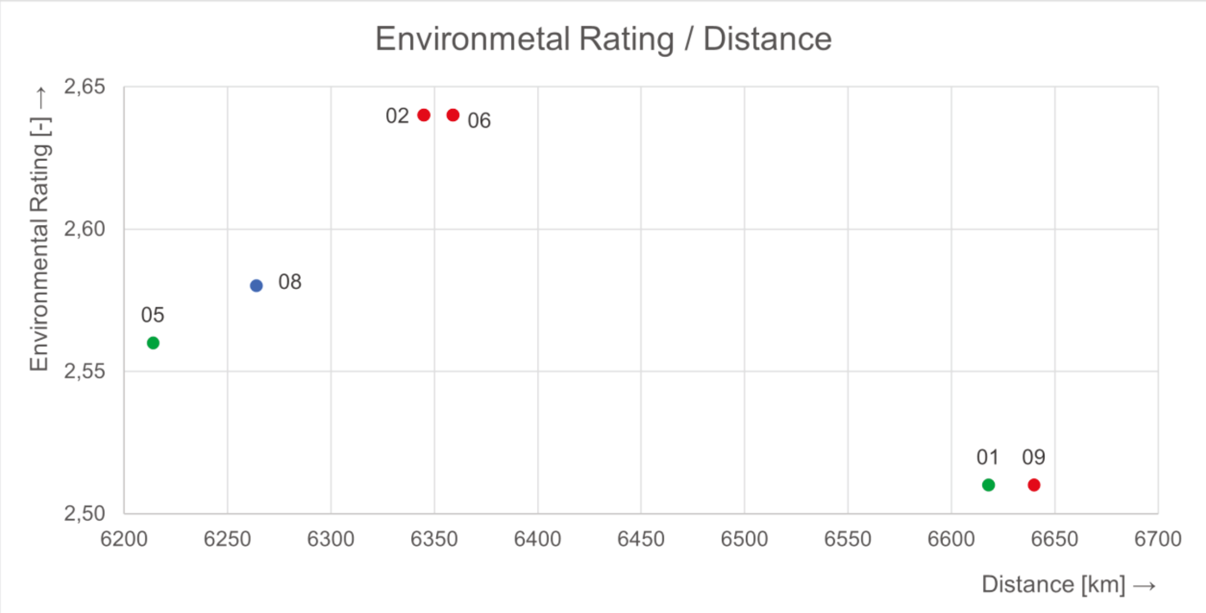

Figure 6.25 Distribution of the Environmental Rating over distance of the flights from Hamburg to New York

6.6 Long-Haul Flight from Hamburg to Bonaire

Table 6.6 Comparison of flights from Hamburg to Bonaire

No.	Airlines	Stopover 1	Stopover 2	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	KL	AMS	AUA	629	11:35	8.457	4,32
03	LH - UA	FRA	IAH	708	16:56	12.255	4,97
04	BA - AA	LHR	MIA	1.704	14:31	9.839	5,07
05	BA - AA	LHR	MIA	1.704	14:19	9.839	5,83
06	KL - DL	AMS	ATL	3.183	15:10	10.355	4,18
07	KL - DL	AMS	ATL	3.183	14:50	10.355	4,14
08	LH - DL	FRA	IAH	2.301	15:46	12.255	4,29

Table 6.6 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Bonaire, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.6 in the appendix.

Figure 6.26 shows the routes of the evaluated flight connections from Hamburg to Bonaire.

Figures 6.27 – 6.30 show the results of Table 6.6 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

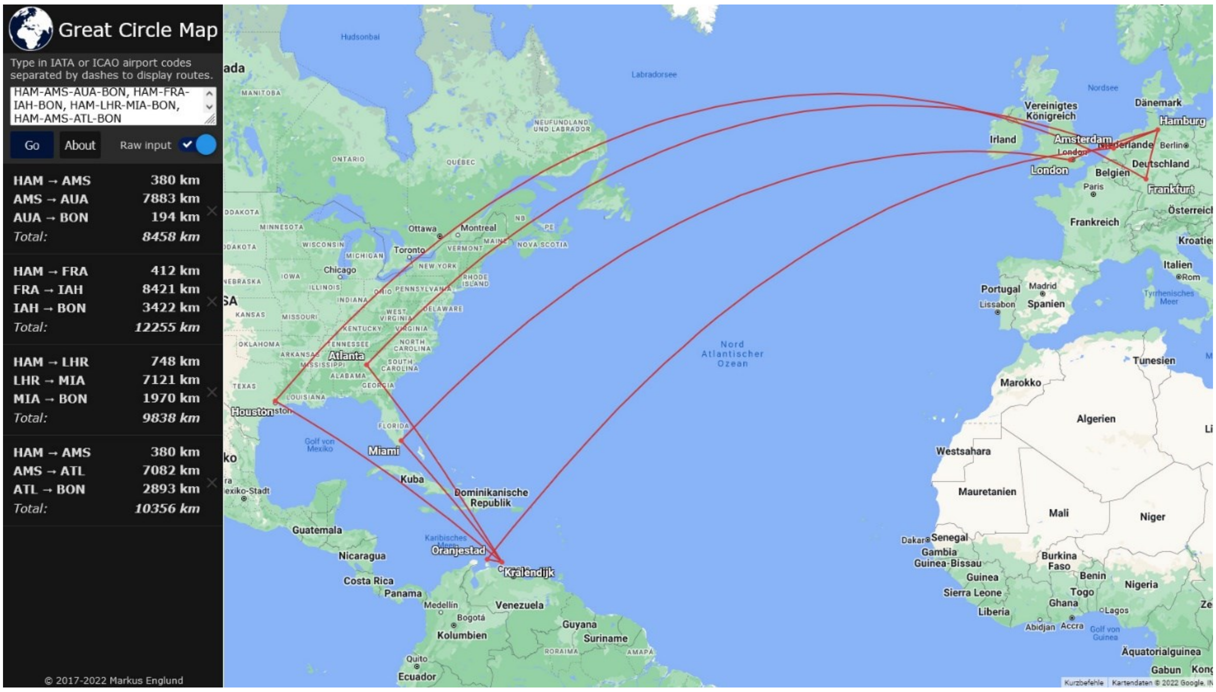

Figure 6.26 Flight connections from Hamburg to Bonaire (greatcirclemap.com)

Figure 6.27 Distribution of costs over duration of the flights from Hamburg to Bonaire

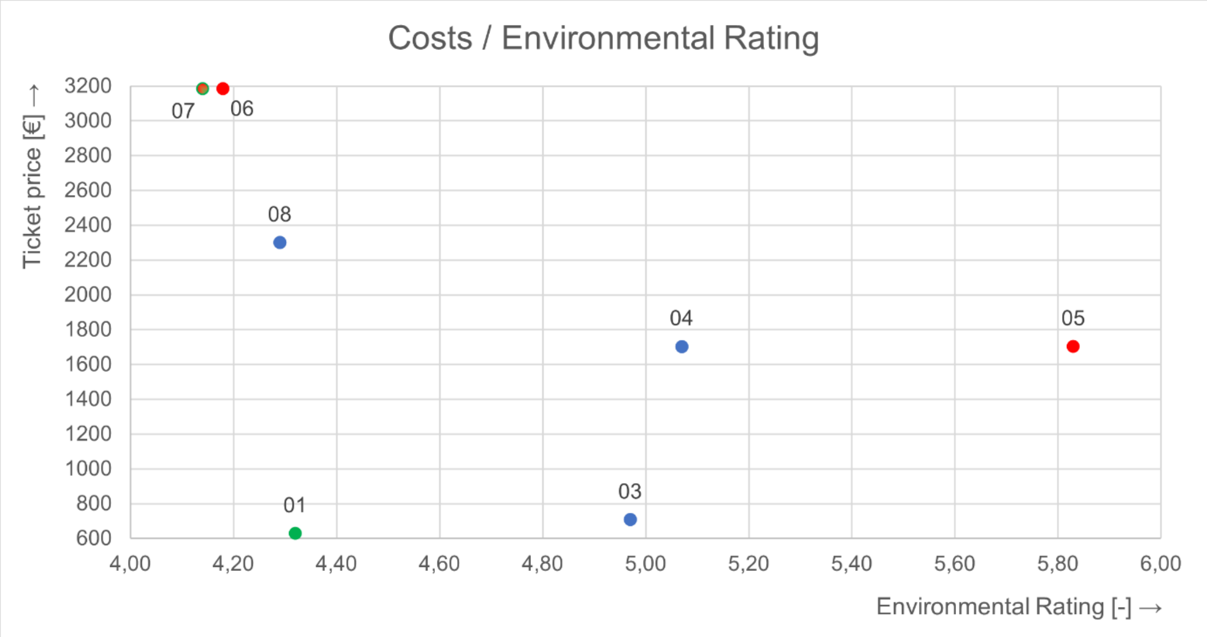

Figure 6.28 Distribution of costs over Environmental Rating of the flights from Hamburg to Bonaire

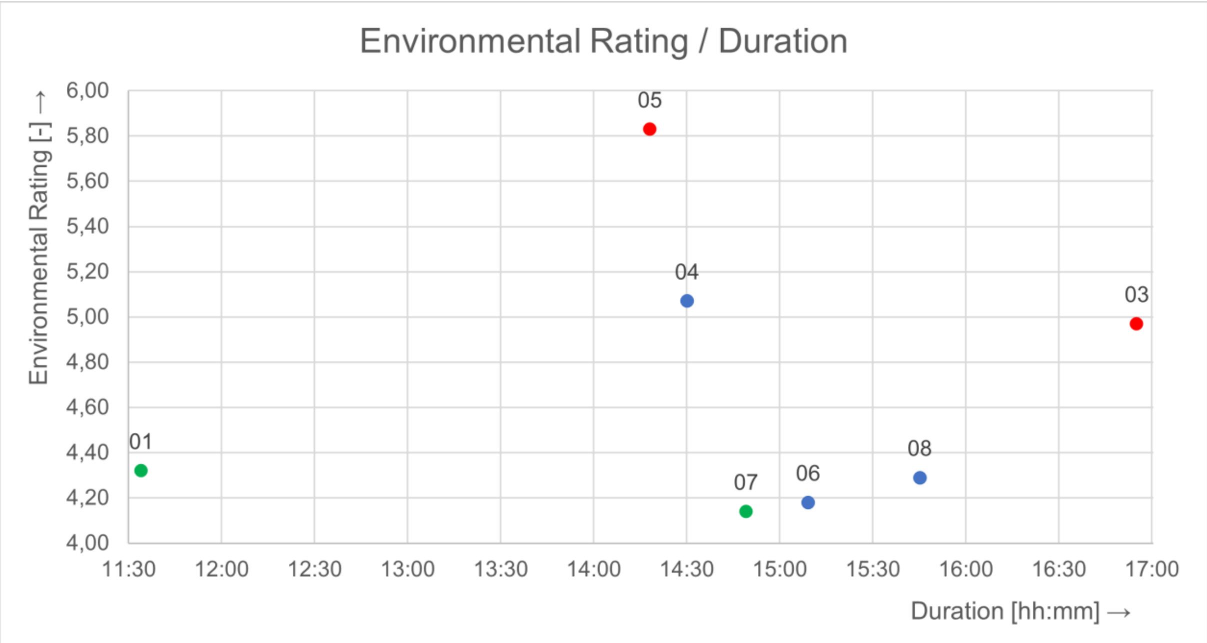

Figure 6.29 Distribution of the Environmental Rating over duration of the flights from Hamburg to Bonaire

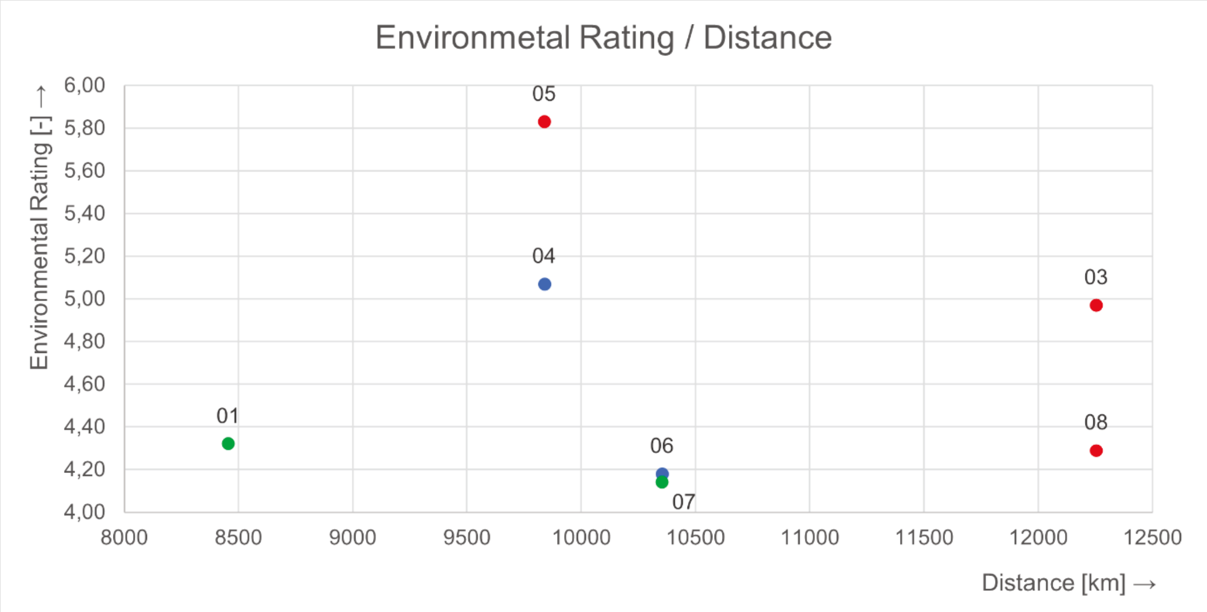

Figure 6.30 Distribution of the Environmental Rating over distance of the flights from Hamburg to Bonaire

6.7 Long-Haul Flight from Hamburg to Bangkok

Table 6.7 Comparison of flights from Hamburg to Bangkok

No.	Airlines	Stopover	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	AY	HEL	533	13:30	9.084	3,27
03	LH - TG	FRA	582	11:50	9.421	4,20
04	LH - TG	MUC	544	11:55	9.409	3,32
05	LX - TG	ZRH	582	12:25	9.757	3,48
06	EK	DXB	695	13:05	9.797	5,41
08	OS	VIE	1.088	11:30	9.228	3,39

Table 6.7 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Bangkok, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.7 in the appendix.

Figure 6.31 shows the routes of the evaluated flight connections from Hamburg to Bangkok.

Figures 6.32 – 6.35 show the results of Table 6.7 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

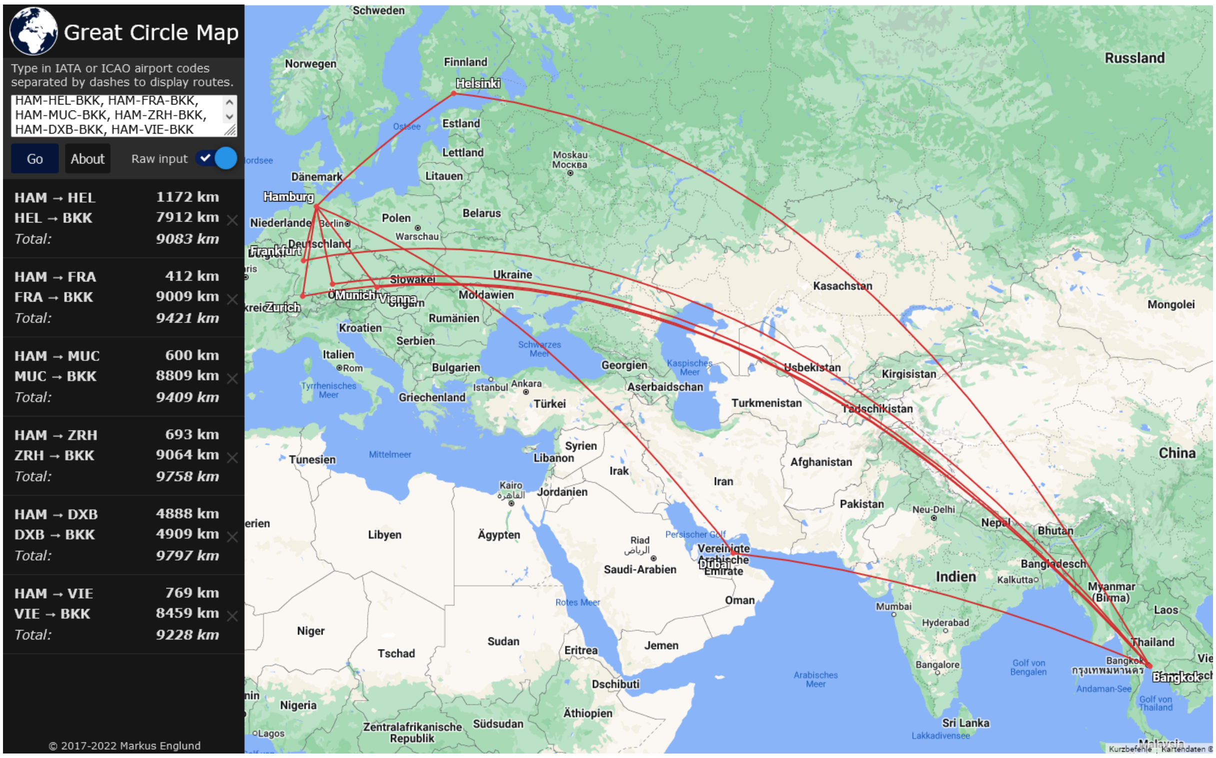

Figure 6.31 Flight connections from Hamburg to Bangkok (greatcirclemap.com)

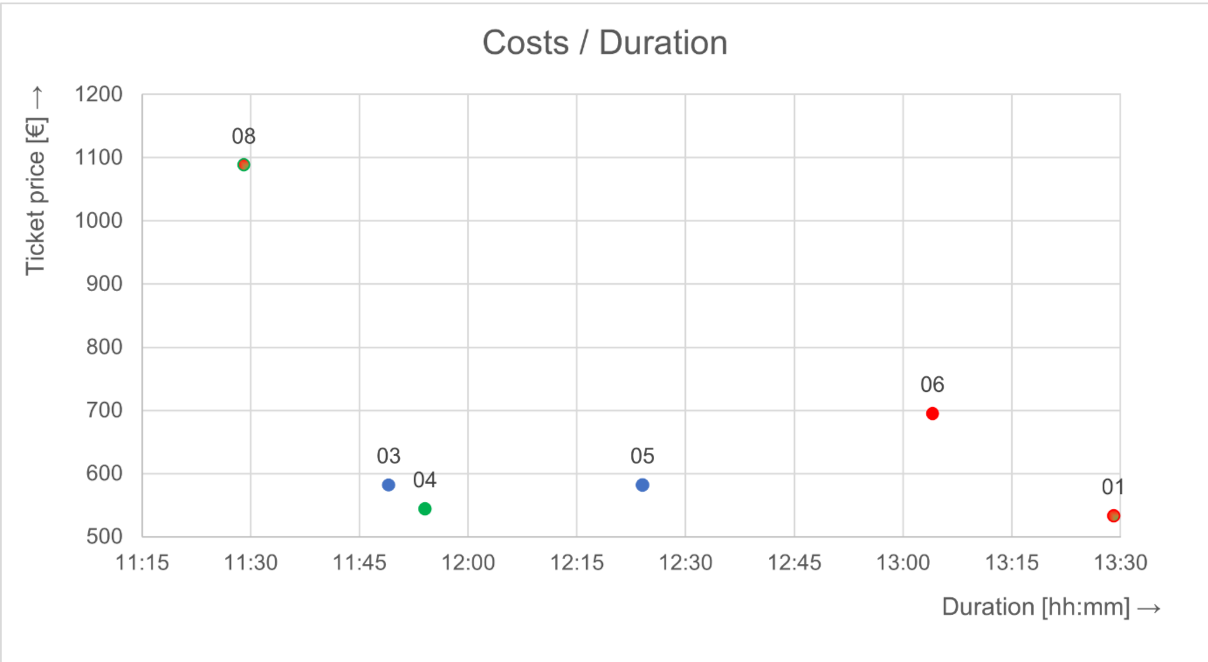

Figure 6.32 Distribution of costs over duration of the flights from Hamburg to Bangkok

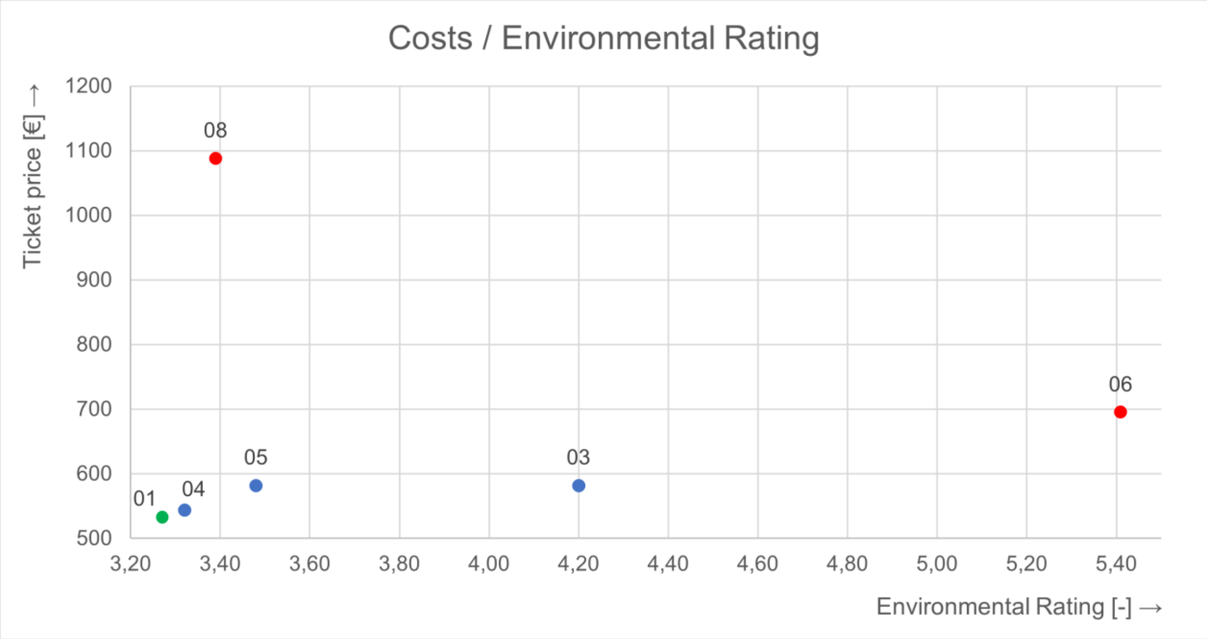

Figure 6.33 Distribution of costs over Environmental Rating of the flights from Hamburg to Bangkok

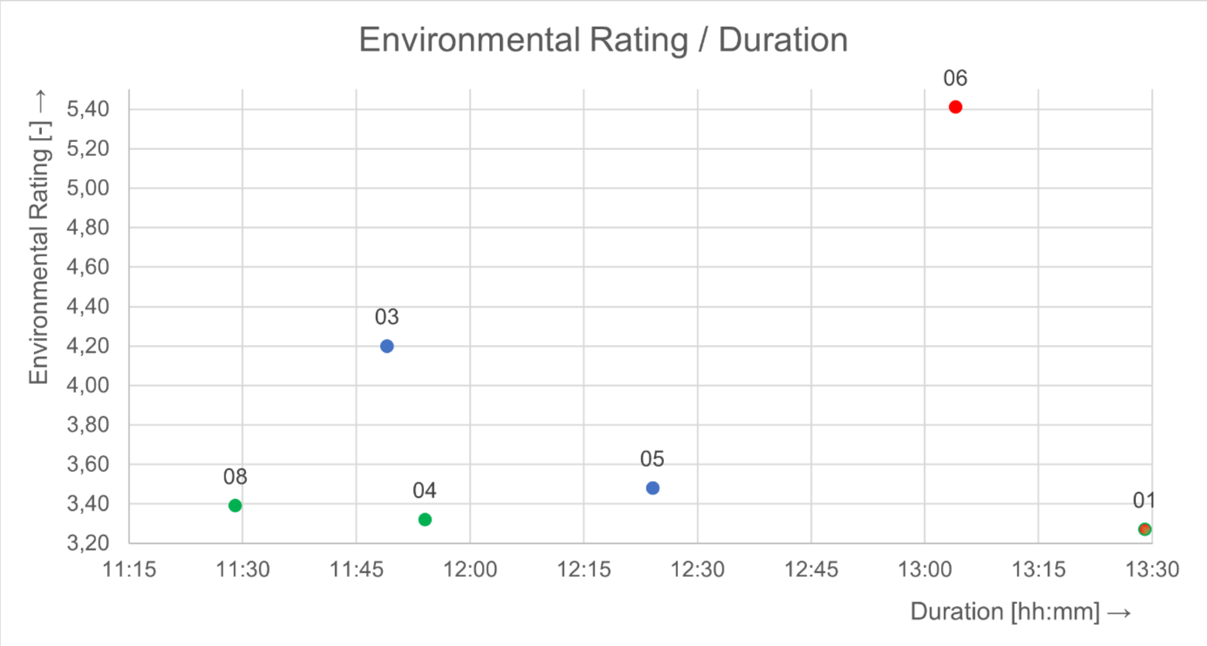

Figure 6.34 Distribution of the Environmental Rating over duration of the flights from Hamburg to Bangkok

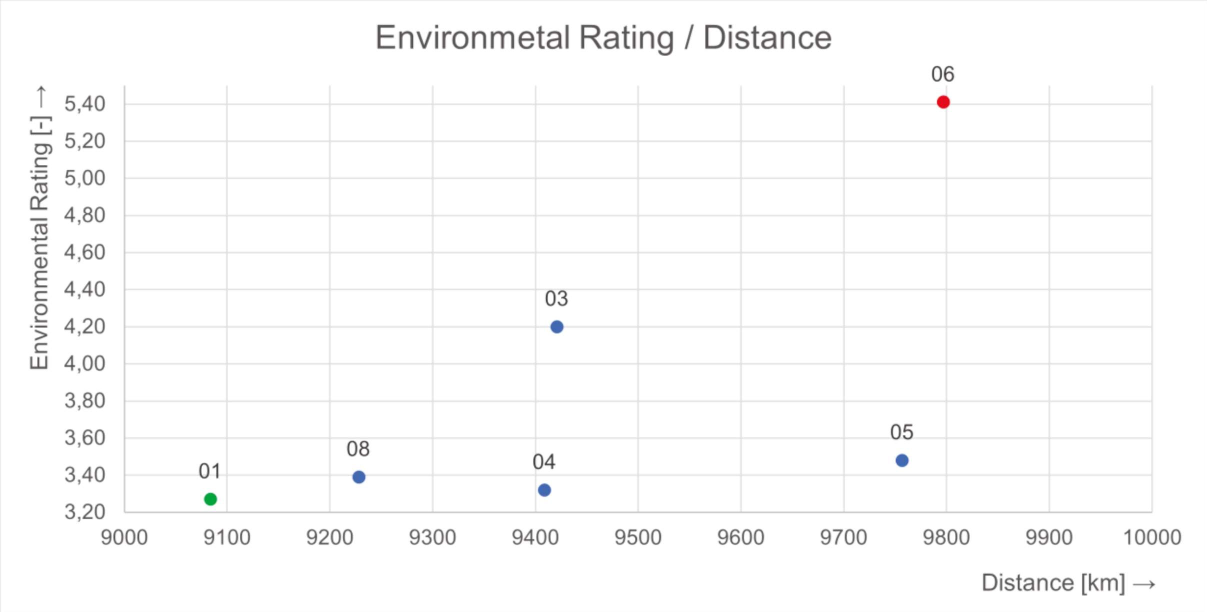

Figure 6.35 Distribution of the Environmental Rating over distance of the flights from Hamburg to Bangkok

6.8 Long-Haul Flight from Hamburg to Hong Kong

Table 6.8 Comparison of flights from Hamburg to Hong Kong

No.	Airlines	Stopover 1	Stopover 2	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	LH - CX	FRA	-	703	12:35	9.581	5,09
02	TK	IST	-	708	13:25	10.012	4,27
03	AY - CX	HEL	BKK	612	16:25	10.773	4,51
05	LH - TG	MUC	BKK	765	14:40	11.098	4,81
06	LH - TG	FRA	BKK	770	14:35	11.110	5,64
07	EW - CX	CDG	-	852	13:30	10.336	4,09

Table 6.8 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Hong Kong, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.8 in the appendix.

Figure 6.36 shows the routes of the evaluated flight connections from Hamburg to Hong Kong.

Figures 6.37 – 6.40 show the results of Table 6.8 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

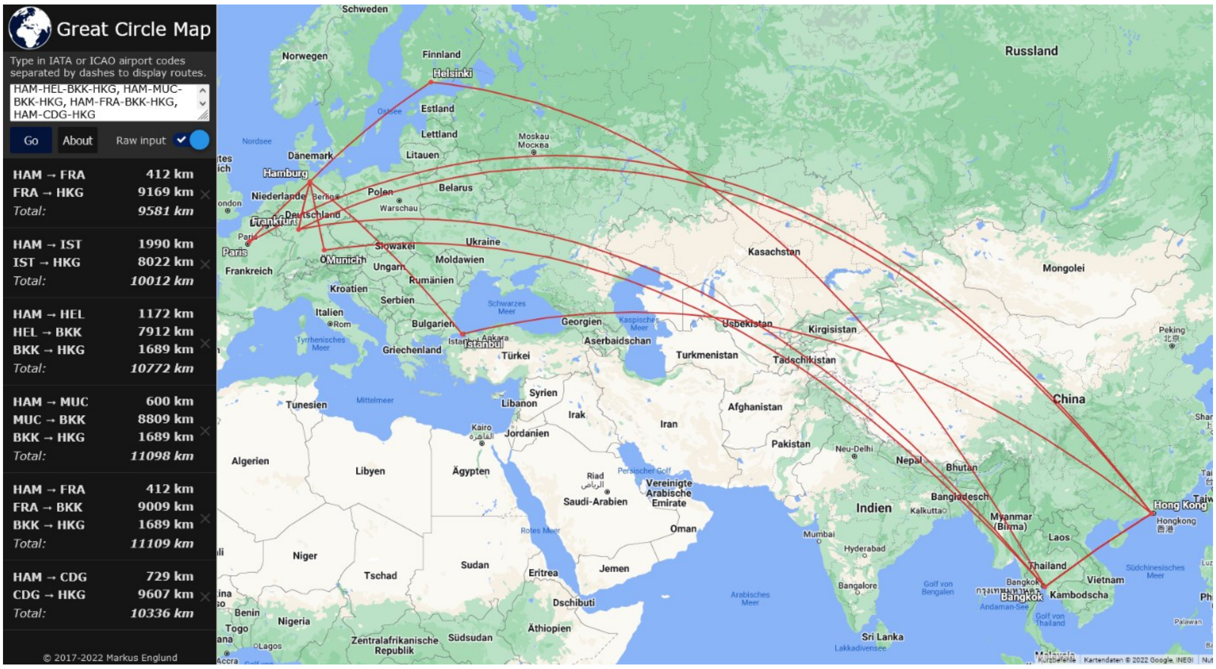

Figure 6.36 Flight connections from Hamburg to Hong Kong (greatcirclemap.com)

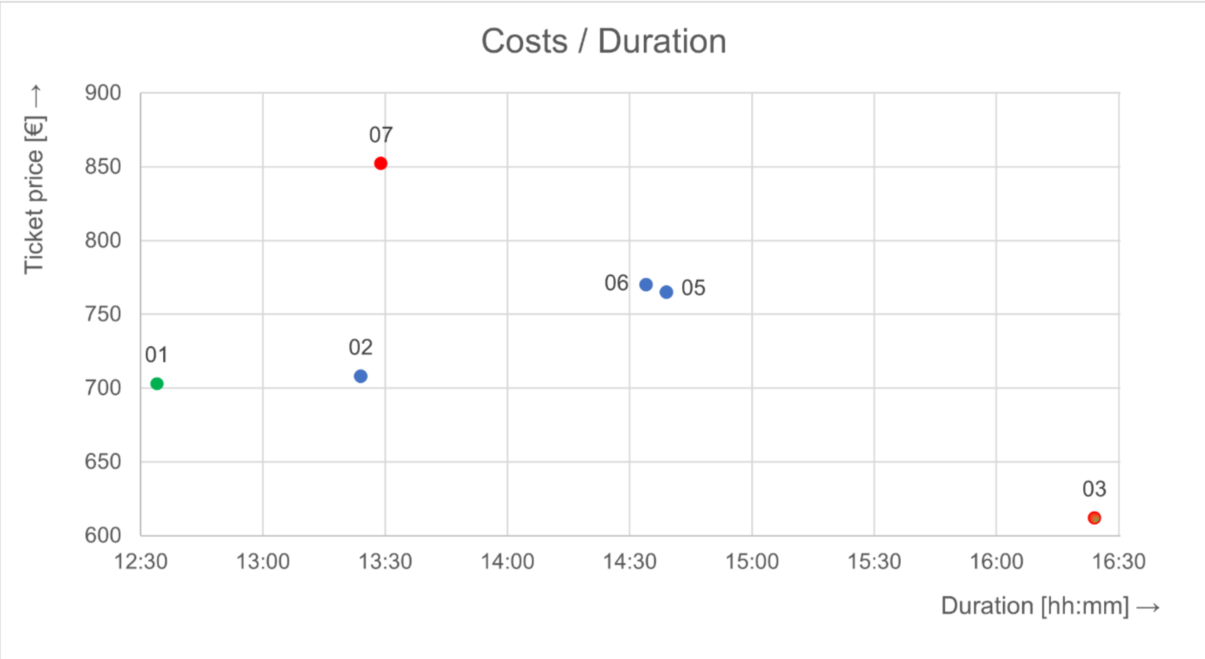

Figure 6.37 Distribution of costs over duration of the flights from Hamburg to Hong Kong

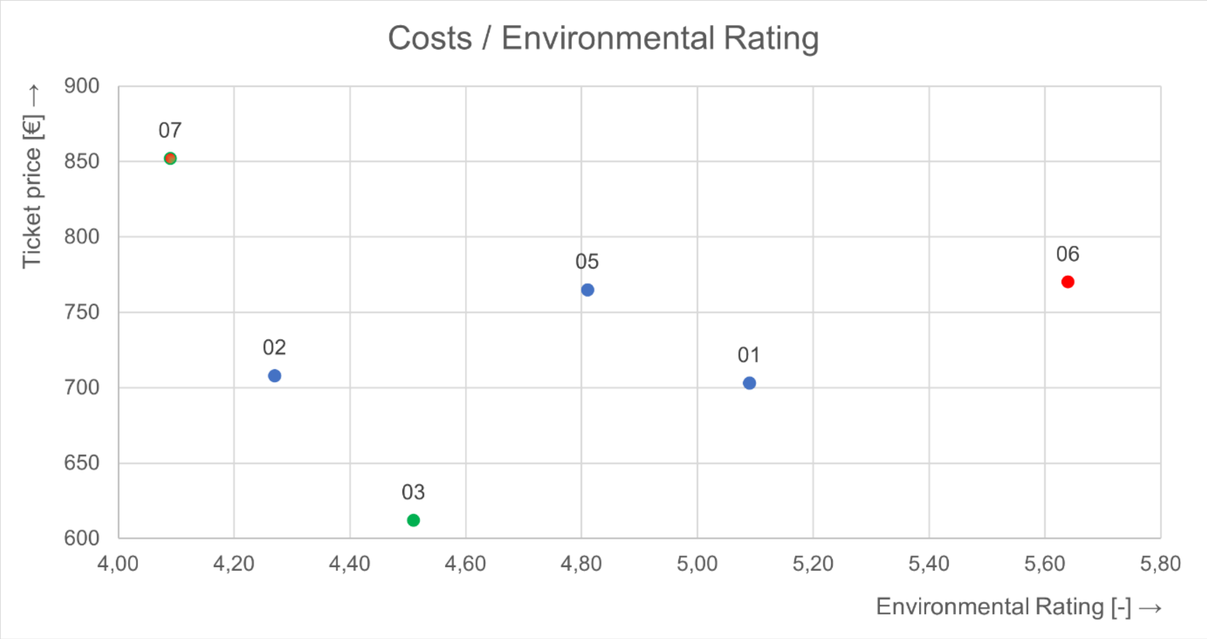

Figure 6.38 Distribution of costs over Environmental Rating of the flights from Hamburg to Hong Kong

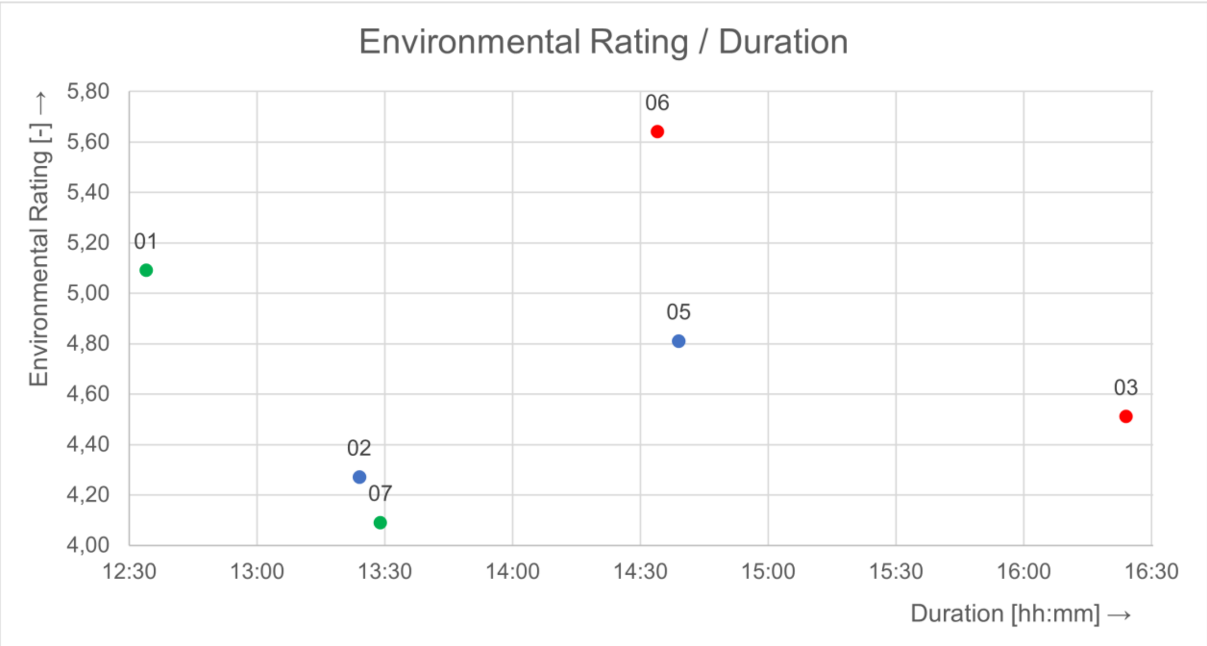

Figure 6.39 Distribution of the Environmental Rating over duration of the flights from Hamburg to Hong Kong

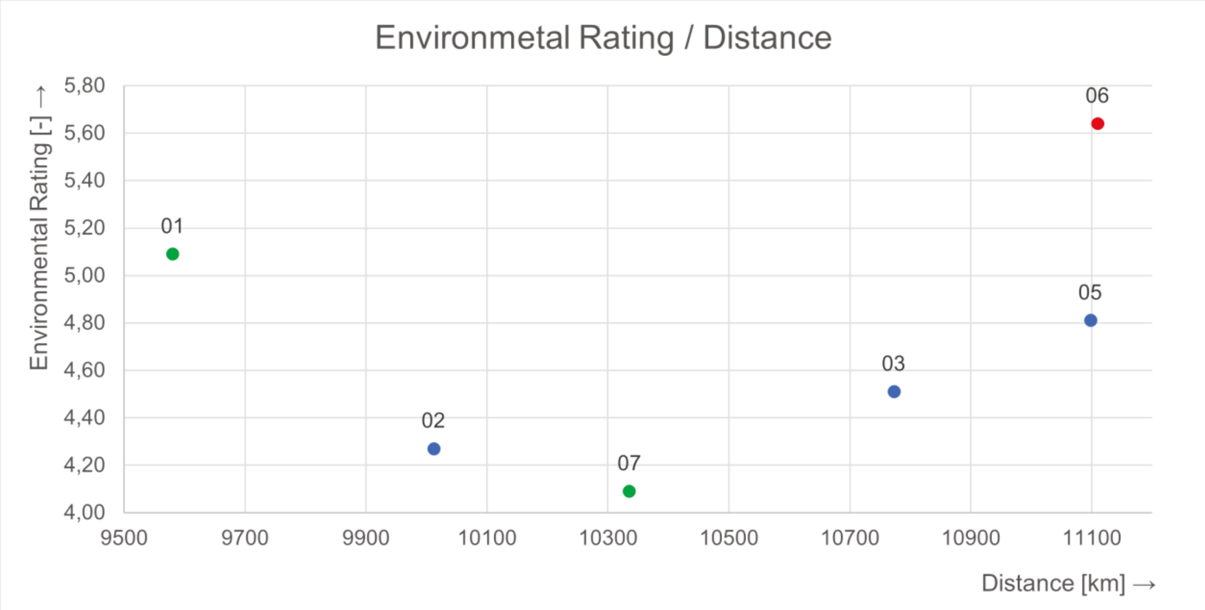

Figure 6.40 Distribution of the Environmental Rating over distance of the flights from Hamburg to Hong Kong

6.9 Long-Haul Flight from Hamburg to Mexico City

Table 6.9 Comparison of flights from Hamburg to Mexico City

No.	Airlines	Stopover	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	TK	IST	956	17:15	13.422	5,22
02	KL	AMS	1.064	12:34	9.600	3,51
03	AF	CDG	1.066	13:30	9.942	3,93
05	KL - AM	AMS	1.144	13:10	9.600	3,86
06	AF - AM	CDG	1.150	13:50	9.942	3,82
08	LH	FRA	1.400	13:10	9.979	3,20

Table 6.9 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Mexico City, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.9 in the appendix.

Figure 6.41 shows the routes of the evaluated flight connections from Hamburg to Mexico City.

Figures 6.42 – 6.45 show the results of Table 6.9 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

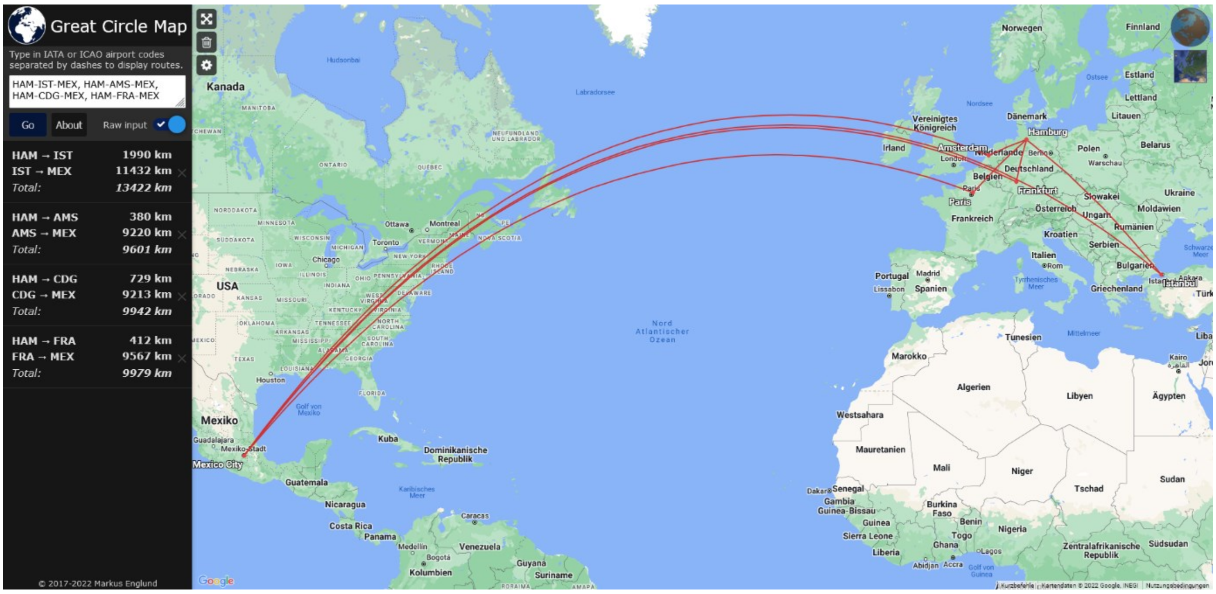

Figure 6.41 Flight connections from Hamburg to Mexico City (greatcirclemap.com)

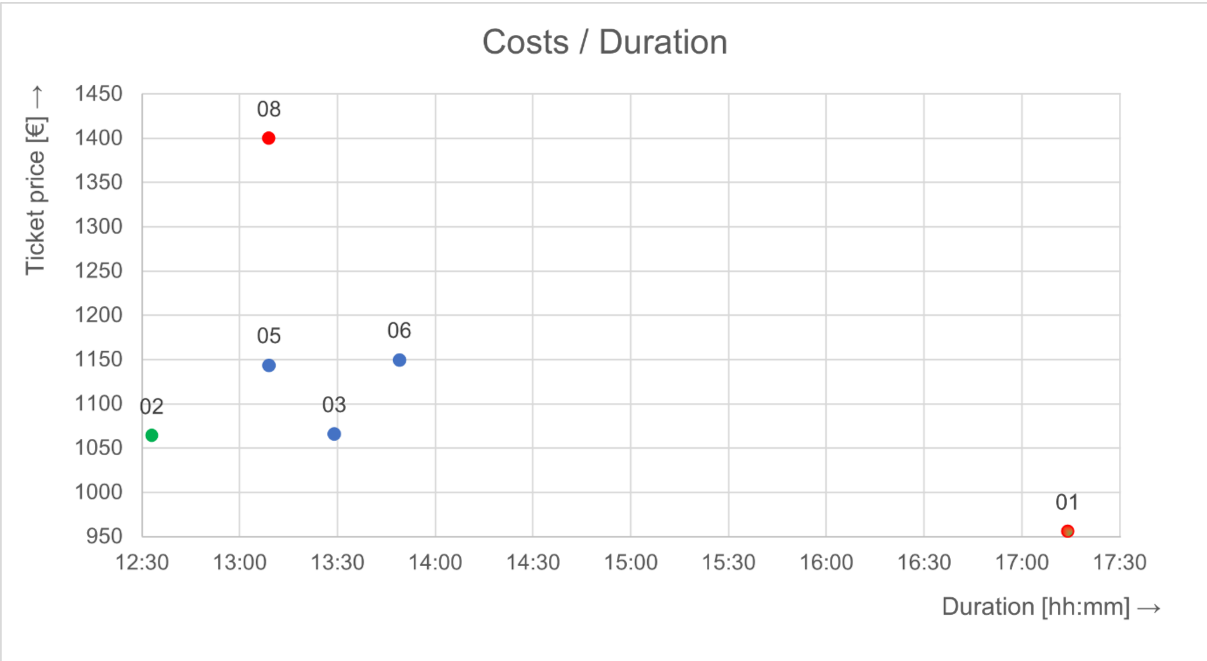

Figure 6.42 Distribution of costs over duration of the flights from Hamburg to Mexico City

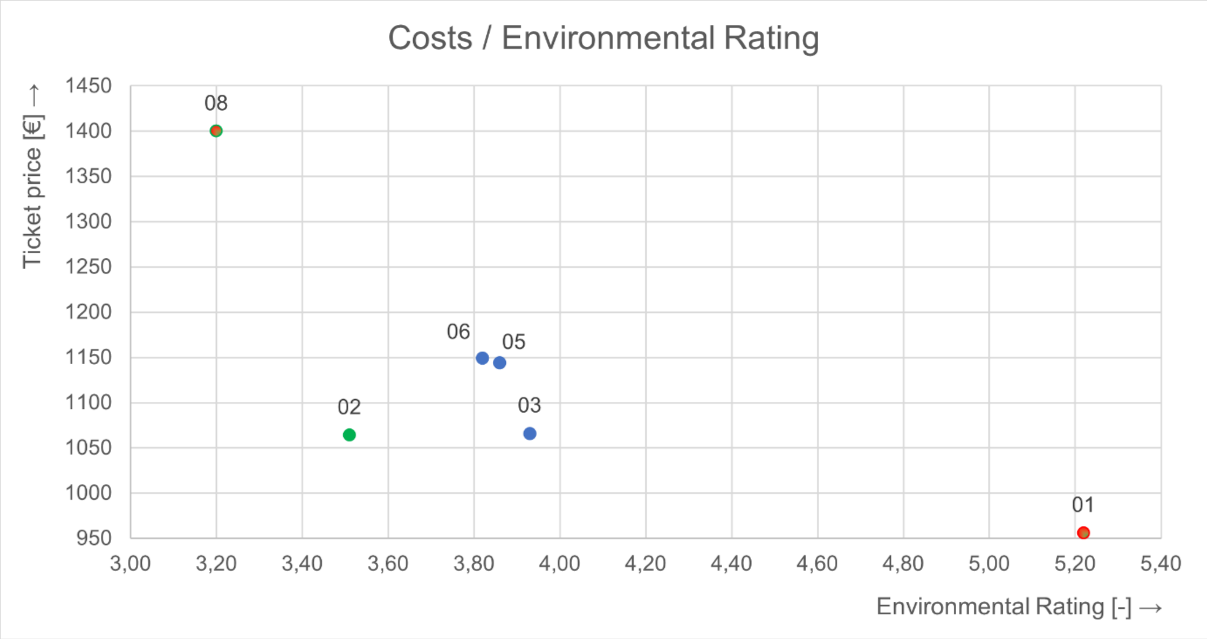

Figure 6.43 Distribution of costs over Environmental Rating of the flights from Hamburg to Mexico City

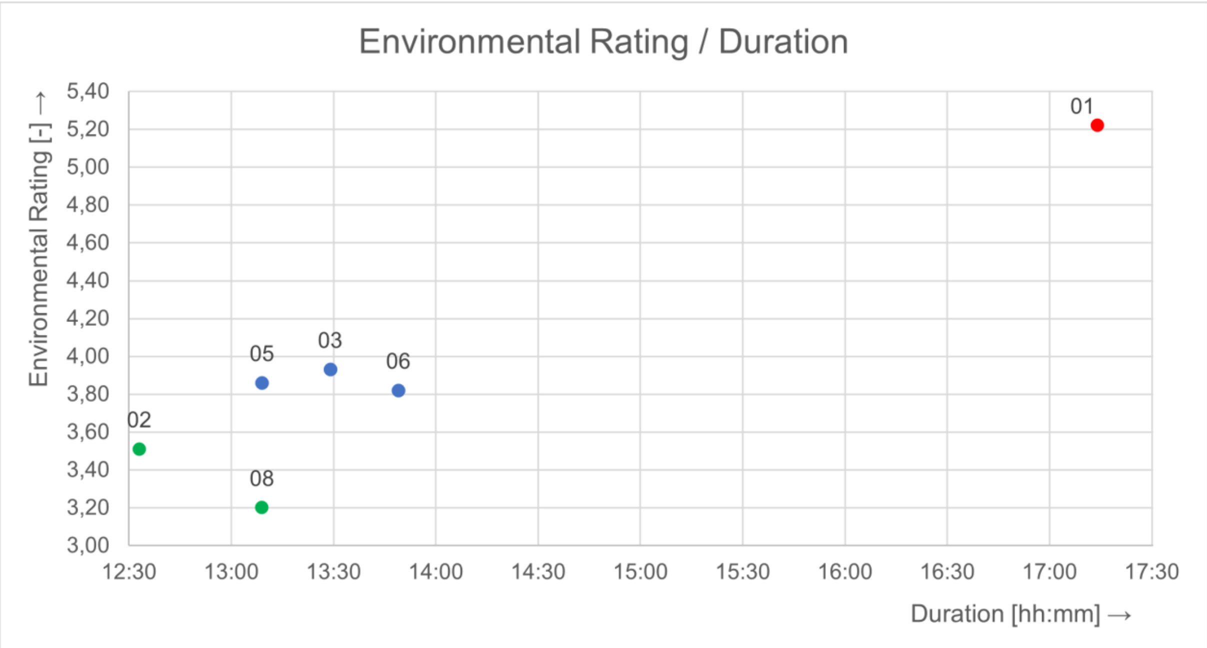

Figure 6.44 Distribution of the Environmental Rating over duration of the flights from Hamburg to Mexico City

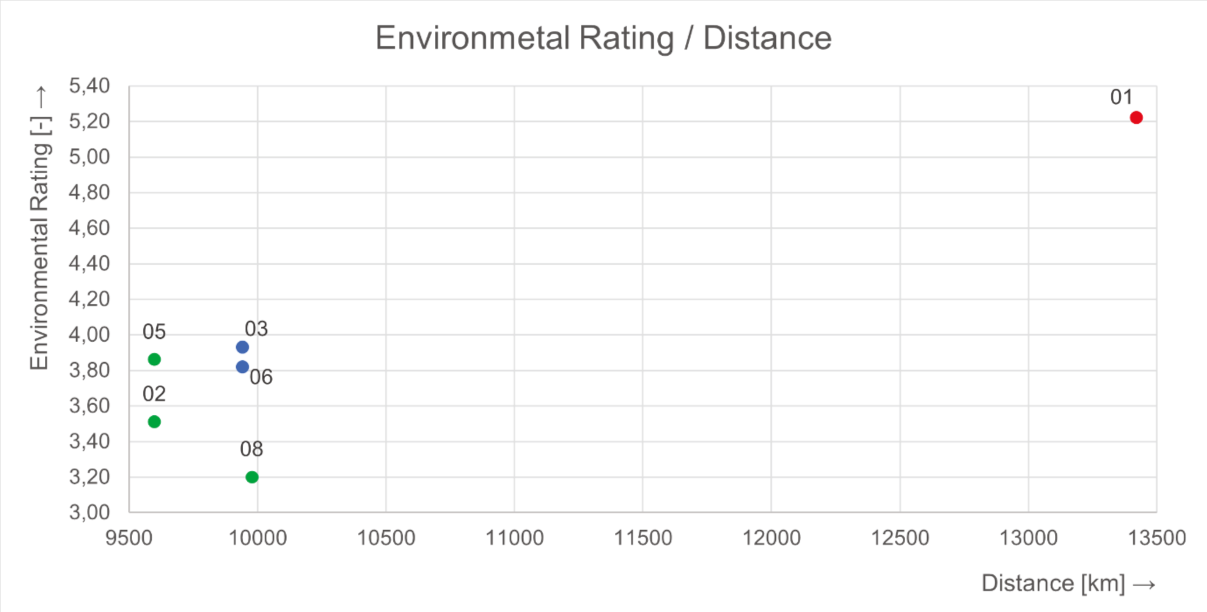

Figure 6.45 Distribution of the Environmental Rating over distance of the flights from Hamburg to Mexico City

6.10 Medium-Haul Flight from Hamburg to Hurghada

Table 6.10 Comparison of flights from Hamburg to Hurghada

No.	Airlines	Stopovers	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	PC	SAW	180	05:55	3.600	1,50
03	DE		300	04:50	3.529	1,55
04	TK	IST	327	06:00	3.588	1,97
05	EW - WK	ZRH	339	05:55	3.840	1,78
06	LX - WK	ZRH	339	05:55	3.840	1,69

Table 6.10 shows the results of the most reasonable flight connections calculated in this project from Hamburg to Hurghada, giving information about the airlines, the airports of stop-/layovers, the ticket price, the overall flight time, the total distance between origin and destination and the *Environmental Rating* calculated with the *Trip Emission Ecolabel*. The detailed table can be found at Table E.10 in the appendix.

Figure 6.46 shows the routes of the evaluated flight connections from Hamburg to Hurghada.

Figures 6.47 – 6.50 show the results of Table 6.10 as distributions of ticket price over flight time, ticket price over *Environmental Rating*, *Environmental Rating* over flight time and *Environmental Rating* over flown distance from origin to destination.

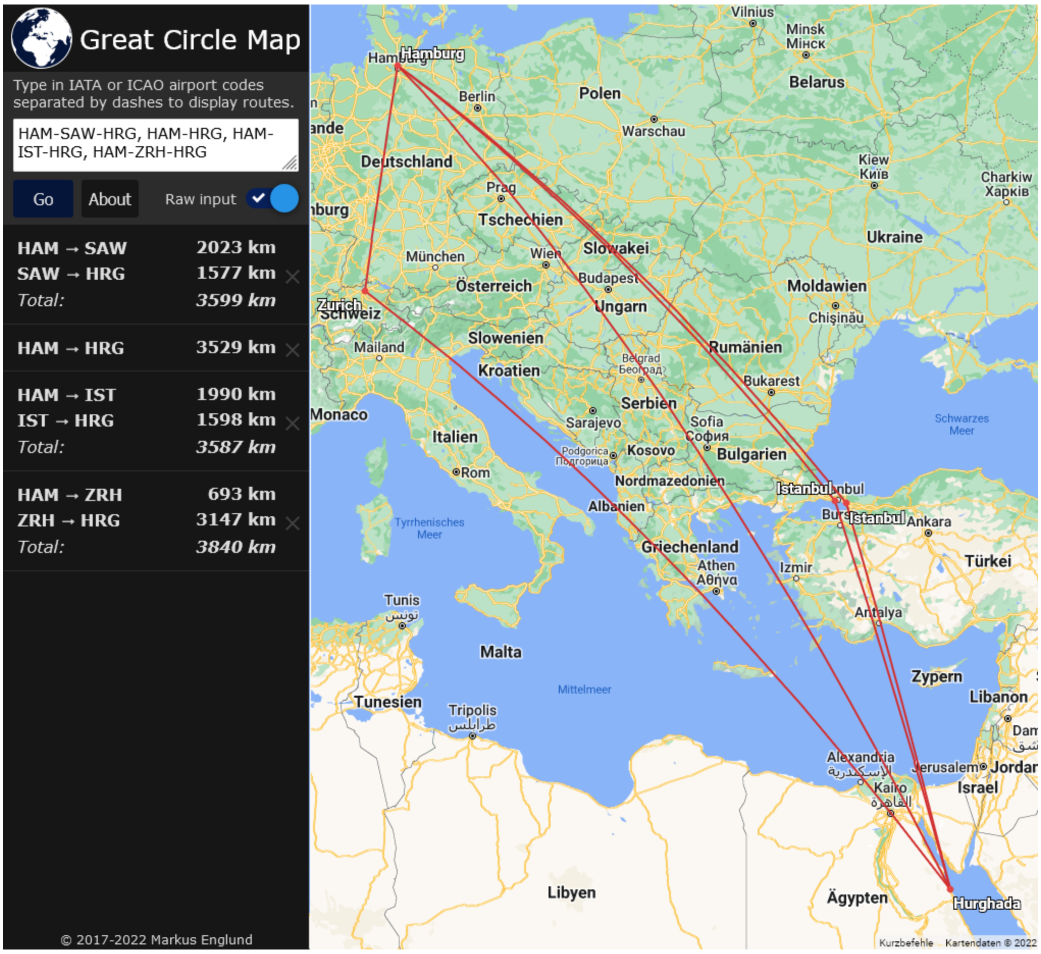

Figure 6.46 Flight connections from Hamburg to Hurghada (greatcirclemap.com)

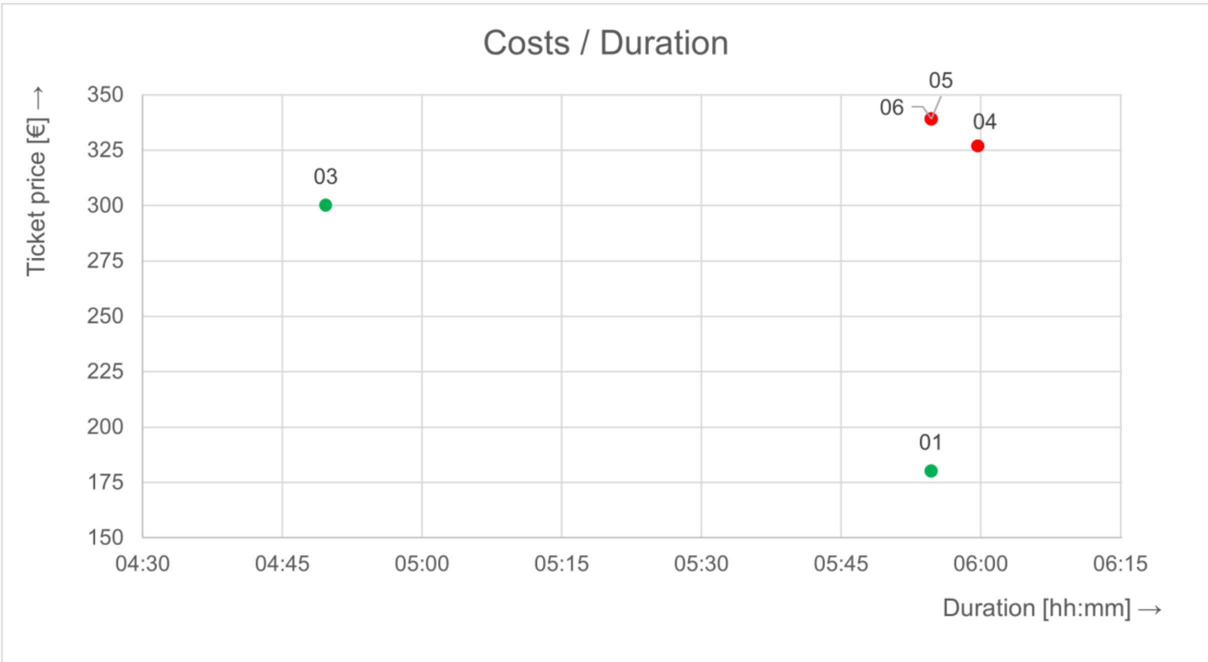

Figure 6.47 Distribution of costs over duration of the flights from Hamburg to Hurghada

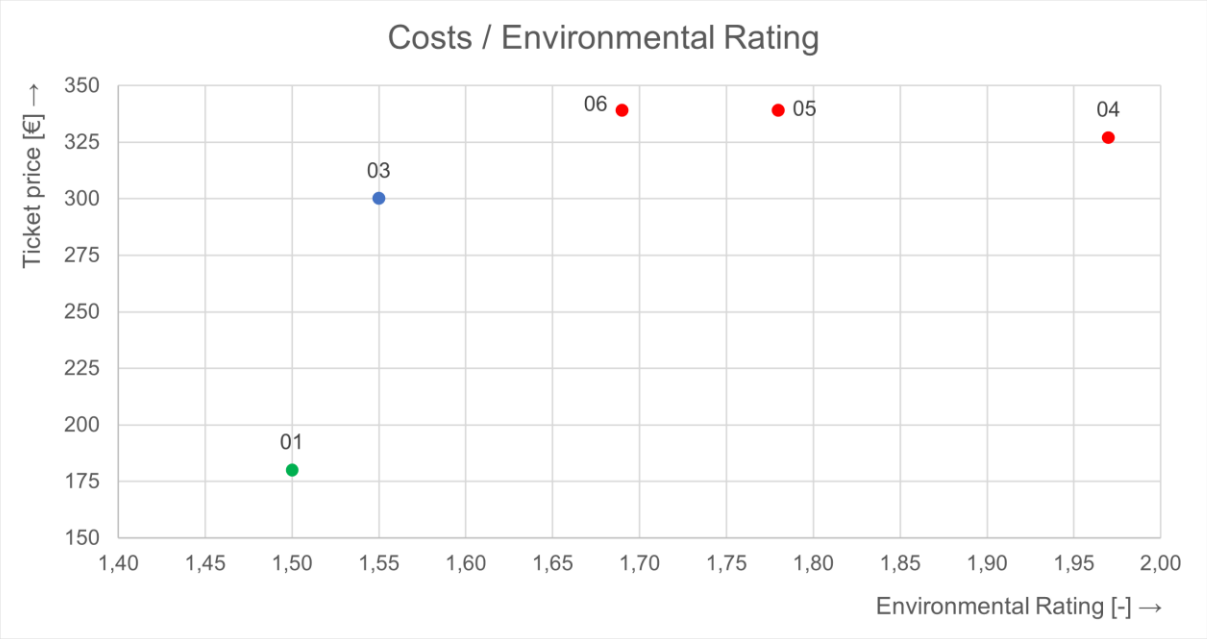

Figure 6.48 Distribution of costs over Environmental Rating of the flights from Hamburg to Hurghada

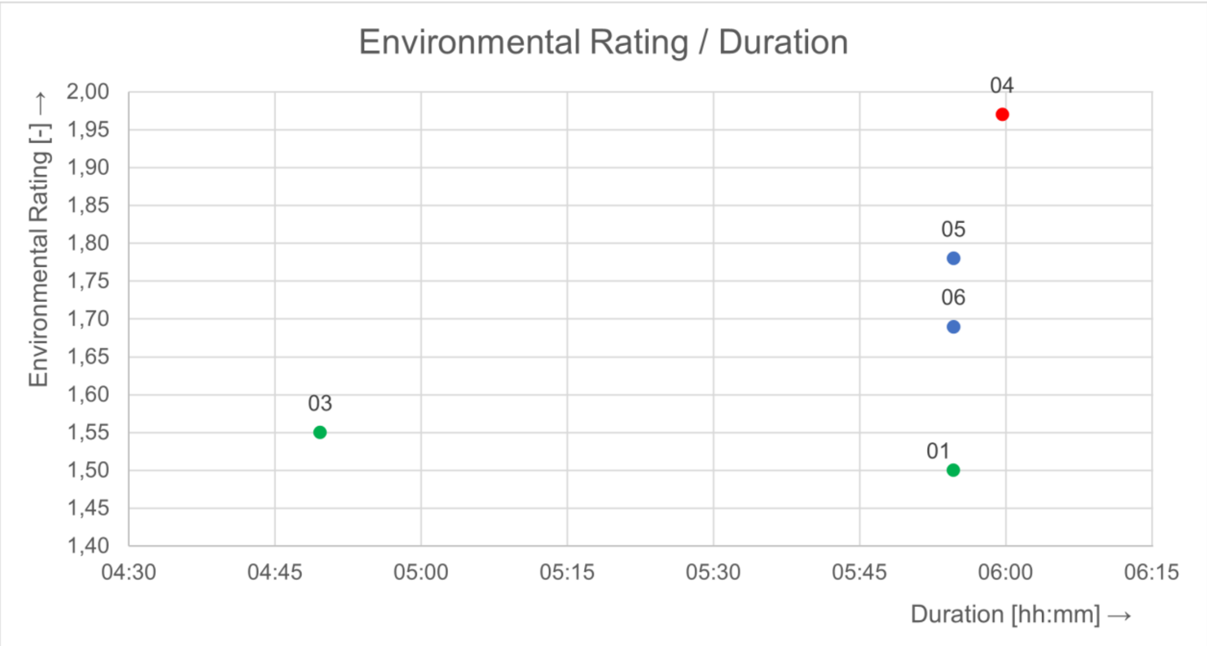

Figure 6.49 Distribution of the Environmental Rating over duration of the flights from Hamburg to Hurghada

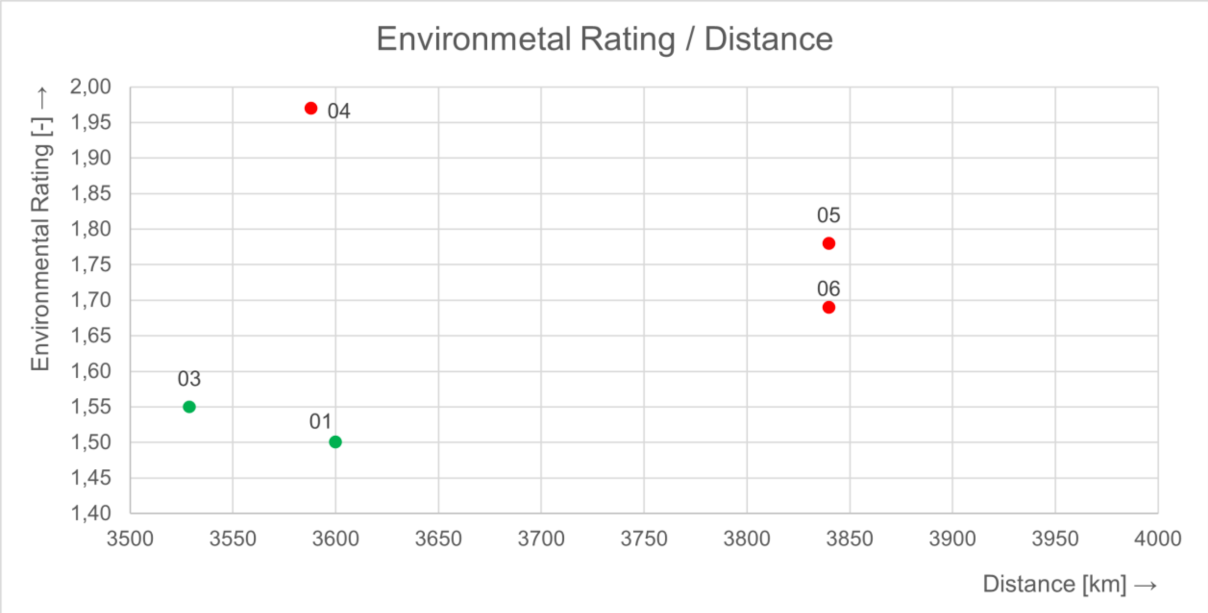

Figure 6.50 Distribution of the Environmental Rating over distance of the flights from Hamburg to Hurghada

7 Discussion

7.1 Domestic Flight from Hamburg to Munich

As seen in Table 6.1 with 0,60 the best *Environmental Rating* is reached with a direct flight of Eurowings with an Airbus A320, also this flight has the lowest ticket price of 64 € and flown distance of 600 km, the flight time is the second lowest with 01:25 h. The worst *Environmental Rating* with 1,23 has a connection of Lufthansa via Frankfurt with an Airbus A321 operating the first leg and an Airbus A320 operating the second leg, even the deviation of the routes is only 112 km. The most expensive connection with 254 € is also the one with the longest flight time of 2:20 h and deviation of 227 km, but with 1,17 not the one with the worst *Environmental Rating*. The connection is via Düsseldorf and operated by Eurowings with an Airbus A319 for the first leg and operated by Lufthansa with an Airbus A320 for the second leg. In Table 6.1 also a second and with a ticket price of 149 € cheaper option via Düsseldorf is shown. The connection is operated by Eurowings with an Airbus A320 for the first leg and an Airbus A320neo for the second leg. In comparison to the other option via Düsseldorf the *Environmental Rating* of 0,97 is a little better due to the use of a better aircraft for the second leg.

7.2 Medium-Haul Flight from Hamburg to Palma de Mallorca

In Table 6.2 the flight with the best *Environmental Rating* of 0,80 is a direct flight of Ryanair with an Airbus A320 from Lauda Europe, this flight is the one with the lowest flight time of 02:35 h and distance of 1.659 km, but not the cheapest flight option with a ticket price of 134 €. The cheapest flight option with 83 € is also a direct flight from Ryanair with a Boeing 737-800 and the same flight time and distance as the other flight of this airline. This cheapest flight has a marginal worse *Environmental Rating* of 0,82 than the other flight option of Ryanair. The flight with the significantly worst *Environmental Rating* of 1,32 is an option via Barcelona from Eurowings with an Airbus A320 for the first leg and Air Europa with a Boeing 737-800 for the second leg. This flight option is also the one with the longest flown distance of 1.695 km. The *Environmental Rating* is significantly worse than all other flights, even the deviation only comes to 27 km.

7.3 Medium-Haul Flight from Hamburg to Gran Canaria

For the following flight routes of this section, the relations of price and *Environmental Rating* of the before mentioned examples do not longer apply, because there are only a few low-cost carriers that serve these connections. As seen in Table 6.3 the flight option via Amsterdam and Madrid of KLM with an Embraer E195-E2 for the first leg and Air Europa with a Boeing 787-9 for the second and third leg is indeed the cheapest one with a ticket price of 181 € and a flight distance of 3.604 km, but also the one with the significantly worst *Environmental Rating* of 4,50. This connection is also the one with the longest flight time of 6:40 h. Even the deviation of only 59 km compared to the option with the best *Environmental Rating* is quite small, the additional landing causes this massive environmental impact. The flight option with the best *Environmental Rating* of 1,63 and shortest flight time of 5:45 h is a connection of Iberia via Madrid with an Airbus A320 for the first leg and an Airbus A321neo for the second leg, but also the most expensive one with a ticket price of 235 €. The flight distance of this connection comes to 3.545 km. Two flight options via Zürich are shown in Table 6.3, both offered by Swiss, Eurowings and Edelweiss Air, the second leg is in both cases operated by Edelweiss Air with an Airbus A320, but the first leg is operated by Swiss with an Airbus A321 for one option and operated by Eurowings with an Airbus A319 for the other option. The *Environmental Rating* of the option with Swiss comes to 1,66 and the option with Eurowings comes to an *Environmental Rating* of 1,75. In this case the difference in the selected aircraft is crucial again.

7.4 Medium-Haul Flight from Hamburg to Antalya

Table 6.4 shows as the cheapest and eco-friendliest flight with a ticket price of 110 € and an *Environmental Rating* of 0,98 a direct flight of SunExpress operated with a Boeing 737-800. This option is also the one with the shortest flight time and distance of 3:35 h and 2.456 km. In this case an option of Lufthansa and SunExpress via Munich is the most expensive one with a ticket price of 188 € and the one with the longest flight distance of 2.603 km. The connection is operated by Lufthansa with an Airbus A321 for the first leg and operated by SunExpress with a Boeing 737-800 for the second leg. The *Environmental Rating* is 1,57. The flight option with the worst *Environmental Rating* of 1,96 is a connection via Istanbul operated by Turkish Airlines with an Airbus A330-300 for the first leg and an Airbus A321 for the second leg. The flight time of this option comes to 4:25 h and a ticket price of 157 €. A second option offered by Turkish Airlines via Istanbul is available. This option operates the same aircraft but in swapped order. The first leg is operated with an Airbus A321 and the second leg by an Airbus A330-300. This change of order causes the worse aircraft to fly a smaller distance and the better aircraft to fly the longer distance. The second option gets an *Environ-*

mental Rating of 1,87 and is with a ticket price of 151 € even cheaper, but with a flight time of 4:40 h slower than the other option.

7.5 Long-Haul Flight from Hamburg to New York

In Table 6.5 the cheapest connection with 469 € is also one with the best *Environmental Rating* of 2,51 and a flight distance of 6.618 km, but the slowest connection with a flight time of 9:55 h. The option connections via Frankfurt, the first leg is operated by Lufthansa with an Airbus A320neo, and the second leg is operated by Condor with a Boeing 767-300ER. The worst *Environmental Ratings* of 2,64 are given to two connections operated by Icelandair which fly via Keflavik. Both options have a ticket price of 503 € and a flight time of 9:30 h. Both options operate a Boeing 737 MAX 9 for the first leg, but the second leg is operated by a Boeing 767-300 in case of one option and a Boeing 737 MAX 9 in case of the other option. Table 6.5 also shows another connection with the best *Environmental Rating* of 2,51, but this time the option is offered completely by Lufthansa and is the connection with the highest ticket price of 1.245 €. This option is operated with an Airbus A320 for the first leg and a Boeing 747-8 for the second leg, also this option is the one with the longest flight distance of 6.640 km and therefore, 22 km longer than the flight with the same rating, but with a flight time of 9:40 h a little bit faster.

7.6 Long-Haul Flight from Hamburg to Bonaire

Table 6.6 shows as the flight option with the best *Environmental Rating* of 4,14 a connection via Amsterdam and Atlanta. This option is operated by KLM with an Embraer E175 for the first leg to Amsterdam and operated by Delta Air Lines with an Airbus A350-900 for the second leg to Atlanta, the final leg is also operated by Delta Air Lines with a Boeing 737-800. The ticket price comes to 3.183 € and is one of the most expensive options calculated for this destination, the flight distance is 10.335 km and the flight time 14:50 h. The cheapest connection with a significant lower ticket price of 629 € is an option operated by KLM via Amsterdam and Oranjestad. The first leg is operated with an Embraer E190, the second leg with a Boeing 777-300ER, the third also with a Boeing 777-300ER. The *Environmental Rating* of this option is 4,32, the flight time and distance are the shortest with 11:35 h and 8.457 km. The worst *Environmental Rating* of 5,83 according to Table 6.6 gets to a connection via London and Miami provided by British Airways and American Airlines. The first leg is operated by British Airways with an Airbus A321neo, the second leg also by British Airways with an Airbus A380-800 and the final leg by American Airlines with an Airbus A319. The ticket price for this option is 1.704 €, the flight time and distance come to 14:19 h and 9.839 km.

British Airways and American Airlines also offer another flight option via the same airports for the same price, the only difference is a slightly longer flight time of 14:50 h and the second leg is operated by American Airlines with a Boeing 777-300ER with a better rating than the Airbus A380-800. Additionally, also the first leg is operated with an Airbus A320, instead of an A321neo. This option has a better *Environmental Rating* than the first option of 5,07. As shown, a change in aircraft over a very long distance can make a big difference on the environmental impact.

7.7 Long-Haul Flight from Hamburg to Bangkok

According to Table 6.7 the cheapest connection operated by Finnair via Helsinki is also the one with the shortest flight distance and the best *Environmental Rating*, but with the longest flight time. The ticket price comes to 533 €, the rating is 3,27, the distance is 9.084 km, and the flight time is 13:30 h. This option operates for the first leg an Embraer E190 and for the second leg an Airbus A350-900. The connection with the worst *Environmental Rating* of 5,41 is operated by Emirates via Dubai and the flight distance is also the longest with 9.797 km. Emirates operates for this connection an Airbus A380-800 for the first leg and a Boeing 777-300ER for the second. The fastest and also most expensive connection with 11:30 h and a ticket price of 1.088 € is offered by Austrian Airlines via Vienna. The first leg is operated with an Airbus 320, the second one with a Boeing 777-200ER. Also, Finnair is probably not a low-cost carrier, the better fleet with this connection allows a low price with low environmental impact.

7.8 Long-Haul Flight from Hamburg to Hong Kong

As in Table 6.8 shown, the connection with the best *Environmental Rating* of 4,09 is a flight option offered by Eurowings and Cathay Pacific via Paris. The first leg is operated Eurowings with an Airbus A319 and the second leg by Cathay Pacific with an Airbus A350-1000. This option is the most expensive one with a ticket price of 852 €. The flight time and distance come to 13:30 h and 10.336 km. Even the route via Paris seems to be counterintuitive, the use of the Airbus A350-1000 and the need of only one layover gives advantage to this connection. Even the flight option of Turkish Airlines via Istanbul with less deviation and better rated aircraft seems to be with an *Environmental Rating* of 4,27 slightly less eco-friendly than the option mentioned before. The option of Turkish Airlines operates an Airbus A321 for the first leg and a Boeing 777-300ER for the second leg at a ticket price of 708 €, a flight time of 13:25 h and a flight distance of 10.012 km. The worst *Environmental Rating* of 5,64 has a connection offered by Lufthansa and Thai Airways via Frankfurt and Bangkok; this flight option is with 11.110 km also the one with the longest flight distance. The first leg is operated by Lufthansa with an Airbus A319 and the second and third leg by Thai Airways with a Boeing 777-300ER. The flight time comes to 14:35 h and the ticket price is 770 €. A similar flight option is the connection of Lufthansa and Thai Airways via Munich and Bangkok. The first leg is again operated by Lufthansa but with an Airbus A320, the second leg is again operated by Thai Airways but with an Airbus A350-900 and the final leg again by Thai Airways with a Boeing 777-300ER. The *Environmental Rating* of this flight option is with 4,81 better than the option mentioned before. The ticket price is 765 €, flight time and distance are similar to the connection before, but this change in aircraft model for the second leg shows again a clear advantage for the environmental impact. The cheapest flight connection according to Table 6.8 is offered by Finnair via Helsinki and Bangkok. The *Environmental Rating* is 4,51 at a ticket price of 612 €, a flight distance of 10.773 km and the longest flight time of 16:25 h.

7.9 Long-Haul Flight from Hamburg to Mexico City

In Table 6.9 and Figures 6.42 – 6.45 one flight connection is pretty obvious placed distant to all other flight options. This flight option via Istanbul offered by Turkish Airlines has the worst *Environmental Rating* of 5,22, the longest flight time of 17:15 h and distance of 13.422 km, but still is the cheapest connection with a ticket price of 956 €. The operated aircraft for the first leg is an Airbus A321 and for the second leg a Boeing 777-300ER. For the connections Mexico City, there are no flight options of low-cost carriers, so sometimes a connection via an airline hub like Istanbul for Turkish Airlines is cheaper for the passenger even a flight contrary to the actual shortest route has to be done. In this example the connection with the best *Environmental Rating* of 3,20 is, with a ticket price of 1.400 €, again for a long-haul flight the most expensive flight option by Lufthansa via Frankfurt. The first leg is operated with an Airbus A321, the second leg with a Boeing 747-8. The flight distance and time for this connection are 13:10 h and 9979 km.

7.10 Medium-Haul Flight from Hamburg to Hurghada

According to Table 6.10 the cheapest and eco-friendliest flight connection is an option offered by Pegasus Airlines via Istanbul. The ticket price comes to 180 € and the *Environmental Rating* is 1,50. The first leg is operated with an Airbus A320neo, the second leg with a Boeing 737-800. The flight time and distance come to 5:55 h and 3.600 km. Although, the flight option by Turkish Airlines is connected via Istanbul, this one is the connection with the worst *Environmental Rating* of 1,97. The first leg is operated with an Airbus A321 and the second leg with a Boeing 737 MAX 8. The flight time and distance come to 6:00 h and 3.588 km, the ticket price is 327 €. The most expensive options are from Eurowings, Swiss and Edelweiss. Both connections go via Zürich and the ticket price is 339 €. In both options the second leg is operated by Edelweiss with an Airbus A320. Both options have the longest flight distance of 3.840 km and a flight time of 5:55 h. In one option the first leg is operated by Eurowings with an Airbus A320 and in the other option the first leg is operated by Swiss with an Airbus A321. The flight option with Eurowings has an *Environmental Rating* of 1,78 and the one with Swiss a rating of 1,69. The last two mentioned options show that an aircraft with similar engine efficiency but more passenger capacity have a less environmental impact per seat. Remarkable in Table 7.10 is, that the only offered direct flight by Condor for this destination is not the cheapest and not the one with the best *Environmental Rating*. This connection is the fastest, with a flight time of 4:50 h, and the shortest, with a flight distance of 3.529 km, but the rating is 1,55 and the ticket price 300 €. This example shows, that it is possible to get a better rating, even when an additional landing is performed, but the rating of the operated aircraft is better.

8 Summary and Conclusions

In this chapter also hints for passengers referring to the choice of a flight option are given.

As seen in Chapter 7 all long-haul flights are connections with layovers at airline hubs, when not starting from an airline hub itself. For airlines, connections via an airline hub are more economical. The passengers are gathered from all surrounding non-hub (spoke) cities and a hub-to-hub connection creates a city-pair where bigger aircraft transport more passengers with one flight. This system may not lead to the shortest routes from origin to destination, but the ecological impact may be less than a lot of point-to-point connections with smaller aircraft. For a hub-and-spoke system the distance between the two hubs needs to be big enough to lead to less ecological impact than a point-to-point connection and the appropriate aircraft need to be in operation of the long-haul flight. This means, that flight connections of short- and medium-haul flights via an airline hub should be avoided to get the eco-friendliest flight. In 9 out of 10 investigated pairs of origin and destination, the flight option with less layovers was always the one with the best and the flight option with the most layovers was always the one with the worst rating. Every start and landing causes additional noise and air pollution at the environment of an airport, this leads to worse ratings and only in one contemplated example the aircraft on a direct flight was worse rated than a flight with a layover.

In general, for long-haul flights the bigger the aircraft from one hub to another, the better. Certainly, there is an exception for this “rule”. The Airbus A380-800 is quite inefficient, but this is due to the wasteful use of its cabin space. The cabin layout of the operated A380s for long-haul flights often shows big first-class seats, or beds, or even suites. The bigger the used space for upper class passengers, the less the amount of passenger capacity and the less the efficient use of an aircraft. Overall, it can be advised, that a low-cost carrier aircraft with only one class and a dense seating is used most efficient and has the lowest environmental impact in comparison to other airlines. Unfortunately, mostly there are no options of low-cost carriers for long-haul flights, but the advice here is, to search for an operating aircraft with the least amount of seats for upper classes and the most amount of economy seats. As seen in Section 6.8, in some cases a flight connection via an airport opposed to the actual travel direction can lead to a better *Environmental Rating*. This shows, a good comparison of all flight options by a passenger is crucial, but not very easy to overview. To reduce the ecological impact of a journey even more, the passenger needs to consider an alternative means of transportation to an airline hub and away from the destination hub, like travelling with the railway.

For short- and medium-haul flights, options of low-cost carriers are often a good way to travel with the least amount of environmental impact at low costs, but there are also connections via unreasonable hubs that are not considered in this project. Finally, domestic and even short-haul flights should be avoided in general, as mentioned before, a passenger should consider using the railway for journey, where not even an advantage of time is given by flying, because the time between arrival at the airport and leaving the airport at the destination is not to be underestimated.

The used tool in this project to calculate *Trip Emission Ecolabels* for the analyzed routes, the second concept developed by Hurtecant, shows, in contrast to an *Ecolabel for Aircraft* or the first developed concept of TEE by Hurtecant, the total environmental impact of a flight without any grading like an energy label.

9 Recommendations

For further research, the database of the *Trip Emission Ecolabel* and therefore the database of the *Ecolabel for Aircraft* need to be updated with new aircraft combinations. At the moment, the calculation of *Trip Emission Ecolabels* for turboprop aircraft is not possible with the second concept described in Section 5.1.2, because the needed database of the Swedish Defence Research Agency including the NO_x-emissions of most common turboprop engines is not publicly available. To make the handling of the Excel-tool for calculation of the *Trip Emission Ecolabel*, especially the second concept by Hurtecant, more efficient and user friendly, the Excel-tool needs direct access to the database, instead of manual input of all data out of the Excel-tool for calculation of the *Ecolabel for Aircraft*. The second concept of Hurtecant for the TEE is very useful to evaluate flight connections but does not have a as pleasant and established design as the first concept. To improve the first concept a consideration of deviation from the direct route should be added and the values of Local Noise Levels and Local Air Pollution should be summed and not averaged.

To make the decision of choosing a flight option easier and more transparent for passengers, the *Trip Emission Ecolabels* and *Ecolabels for Aircraft* need to be published or automatically implemented in flight search and booking engines. A study on how passengers would deal with the ecolabels could help to improve the designs and to overthink the given values. The actual declared amount of emitted CO_2 at flight search and booking engines needs to be investigated and compared to the calculated ratings of the *Trip Emission Ecolabel* to emphasize the need of those ecolabels. To implement the ratings, additional from the passenger free adjustable weighing factors for travel time, price and *Environmental Rating* would be useful.

To optimize the results on eco-friendly journeys, the price for connections via railway must be more attractive and must be marked more with the CO_2-savings in comparison to the not performed flight. For medium-haul flights airlines should consider introducing a cabin layout with more seats of economy class and less seats of business class. Overall, for eco-friendly flight connections, a modern fleet with efficient engines is needed.

List of References

AIRFLEETS, 2022. *Airbus A350 MSN 74*.
Available from: https://www.airfleets.net/ficheapp/plane-a350-74.htm
Archived at: https://perma.cc/L7NA-9SKW

CAMBRIDGE DICTIONARY, 2022b. *Trip*.
Available from: https://dictionary.cambridge.org/de/worterbuch/englisch/trip
Archived at: https://perma.cc/76EG-26DZ

CAMBRIDGE DICTIONARY, 2022c. *Emission*.
Available from: https://dictionary.cambridge.org/de/worterbuch/englisch/emission
Archived at: https://perma.cc/V5PR-7R79

CAMBRIDGE DICTIONARY, 2022d. *Analysis*.
Available from: https://dictionary.cambridge.org/de/worterbuch/englisch/analysis
Archived at: https://perma.cc/LDP2-PLQZ

CAMBRIDGE DICTIONARY, 2022e. *Route*.
Available from: https://dictionary.cambridge.org/de/worterbuch/englisch/route
Archived at: https://perma.cc/SU4Q-4AJV

CAMBRIDGE DICTIONARY, 2022f. *Flight*.
Available from: https://dictionary.cambridge.org/de/worterbuch/englisch/flight
Archived at: https://perma.cc/6KJ4-ZKQ8

EPA, 2022. *Introduction to Ecolabels and Standards for Greener Products*.
Available from: https://bit.ly/3Pqvw7y
Archived at: https://perma.cc/LL9E-FVR9

EUROCONTROL, 2011. *Study into the Impact of the Global Economic Crisis on Airframe Utilisation*. Brussels, EUROCONTROL, Central Office for Delay Analysis, Information Paper
Archived at: https://bit.ly/3PtLn5k

FLIGHTRADAR24, 2022. *Flights*.
Available from: https://www.flightradar24.com/data/flights

GOOGLE, Travel, 2022. *Flights*.
Available from: https://www.google.com/travel/flights

HAMBURG AIRPORT, 2021. *Top 10 Ziele 2020*.
Available from: https://bit.ly/3aBE7pj
Archived at: https://perma.cc/U982-GQ73

HAß, Tim, 2015. *Developing an Ecolabel for Aircraft*. Bachelor Thesis. Hamburg University of Applied Science, Department of Automotive and Aeronautical Engineering
Available from: https://www.fzt.haw-hamburg.de/pers/Scholz/arbeiten/TextHass.pdf
Archived at: https://perma.cc/VT2V-EQFE

HURTECANT, Daan, 2021. *Launch of an Ecolabel for Passenger Aircraft*. Master Thesis. Hamburg University of Applied Science, Department of Automotive and Aeronautical Engineering
Available from: https://doi.org/10.15488/11558

IATA, 2020. *Air Transport & Travel Industry – IATA EDIFACT and XML Codeset*. Montreal, IATA, Information Paper
Available from: https://bit.ly/3PdVxqM
Archived at: https://perma.cc/8JXY-2NMR

MACDONALD, Allan, 2012. *A General View on Fuel Efficiency in Commercial Aviation*. Master Thesis. Hamburg University of Applied Science, Department of Automotive and Aeronautical Engineering
Available from: https://bit.ly/3bqFG6i
Archived at: https://perma.cc/CLC4-EDWJ

OXFORD DICTIONARY, 2022a. *Hint*.
Available from: https://www.lexico.com/definition/hint
Archived at: https://perma.cc/9V7F-NPDJ

OXFORD DICTIONARY, 2022b. *Passenger*.
Available from: https://www.lexico.com/definition/passenger
Archived at: https://perma.cc/TVQ9-TMRA

OXFORD DICTIONARY, 2022c. *Leg*.
Available from: https://www.lexico.com/definition/leg
Archived at: https://perma.cc/FW7M-Z6FX

SEATGURU, 2022. *Lufthansa Seat Maps: Airbus A350-900 (359) Layout 2*.
Available from: https://bit.ly/3aUICv8
Archived at: https://perma.cc/QA4U-8JWX

SOKOUR, Sophie and Tobias BÄHR, 2018. *Calculating and Comparing Ecolabels for Popular Passenger Aircraft*. Project. Hamburg University of Applied Science, Department of Automotive and Aeronautical Engineering
Available from: https://bit.ly/3dp0jjV
Archived at: https://perma.cc/2BKP-SKZH

VAN ENDERT, Lynn, 2017. *Definition of an Ecolabel for Aircraft*. Master Thesis. Hamburg University of Applied Science, Department of Automotive and Aeronautical Engineering
Available from: https://doi.org/10.15488/11584

VELASCO, Alejandro R., 2020. *Environmental Information for Aviation Passengers*. Bachelor Thesis. Hamburg University of Applied Science, Department of Automotive and Aeronautical Engineering
Available from: https://doi.org/10.15488/11552

WIKIPEDIA, 2022a. *Airline Hub*.
Available from: https://en.wikipedia.org/wiki/Airline_hub
Archived at: https://perma.cc/YJL5-T8BB

WIKIPEDIA, 2022b. *Layover*.
Available from: https://en.wikipedia.org/wiki/Layover
Archived at: https://perma.cc/4AAJ-FYGG

WIKIPEDIA, 2022c. *International Organization for Standardization*.
Available from: https://bit.ly/3uQCsD2
Archived at: https://perma.cc/48KK-J4BU

WIKIPEDIA, 2022d. *Domestic Flight*.
Available from: https://en.wikipedia.org/wiki/Domestic_flight
Archived at: https://perma.cc/ZWM7-7LZ6

WIKIPEDIA, 2022e. *International Air Transport Association*.
Available from: https://en.wikipedia.org/wiki/International_Air_Transport_Association
Archived at: https://perma.cc/FNL8-PXQH

WIKIPEDIA, 2022f. *Eurocontrol*.
Available from: https://en.wikipedia.org/wiki/Eurocontrol
Archived at: https://perma.cc/3PV3-28WJ

Appendix A – Selected Routes and Flight Connections

Table A.1 The selected routes and flight connections for Trip Emission Ecolabel

Destination	Airline 1. Leg	Aircraft 1. Leg	Layover 1	Airline 2. Leg	Aircraft 2. Leg	Layover 2	Airline 3. Leg	Aircraft 3. Leg
Antalya								
	Corendon	B738	-	-	-	-	-	-
	SunExpress	B738	-	-	-	-	-	-
	Turkish Airlines	B738	-	-	-	-	-	-
	Turkish Airlines	B738	SAW	Pegasus Airlines	A20N	-	-	-
	Turkish Airlines	B738	SAW	Turkish Airlines	B738	-	-	-
	SunExpress	B738	ADB	SunExpress	B738	-	-	-
	Turkish Airlines	A321	IST	Turkish Airlines	A333	-	-	-
	Turkish Airlines	A321	IST	Turkish Airlines	A321	-	-	-
	Turkish Airlines	A333	IST	Turkish Airlines	A321	-	-	-
	Lufthansa	A321	MUC	SunExpress	B738	-	-	-
Bangkok								
	Finnair	E190	HEL	Finnair	A359	-	-	-
	Eurowings	A319	AMS	EVA Air	B77W	-	-	-
	Lufthansa	A321	FRA	Thai Airways	B77W	-	-	-
	Lufthansa	A320	MUC	Thai Airways	A359	-	-	-
	Swiss	A20N	ZRH	Thai Airways	B788	-	-	-
	Emirates	A388	DXB	Emirates	B77W	-	-	-
	KLM	B738	AMS	KLM	B77W	-	-	-
	Austrian Airlines	A320	VIE	Austrian Airlines	B772	-	-	-
	Lufthansa	A321	FRA	SriLankan Airlines	A333	CMB	SriLankan Airlines	A321
	Lufthansa	A321	FRA	Gulf Air	A21N	BAH	Gulf Air	B789
Bonaire								
	KLM	E190	AMS	KLM	B77W	AUA	KLM	B77W
	Eurowings	A320	LHR	United Airlines	B789	IAH	United Airlines	B738
	Lufthansa	A320	FRA	United Airlines	B772	IAH	United Airlines	B738
	British Airways	A320	LHR	American Airlines	B77W	MIA	American Airlines	A319
	British Airways	A21N	LHR	British Airways	A388	MIA	American Airlines	A319
	KLM	E175	AMS	Delta Airlines	A333	ATL	Delta Airlines	B738
	KLM	E175	AMS	Delta Airlines	A359	ATL	Delta Airlines	B738
	Lufthansa	A320	FRA	Lufthansa	B748	IAH	Delta Airlines	B738
Hong Kong								
	Lufthansa	A319	FRA	Cathay Pacific	B77W	-	-	-
	Turkish Airlines	A321	IST	Turkish Airlines	B77W	-	-	-
	Finnair	E190	HEL	Finnair	A359	BKK	Cathay Pacific	A359
	Emirates	A338	DXB	Emirates	B77W	BKK	Emirates	B77W
	Lufthansa	A320	MUC	Thai Airways	A359	BKK	Thai Airways	B77W
	Lufthansa	A319	FRA	Thai Airways	B77W	BKK	Thai Airways	B77W
	Eurowings	A319	CDG	Cathay Pacific	A35K	-	-	-
	British Airways	A320	LHR	Cathay Pacific	A35K	-	-	-

Destination	Airline 1. Leg	Aircraft 1. Leg	Layover 1	Airline 2. Leg	Aircraft 2. Leg	Layover 2	Airline 3. Leg	Aircraft 3. Leg
Hong Kong								
	British Airways	A320	LHR	Qatar Airways	A388	DOH	Qatar Airways	A359
	Emirates	A388	DXB	Emirates	B77W	KUL	Malaysia Airlines	A333
Hurghada								
	Pegasus Airlines	A20N	SAW	Pegasus Airlines	B738	-	-	-
	Eurowings	A319	DUS	Eurowings	A320	-	-	-
	Condor	B753	-	-	-	-	-	-
	Turkish Airlines	A321	IST	Turkish Airlines	B38M	-	-	-
	Eurowings	A320	ZRH	Edelweiss Air	A320	-	-	-
	Swiss	A321	ZRH	Edelweiss Air	A320	-	-	-
	Lufthansa	A320	MUC	Air Cairo	A20N	-	-	-
	Lufthansa	A321	FRA	Lufthansa	A21N	CAI	EgyptAir	B738
	Lufthansa	A320	FRA	Eurowings Discover	A320	-	-	-
New York								
	Lufthansa	A20N	FRA	Condor	B763	-	-	-
	Icelandair	B39M	KEF	Icelandair	B763	-	-	-
	Air France	BCS3	CDG	Air France	B772	-	-	-
	KLM	E175	AMS	KLM	B789	-	-	-
	Aer Lingus	A320	DUB	Aer Lingus	A21N	-	-	-
	Icelandair	B39M	KEF	Icelandair	B38M	-	-	-
	KLM	E190	AMS	Delta Airlines	A359	DTW	Delta Airlines	B712
	KLM	E190	AMS	KLM	B78X	-	-	-
	Lufthansa	A320	FRA	Lufthansa	B748	-	-	-
	TAP Portugal	A320	LIS	TAP Portugal	A339	-	-	-
	Lufthansa	A320	MUC	Lufthansa	A359	-	-	-
Gran Cana-ria								
	Lufthansa	A320	FRA	Eurowings Discover	A320	-	-	-
	Iberia	A320	MAD	Iberia	A21N	-	-	-
	Vueling	A320	BCN	Vueling	A320	-	-	-
	Condor	B753	FUE	Binter Canarias	AT72	-	-	-
	Swiss	A321	ZRH	Edelweiss Air	A320	-	-	-
	KLM	E295	AMS	Air Europa	B789	MAD	Air Europa	B789
	TAP Portugal	E190	LIS	TAP Portugal	A320	-	-	-
	Eurowings	A319	ZRH	Edelweiss Air	A320	-	-	-
	Austrian Airlines	A320	VIE	Austrian Airlines	A320	-	-	-
	Iberia	A320	MAD	Iberia	A319	VGO	Iberia	CRJX
Mexico City								
	Turkish Airlines	A321	IST	Turkish Airlines	B77W	-	-	-
	KLM	E190	AMS	KLM	B789	-	-	-
	Air France	A320	CDG	Air France	B77W	-	-	-
	Air France	A319	CDG	Air France	B772	ATL	Delta Airlines	B738
	KLM	B738	AMS	Aeromexico	B789	-	-	-
	Air France	A319	CDG	Aeromexico	B789	-	-	-
	Lufthansa	A321	FRA	Singapore Airlines	A388	JFK	Aeromexico	B789
	Lufthansa	A321	FRA	Lufthansa	B748	-	-	-
	Lufthansa	A321	FRA	Lufthansa	B748	IAD	United Airlines	A320
	British Airways	A320	LHR	American Airlines	B77W	DFW	American Airlines	B738
	British Airways	A319	LHR	British Airways	B789	-	-	-

Destination	Airline 1. Leg	Aircraft 1. Leg	Layover 1	Airline 2. Leg	Aircraft 2. Leg	Layover 2	Airline 3. Leg	Aircraft 3. Leg
Munich								
	Eurowings	A320	-	-	-	-	-	-
	Lufthansa	A320	-	-	-	-	-	-
	Lufthansa	A321	-	-	-	-	-	-
	Eurowings	A319	-	-	-	-	-	-
	Eurowings	A319	DUS	Lufthansa	A320	-	-	-
	Air Baltic	BCS1	RIX	Air Baltic	BCS1	-	-	-
	Eurowings	A320	CGN	Lufthansa	A320	-	-	-
	Eurowings	A319	DUS	Eurowings	A20N	-	-	-
	Lufthansa	A321	FRA	Lufthansa	A320	-	-	-
Mallorca								
	Ryanair	B738	-	-	-	-	-	-
	Eurowings	A320	-	-	-	-	-	-
	Condor	B753	-	-	-	-	-	-
	Ryanair	A320	-	-	-	-	-	-
	Eurowings	A319	VLC	Air Europa	B738	-	-	-
	Eurowings	A320	MUC	Eurowings	A320	-	-	-
	Eurowings	A319	-	-	-	-	-	-
	Eurowings	A320	BCN	Air Europa	B738	-	-	-
	Vueling	A320	BCN	Vueling	A320	-	-	-
	Eurowings	A320	CGN	Eurowings	A319	-	-	-
	Iberia	A320	MAD	Iberia	A21N	-	-	-
	Swiss	A321	ZRH	Swiss	A321	-	-	-

Appendix B – New Generated Aircraft Combinations

Table B.2 Aircraft combinations of airlines with engine type and cabin layout

Airline	**Aircraft**	**Engine**	**Seats Economy**	**Seats Premium Economy**	**Seats Business**	**Seats First**
Aer Lingus	Airbus A320	CFM56-5B4/P	174	0	0	0
Aer Lingus	Airbus A321neo	LEAP-1A33	168	0	16	0
Aeromexico	Boeing 787-9	GEnx-1B74/75/P2G01	211	27	36	0
Air Cairo	Airbus A320neo	LEAP-1A26	186	0	0	0
Air Europa	Boeing 737-800	CFM56-7B26	168	0	12	0
Air Europa	Boeing 787-9	Trent 1000-K3	303	0	32	0
Air France	Boeing 777-200ER	GE90-90B	216	24	40	0
Air France	Airbus A220-300	PW1521G-3	115	0	20	0
Air France	Airbus A320	CFM56-5B4/P	178	0	0	0
Air France	Airbus A319	CFM56-5B5/3	142	0	0	0
Air France (4 classes)	Boeing 777-300ER	GE90-115B	206	28	58	4
American Airlines	Boeing 777-300ER	GE90-115B	216	28	52	8
American Airlines	Airbus A319	CFM56-5B6/P	96	24	0	8
Austrian Airlines	Airbus A320	CFM56-5B4/P	133	0	28	0
Austrian Airlines	Boeing 777-200ER	GE90-90B	244	24	40	0
Binter Canarias	ATR 72	PW127M	72	0	0	0
British Airways	Airbus A320	V2527E-A5	171	0	0	0
British Airways	Airbus A321neo	LEAP-1A32	190	20	0	0
British Airways	Airbus A380-800	Trent 970-84	303	0	55	111
British Airways	Airbus A319	V2522-A5	143	0	0	0
Cathay Pacific	Boeing 777-300ER	GE90-115B	182	34	53	6
Condor	Boeing 767-300ER	PW4060	204	35	18	0
Corendon	Boeing 737-800	CFM56-7B27	189	0	0	0
Delta	Airbus A350-900	Trent XWB-75	226	48	32	0
Delta	Boeing 717-200	BR700-715A1-30	78	20	12	0
Delta Air Lines	Airbus A330-300	PW4168A	219	40	0	34
Delta Air Lines	Boeing 737-800	CFM56-7B26	108	36	0	16
Edelweiss Air	Airbus A320	CFM56-5B4/P	162	0	12	0
EgyptAir	Boeing 737-800	CFM56-7B26	138	0	16	0
Emirates	Boeing 777-300ER	GE90-115B	304	0	42	8
Eurowings	Airbus A320neo	LEAP-1A26	162		12	
Eurowings Discover	Airbus A320	CFM56-5B4/P	162	0	12	0
EVA Air	Boeing 777-300ER	GE90-115B	211	64	0	38
Finnair	Embraer E190	CF34-10E7	88	0	12	0
Gulf Air	Airbus A321neo	LEAP-1A33	161	0	8	0
Gulf Air	Boeing 787-9	Trent 1000-K2	256	0	26	0
Iberia	Airbus A321neo	LEAP-1A32	184	0	24	0
Iberia	Airbus A319	CFM56-5B5/3	184	0	24	0
Icelandair	Boeing 737 MAX 9	LEAP-1B28	162	0	16	0
KLM	Embraer E175	CF34-8E5	60	8	20	0
Lauda Europe	Airbus A320	V2527-A5	180	0	0	0
Malaysia Airlines	Airbus A330-300	PW4168A	263	0	27	0
Pegasus Airlines	Airbus A320neo	LEAP-1A26	186	0	0	0
Pegasus Airlines	Boeing 737-800	CFM56-7B26	189	0	0	0
Qatar Airways	Airbus A380-800	GP7270	461	0	48	8
Qatar Airways	Airbus A350-900	Trent XWB-75	247	0	36	0
Singapore Airlines	Airbus A380-800	Trent 970-84	343	44	82	6
SriLankan Airlines	Airbus A330-300	Trent 772B-60	269	0	28	0
SriLankan Airlines	Airbus A321	V2533-A5	165	0	16	0
SunExpress	Boeing 737-800	CFM56-7B26	189	0	0	0
Swiss	Airbus A321	CFM56-5B1/3	165	0	54	0

Airline	Aircraft	Engine	Seats Economy	Seats Premium Economy	Seats Business	Seats First
Swiss	Airbus A320neo	PW1127G-JM	150	0	30	0
TAP Portugal	Airbus A320	CFM56-5B4/P	114	0	42	0
Thai Airways	Boeing 777-300ER	GE90-115B	306	0	42	0
Thai Airways	Airbus A350-900	Trent XWB-75	289	0	32	0
Thai Airways	Boeing 787-8	Trent 1000-C2	240	0	24	0
Turkish Airlines	Boeing 737-800	CFM56-7B26	135	0	16	0
Turkish Airlines	Airbus A330-300	CF6-80E1A3	261	0	28	0
Turkish Airlines	Airbus A321	V2533-A5	158	0	20	0
Turkish Airlines	Boeing 777-300ER	GE90-115B	300	0	49	0
Turkish Airlines	Boeing 737 MAX 8	LEAP-1B27	135	0	16	0
United Airlines	Boeing 787-9	GEnx-1B74/75/P2G01	149	39	21	48
United Airlines	Boeing 737-800	CFM56-7B24	108	42	16	0
United Airlines	Boeing 777-200ER	GE90-90B	145	72	0	50
United Airlines	Airbus A320	V2527-A5	96	42	0	12

Appendix C – Ecolabel for Aircraft

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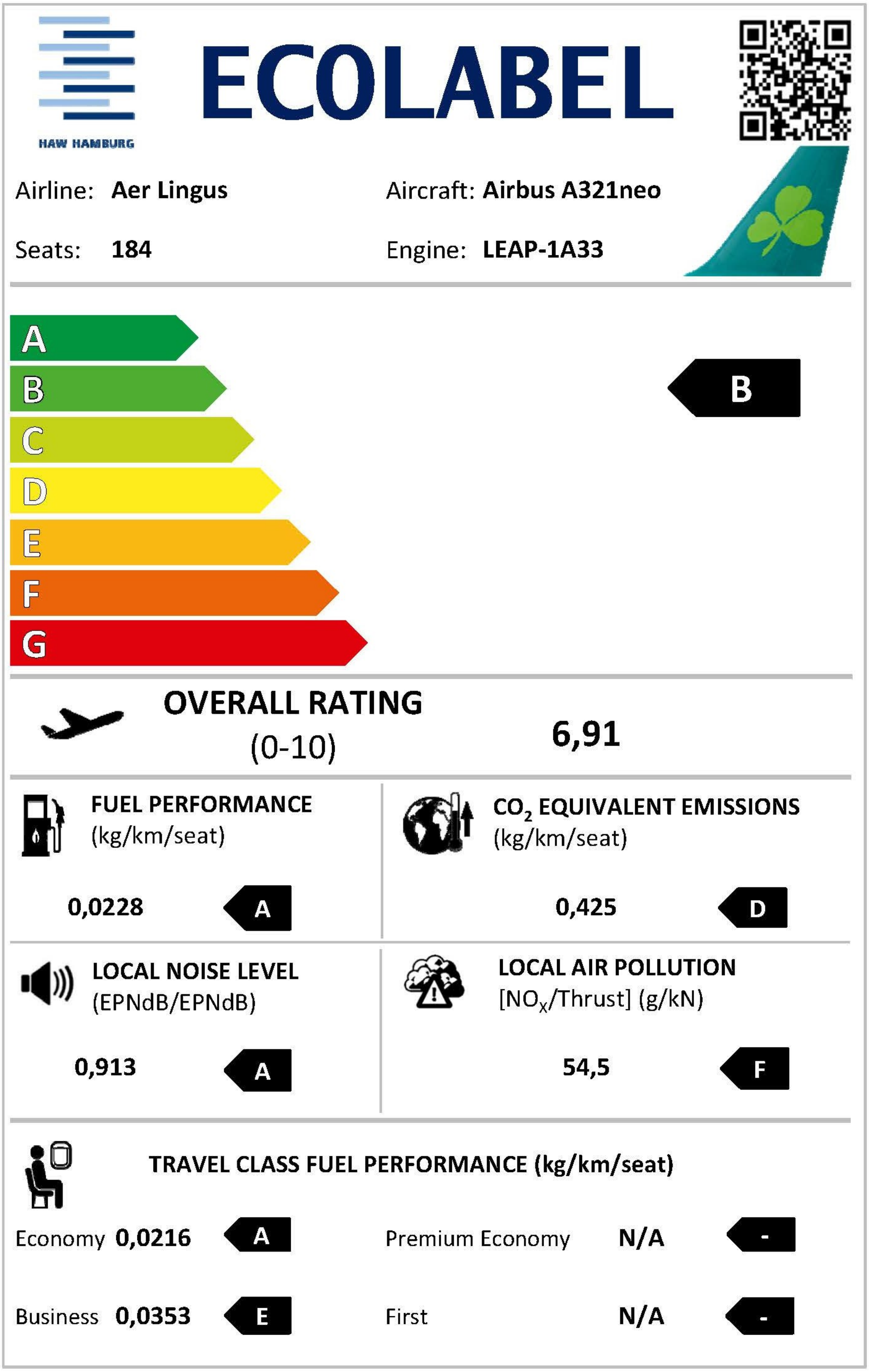

Figure C.1 Ecolabel for Airbus A321neo of Aer Lingus

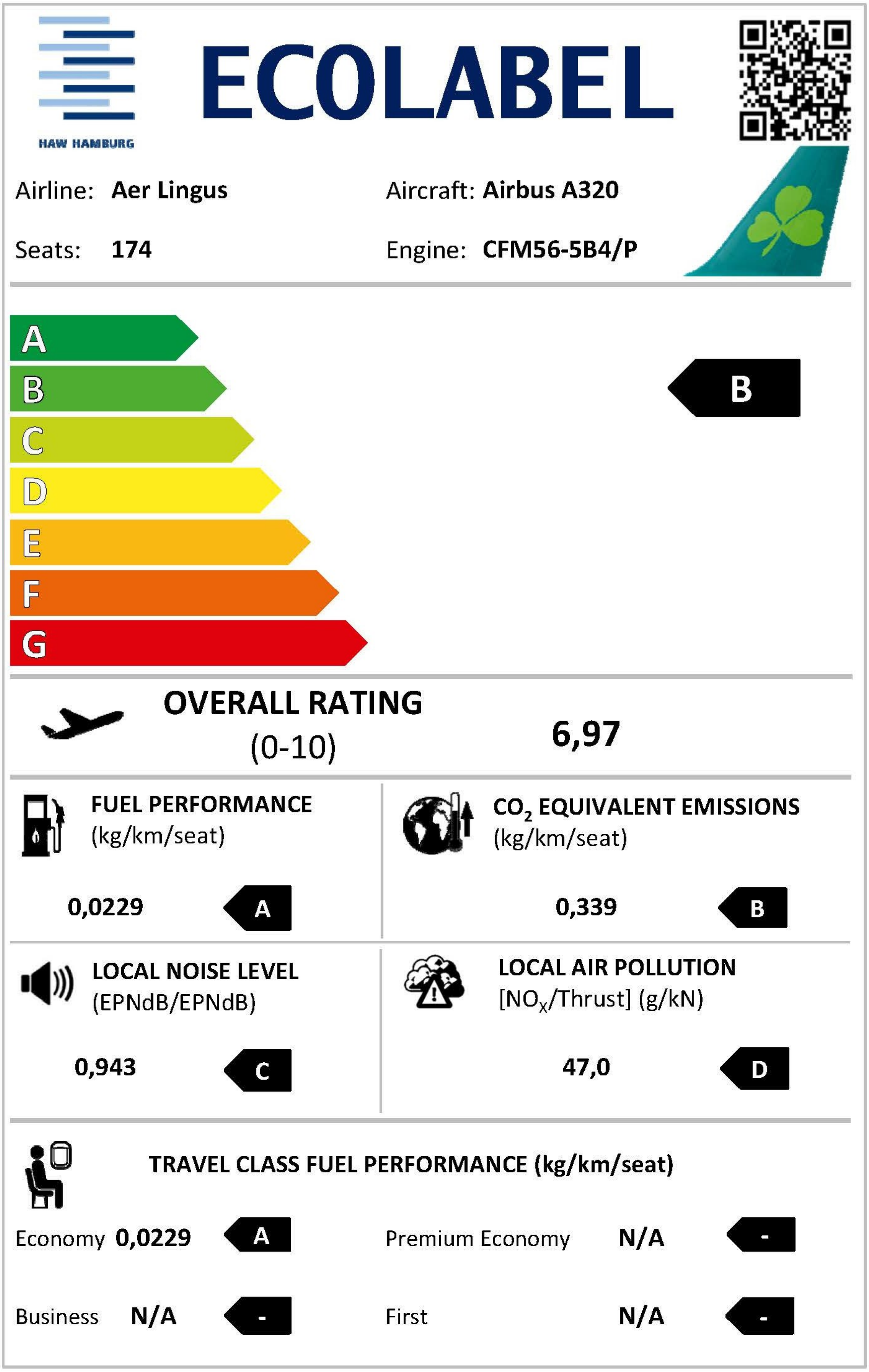

Figure C.2 Ecolabel for Airbus A320 of Aer Lingus

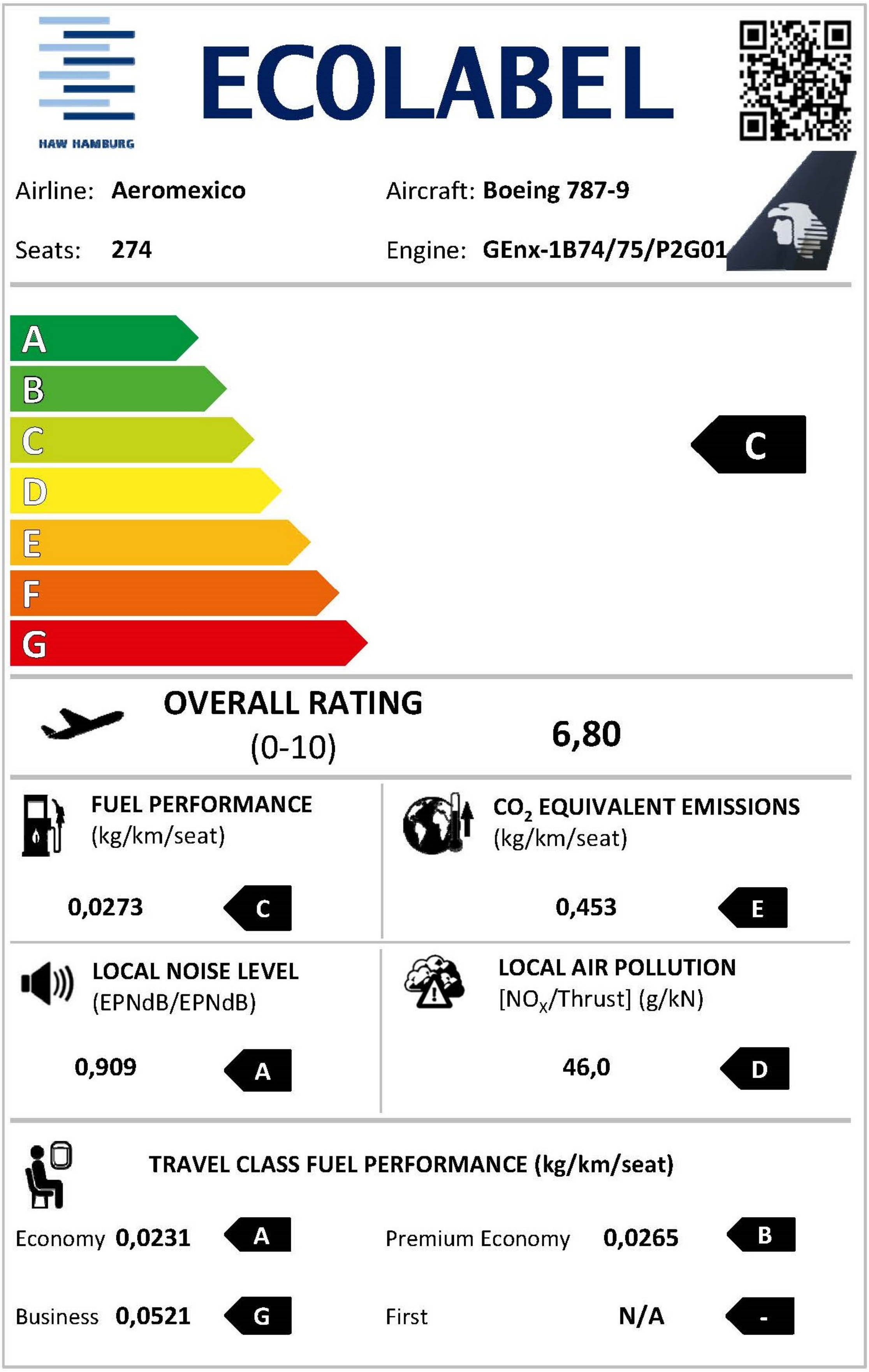

Figure C.3 Ecolabel for Boeing 787-9 of Aeromexico

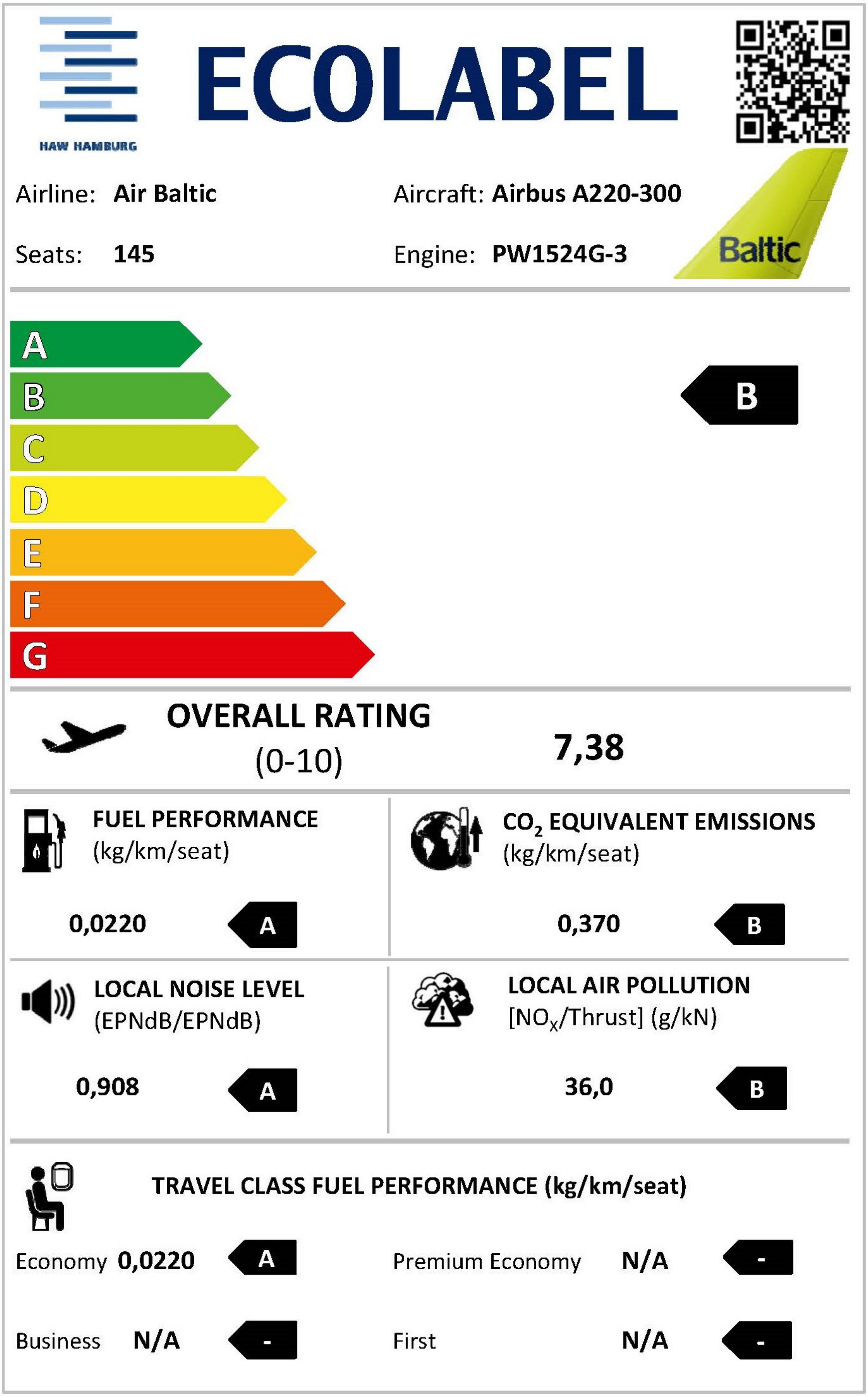

Figure C.4 Ecolabel for Airbus A220-300 of Air Baltic

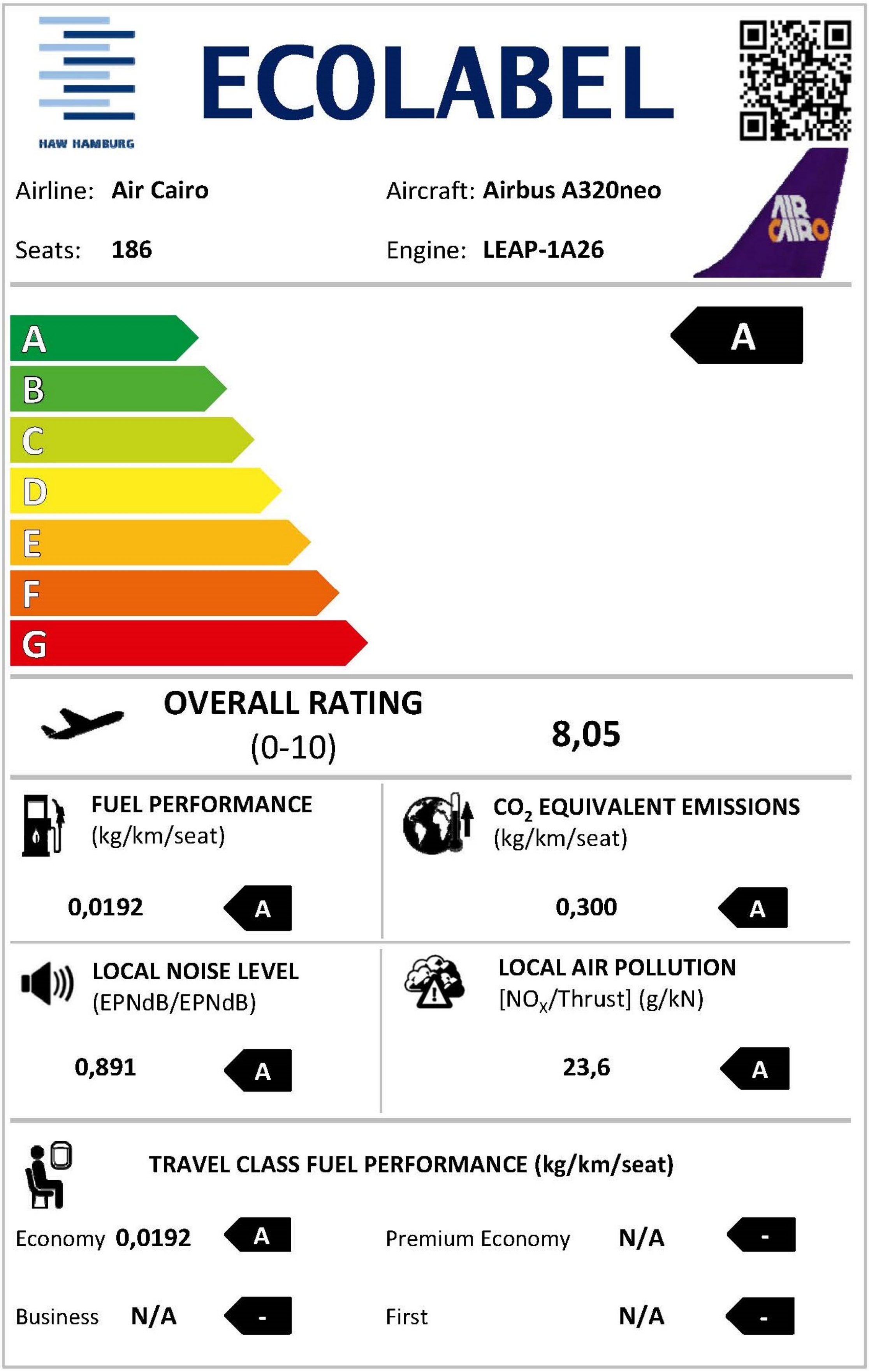

Figure C.5 Ecolabel for Airbus A320neo of Air Cairo

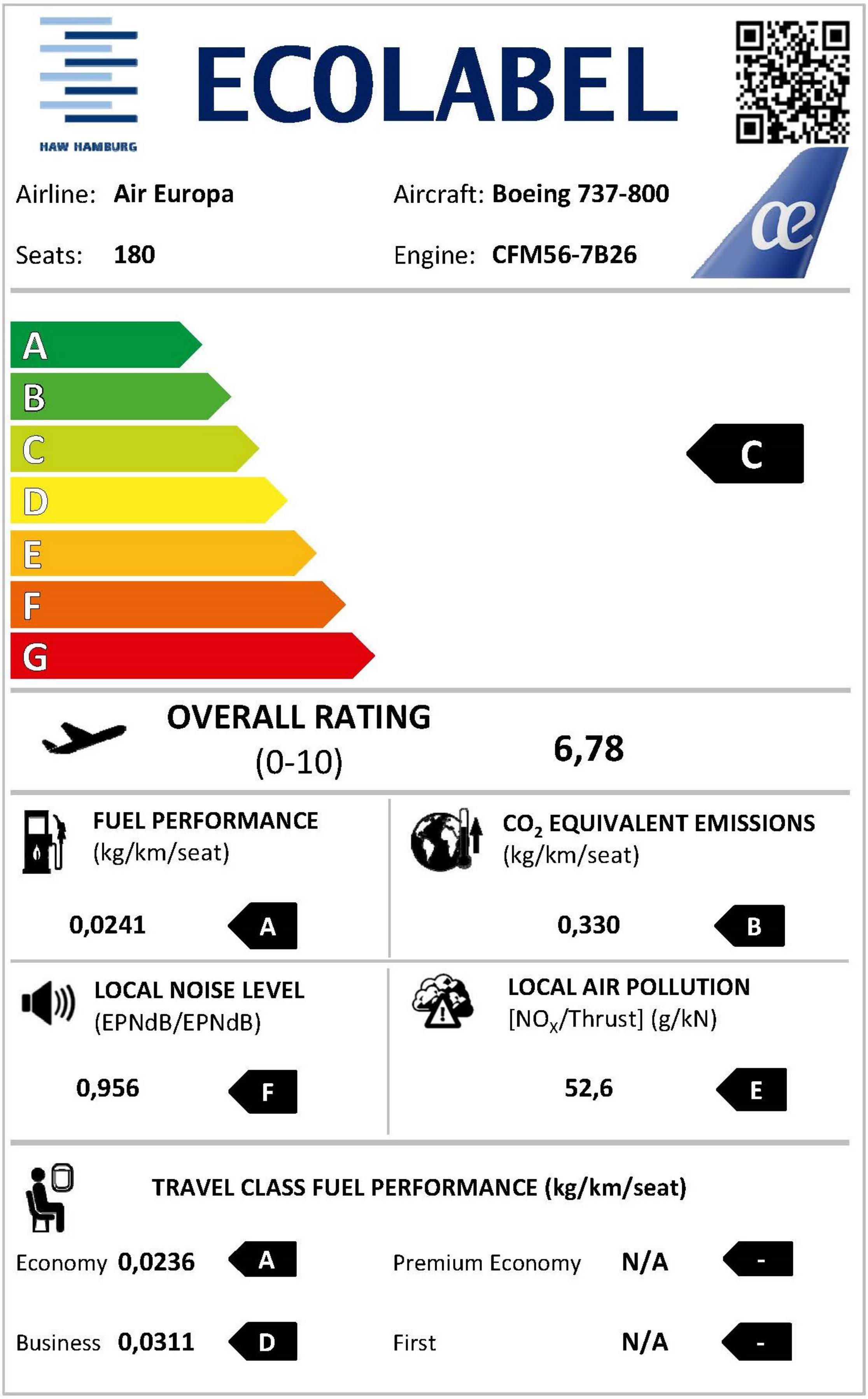

Figure C.6 Ecolabel for Boeing 737-800 of Air Europa

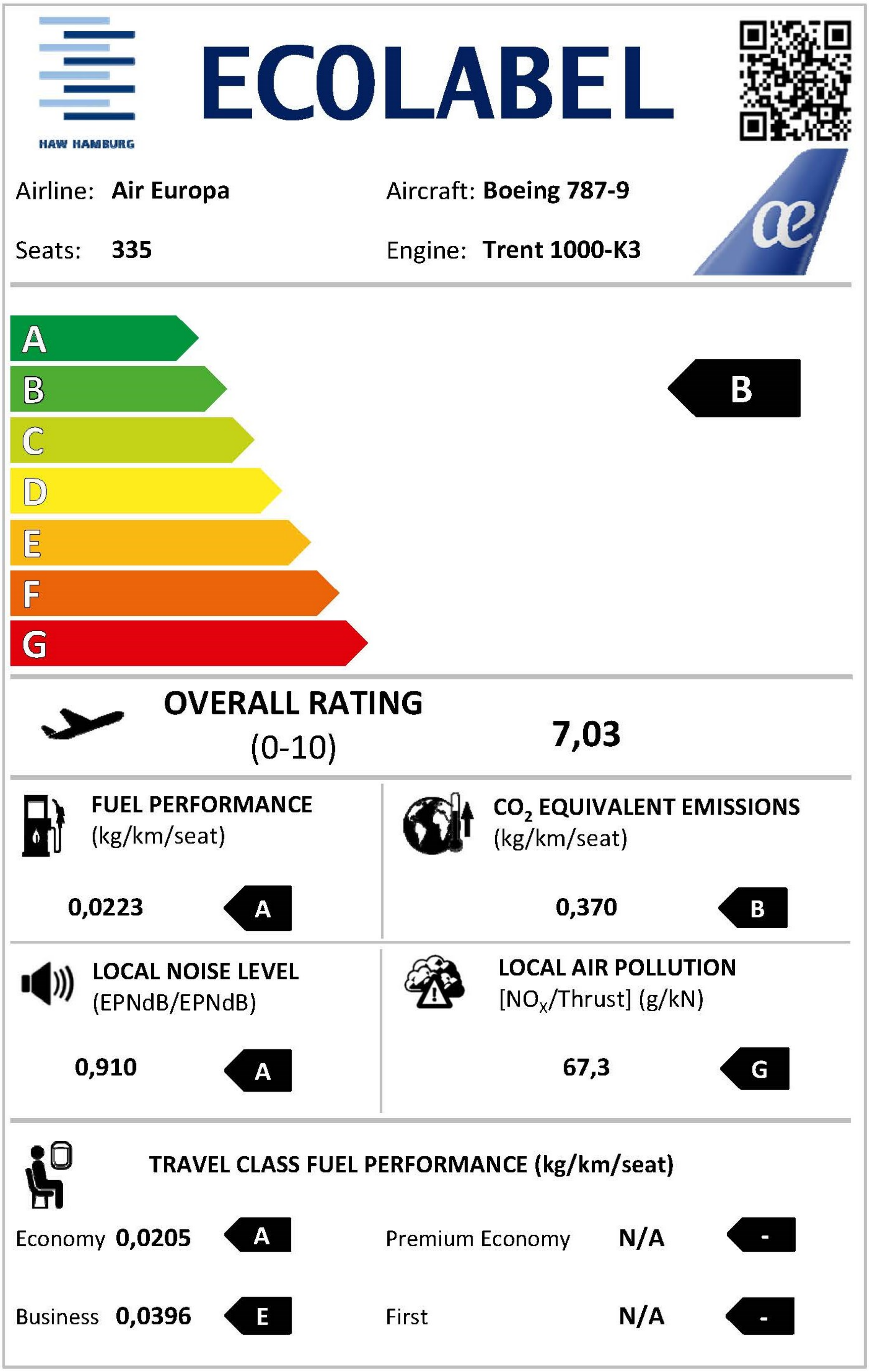

Figure C.7 Ecolabel for Boeing 787-9 of Air Europa

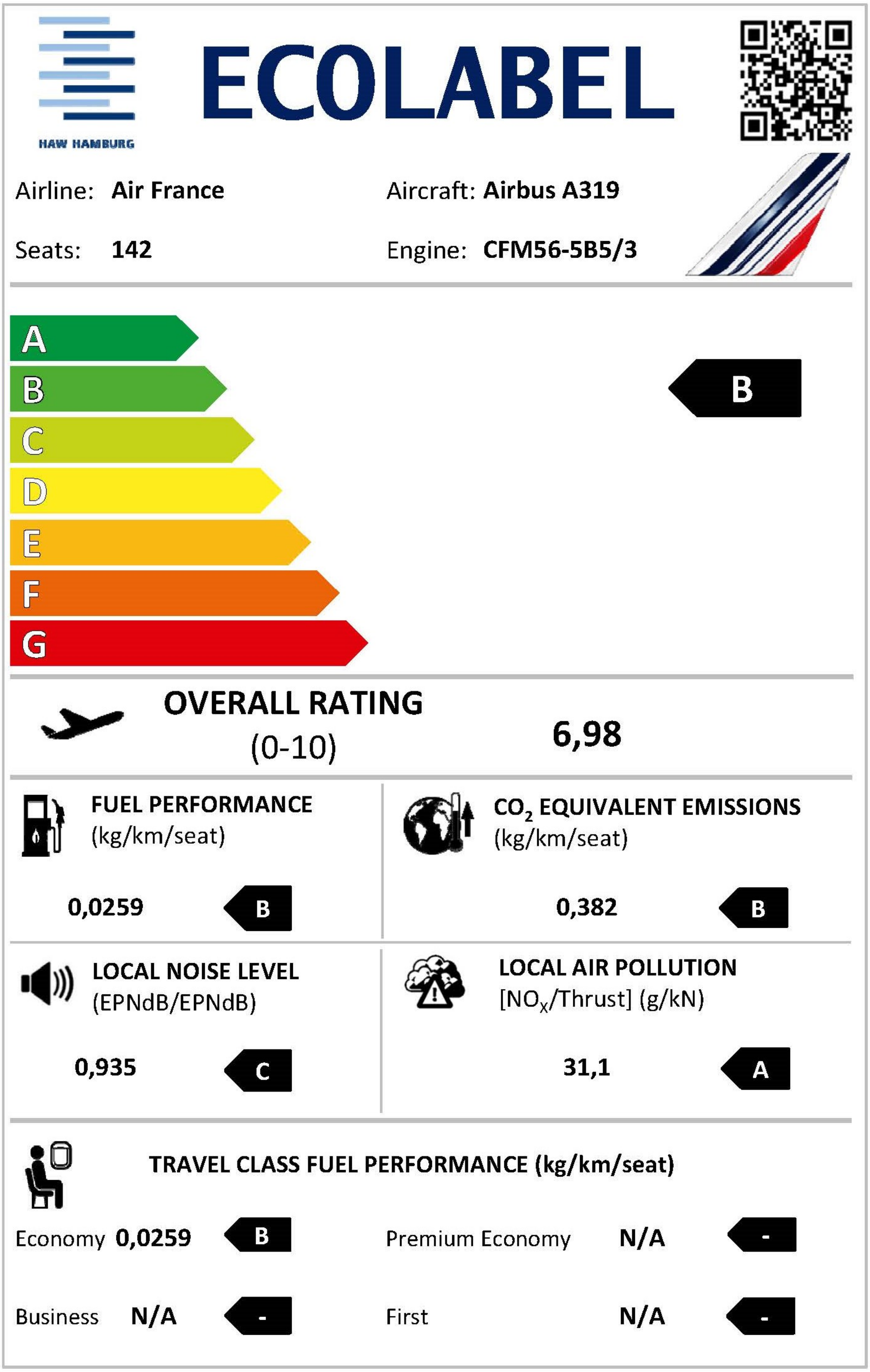

Figure C.8 Ecolabel for Airbus A319 of Air France

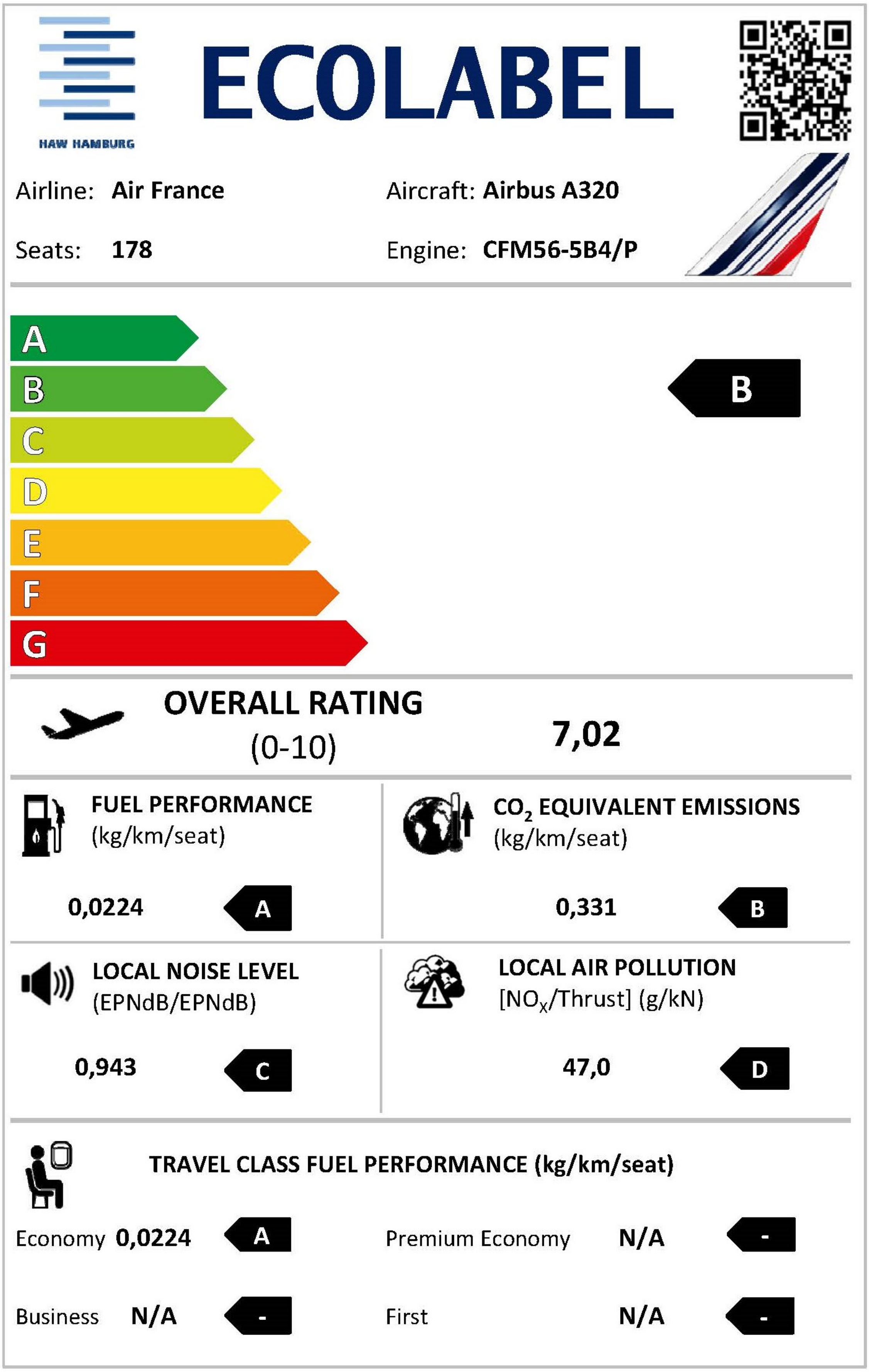

Figure C.9 Ecolabel for Airbus A320 of Air France

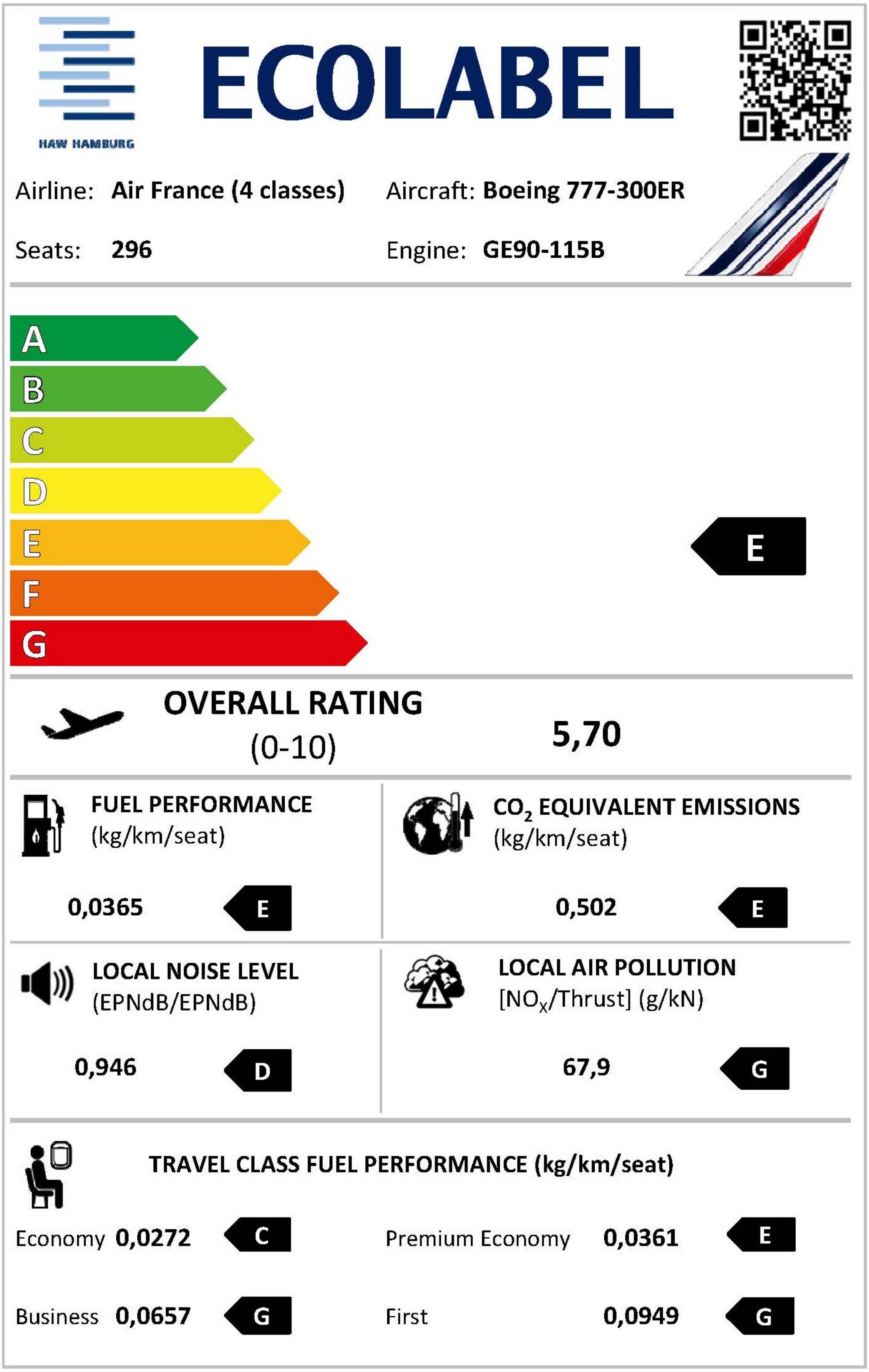

Figure C.10 Ecolabel for Boeing 777-300ER of Air France

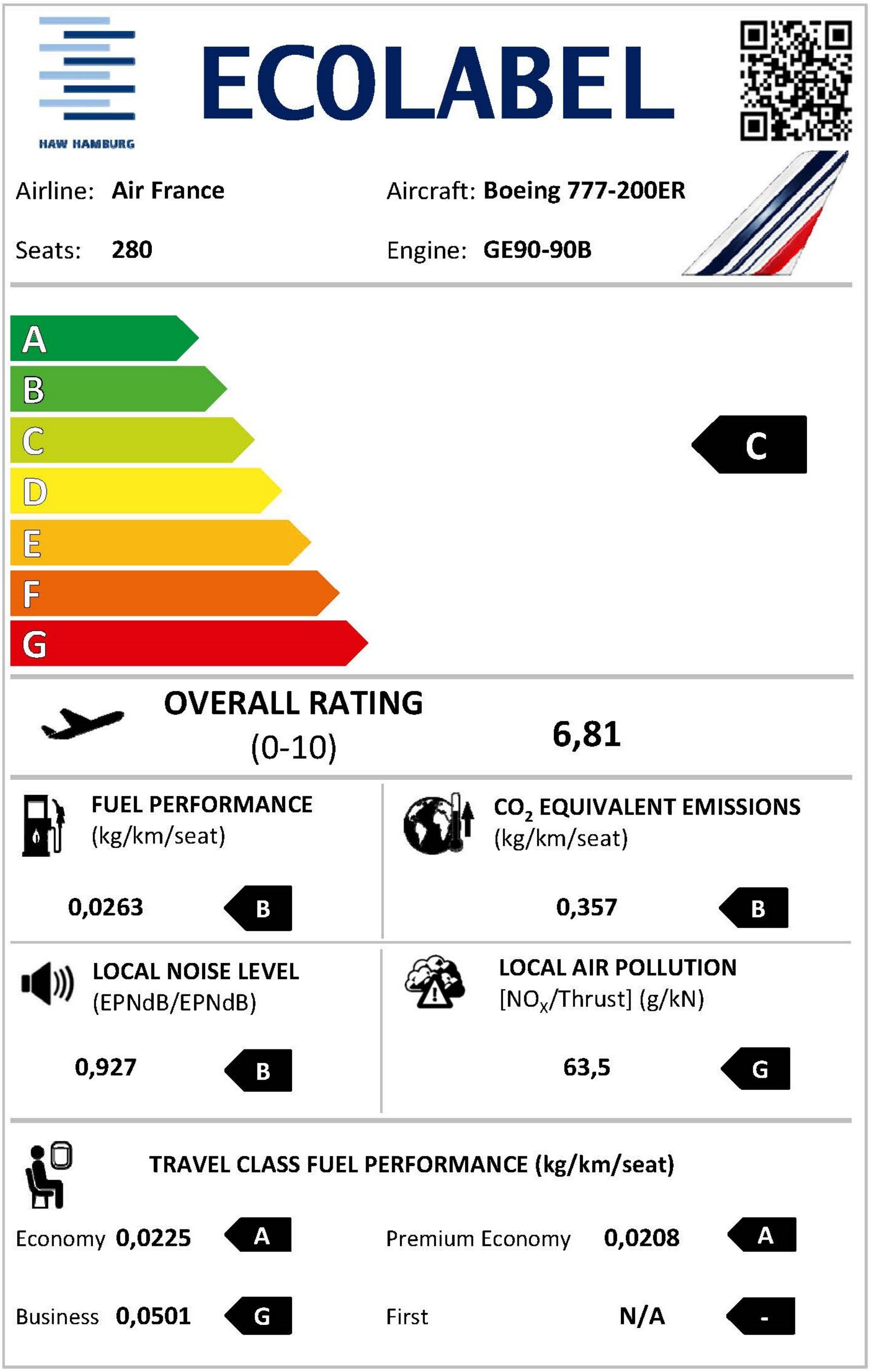

Figure C.11 Ecolabel for Boeing 777-200ER of Air France

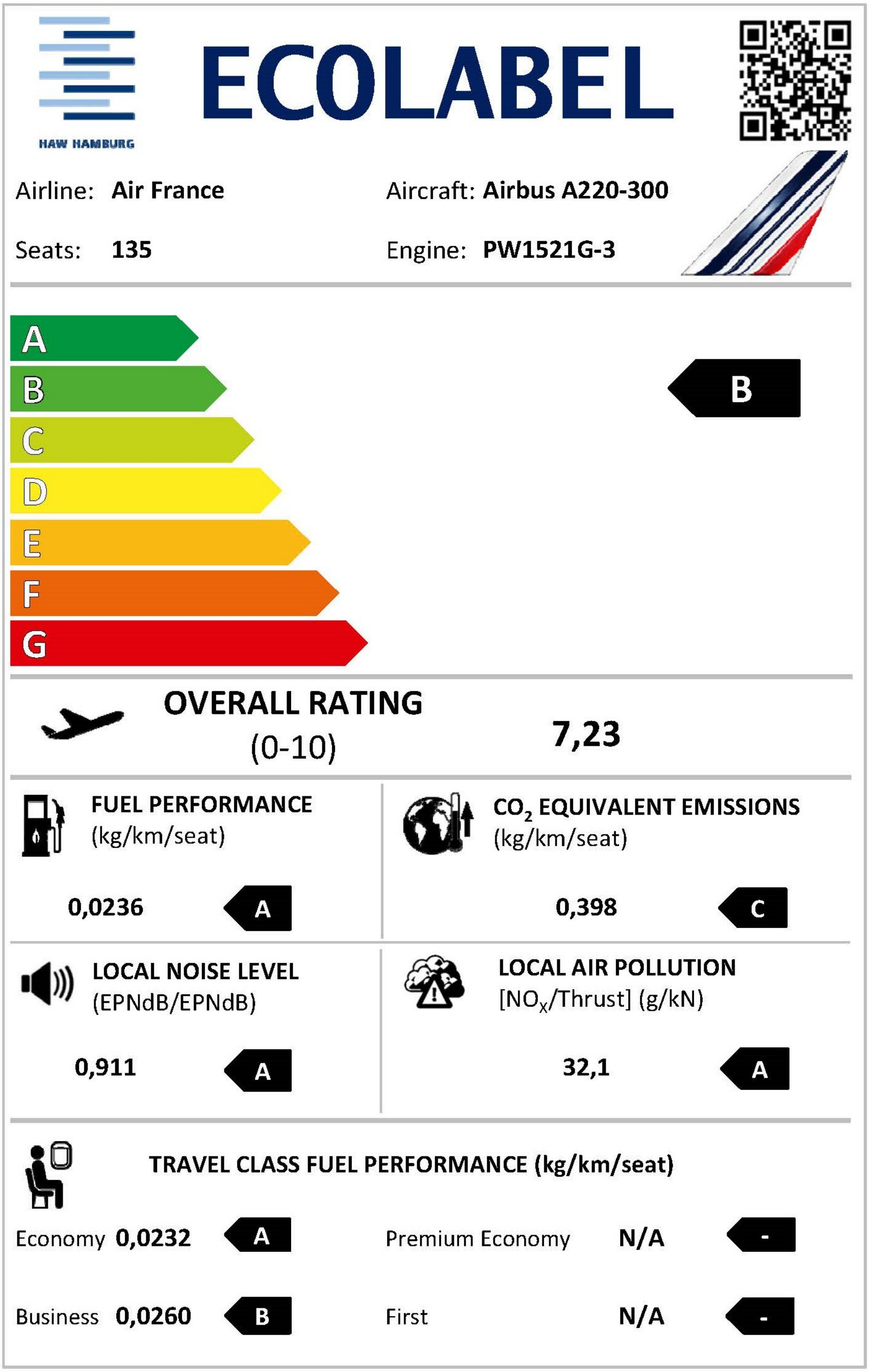

Figure C.12 Ecolabel for Airbus A220-300 of Air France

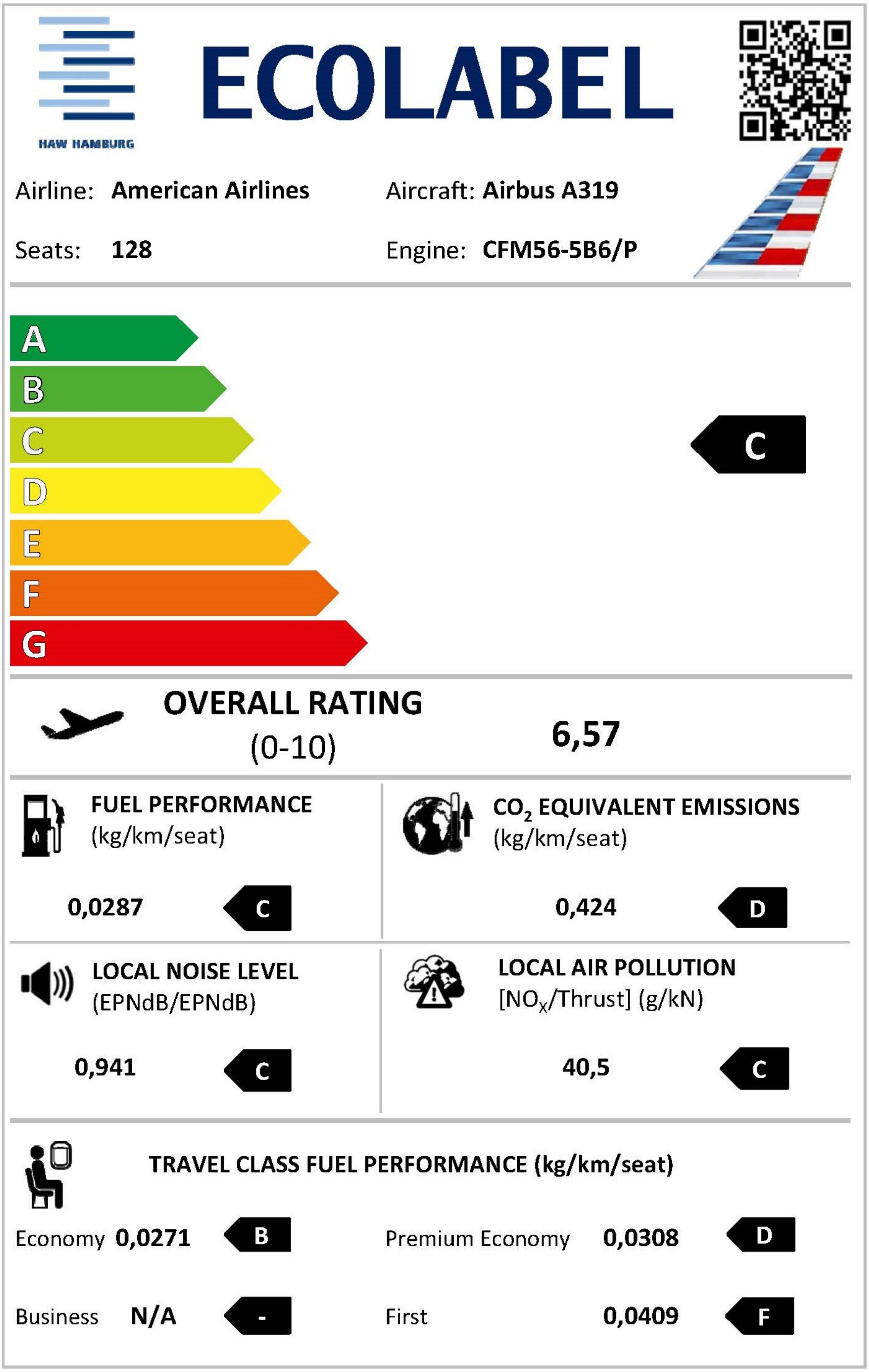

Figure C.13 Ecolabel for Airbus A319 of American Airlines

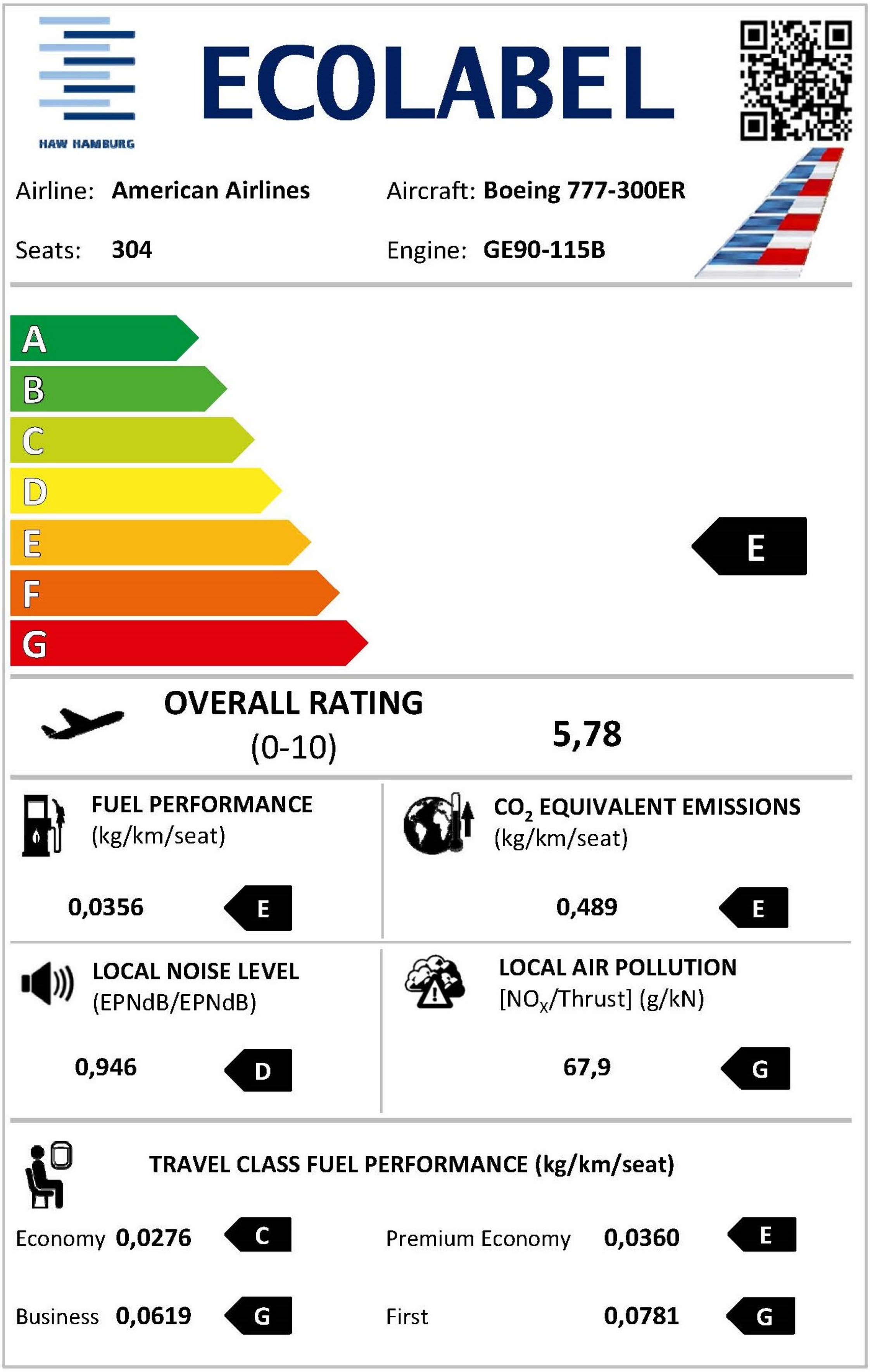

Figure C.14 Ecolabel for Boeing 777-300ER of American Airlines

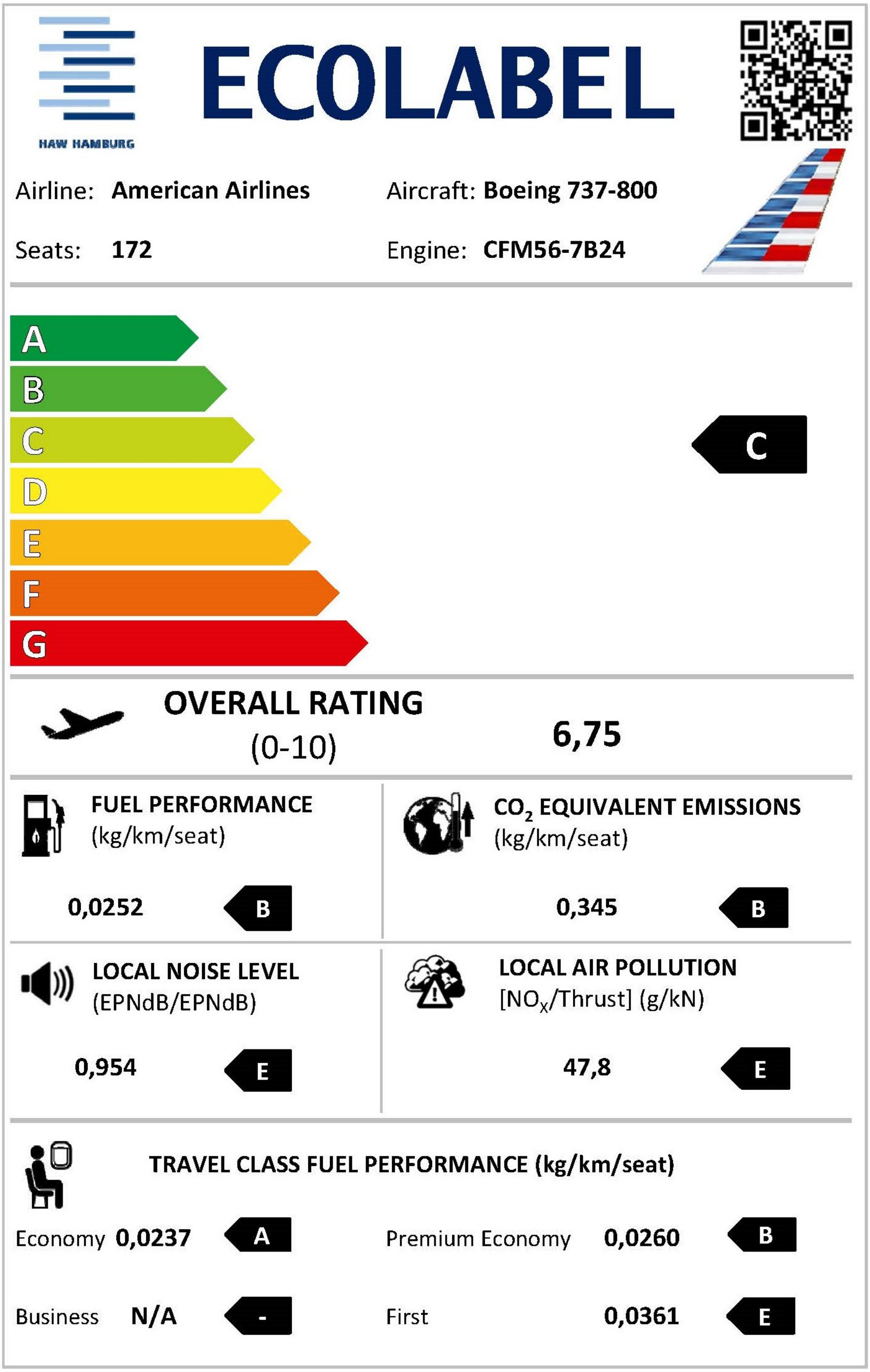

Figure C.15 Ecolabel for Boeing 737-800 of American Airlines

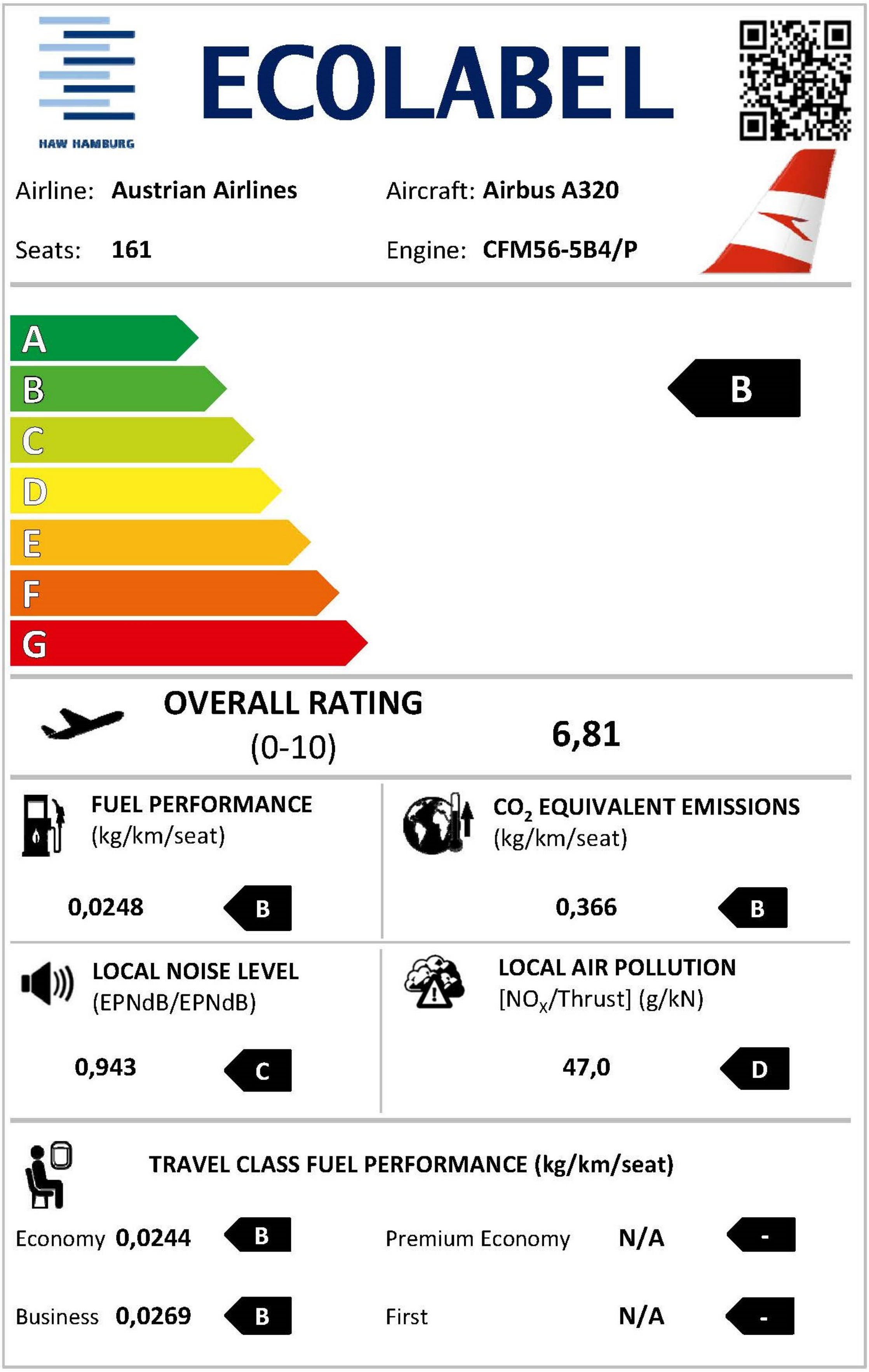

Figure C.16 Ecolabel for Airbus A320 of Austrian Airlines

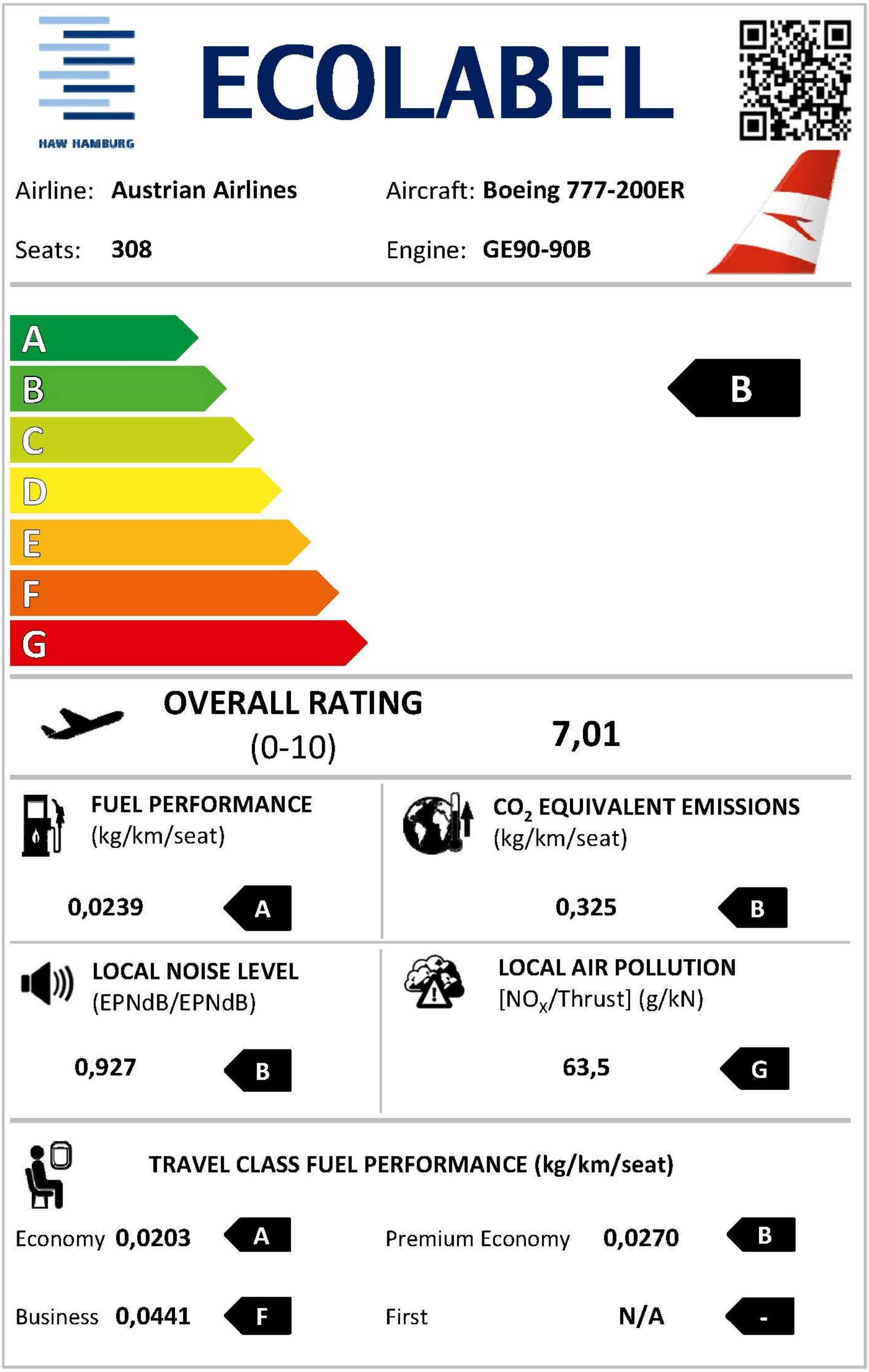

Figure C.17 Ecolabel for Boeing 777-200ER of Austrian Airlines

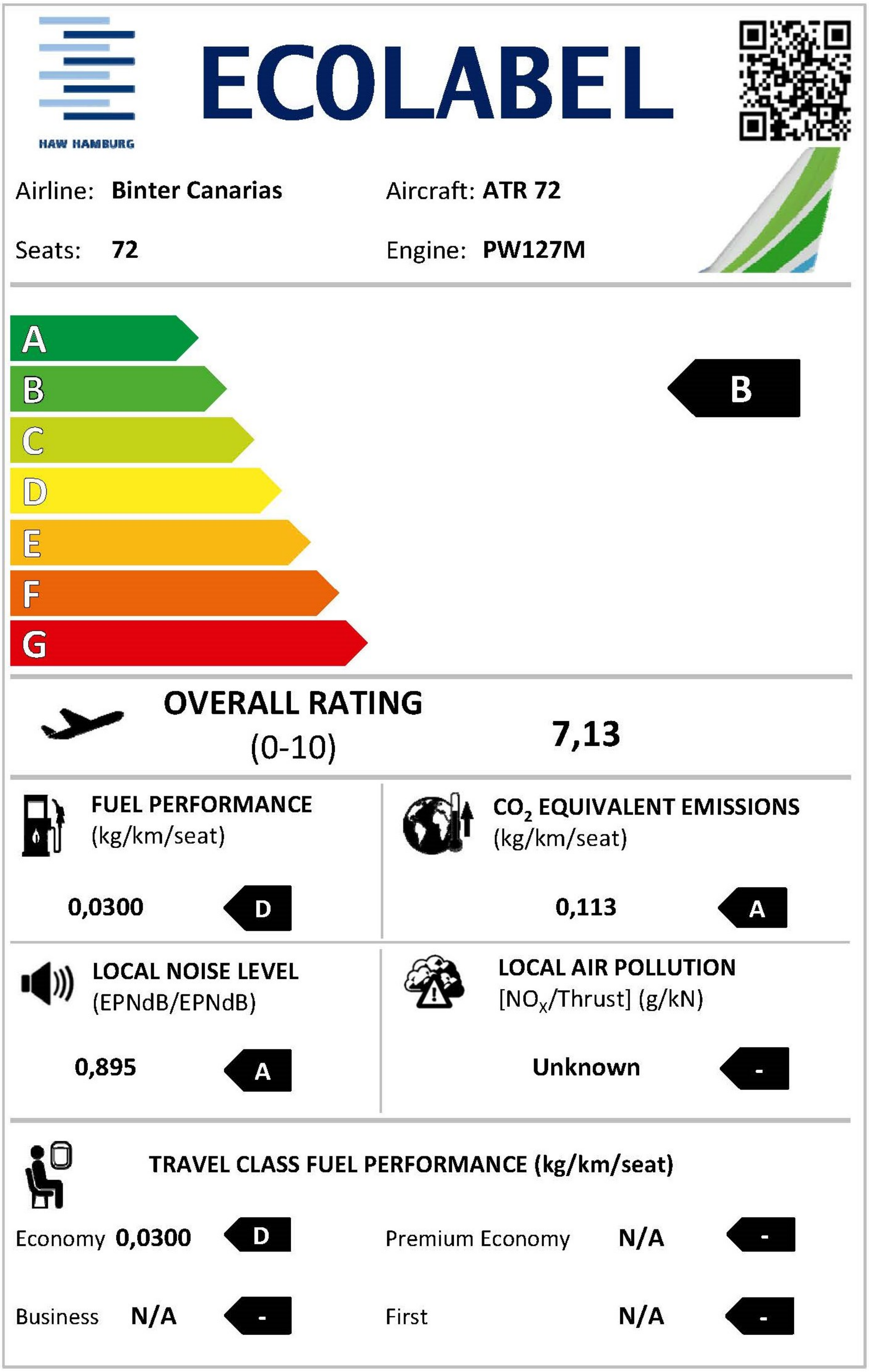

Figure C.18 Ecolabel for ATR 72 of Binter Canarias

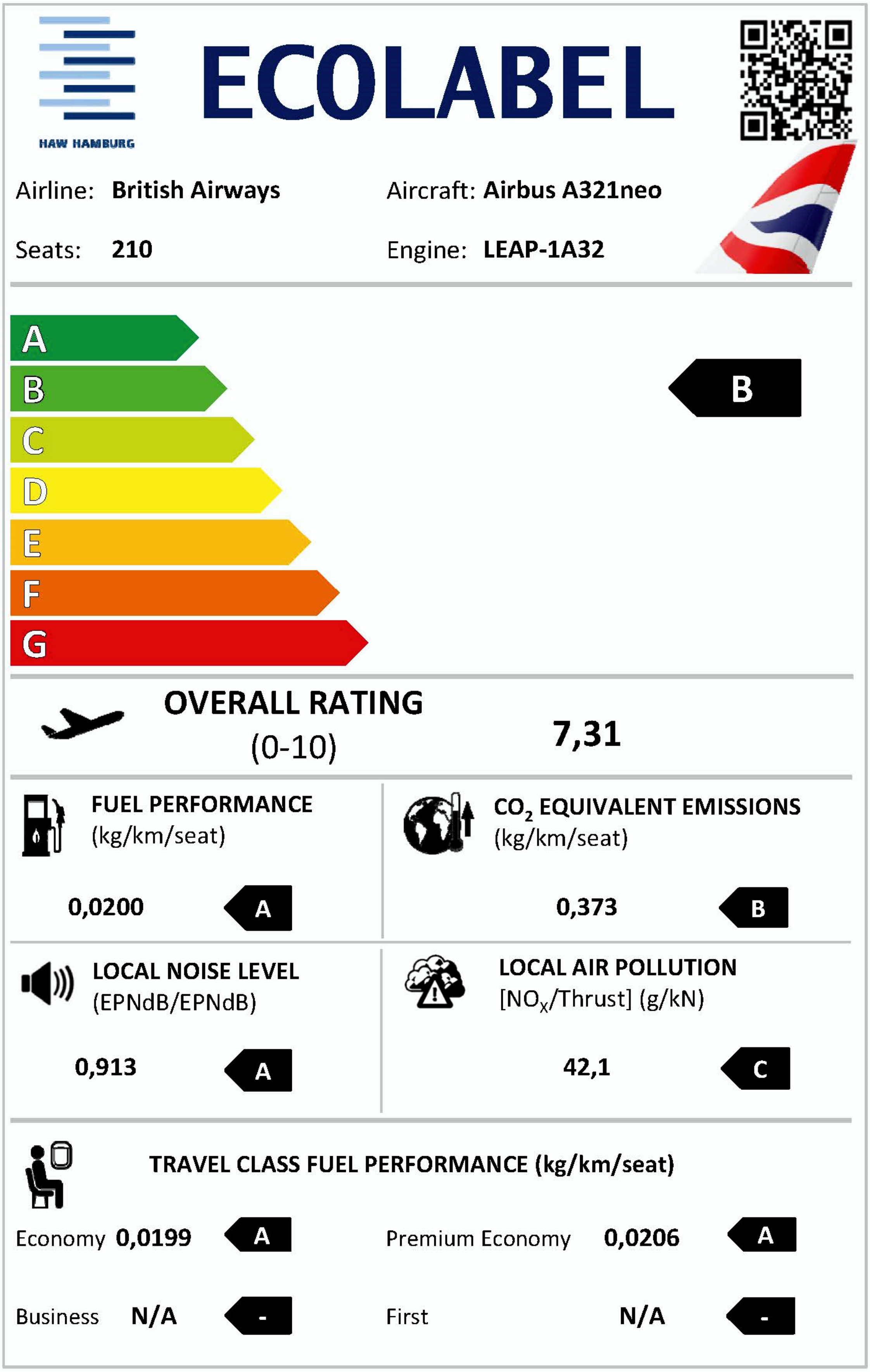

Figure C.19 Ecolabel for Airbus A321neo of British Airways

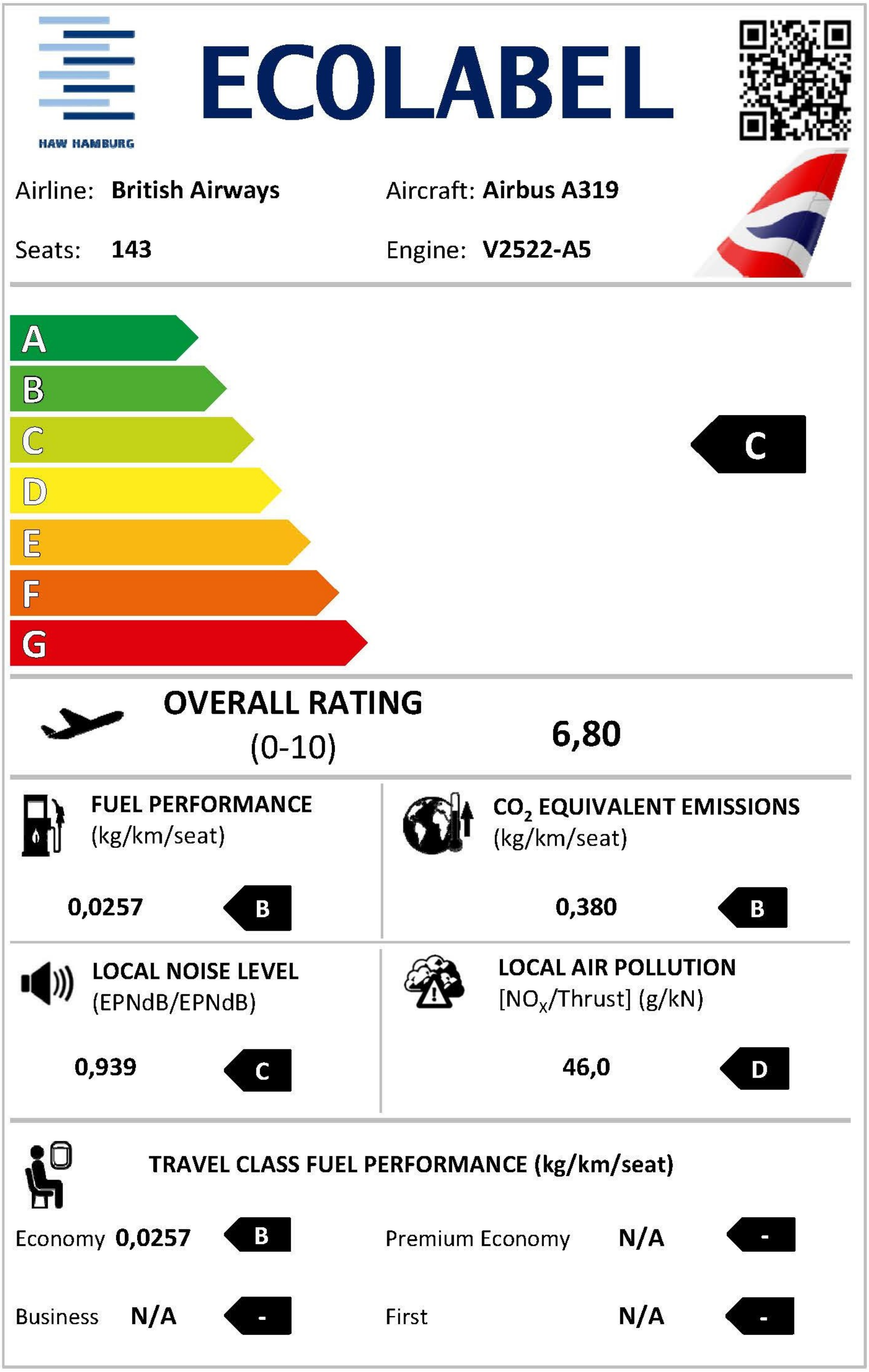

Figure C.20 Ecolabel for Airbus A319 of British Airways

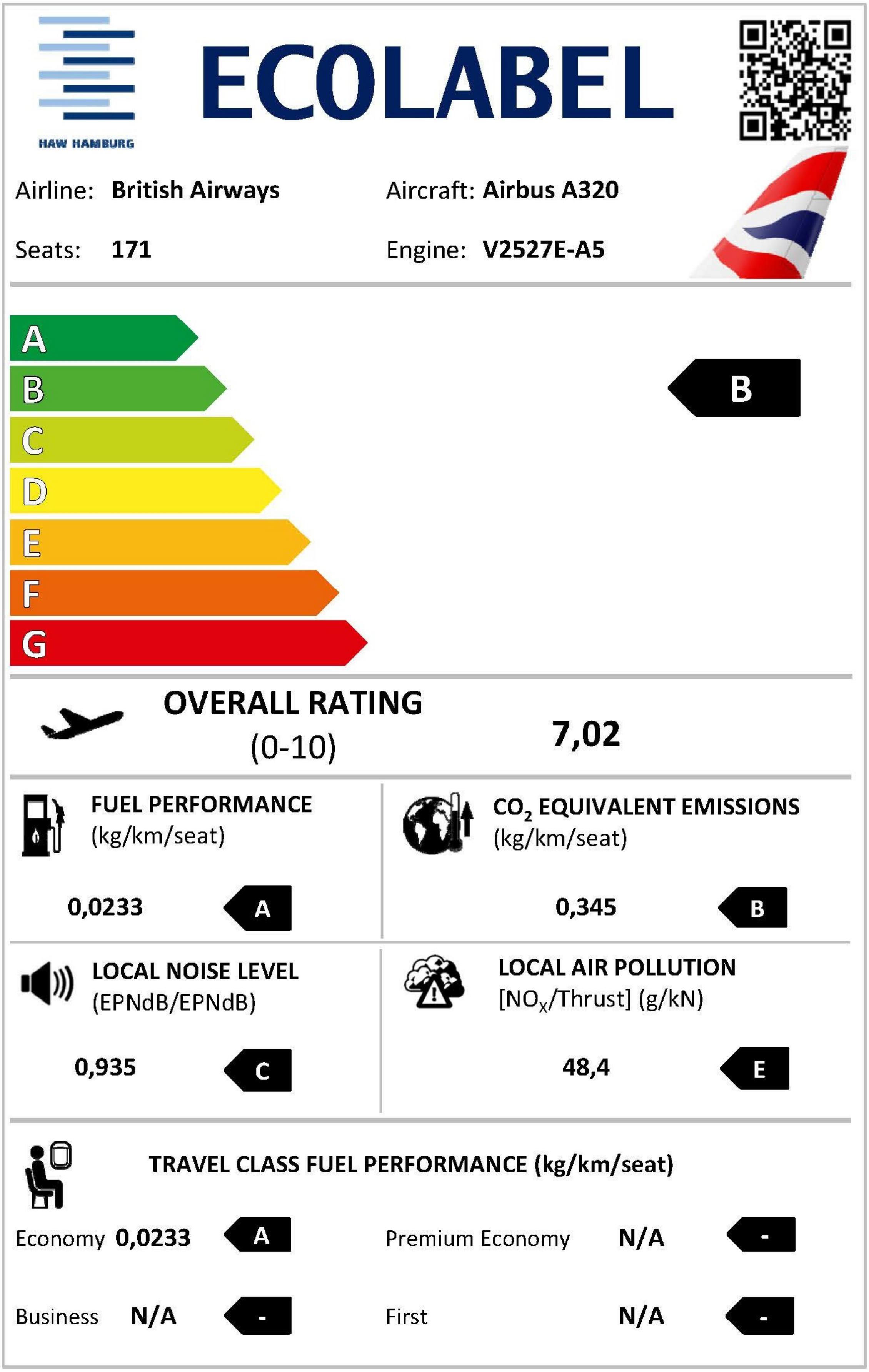

Figure C.21 Ecolabel for Airbus A320 of British Airways

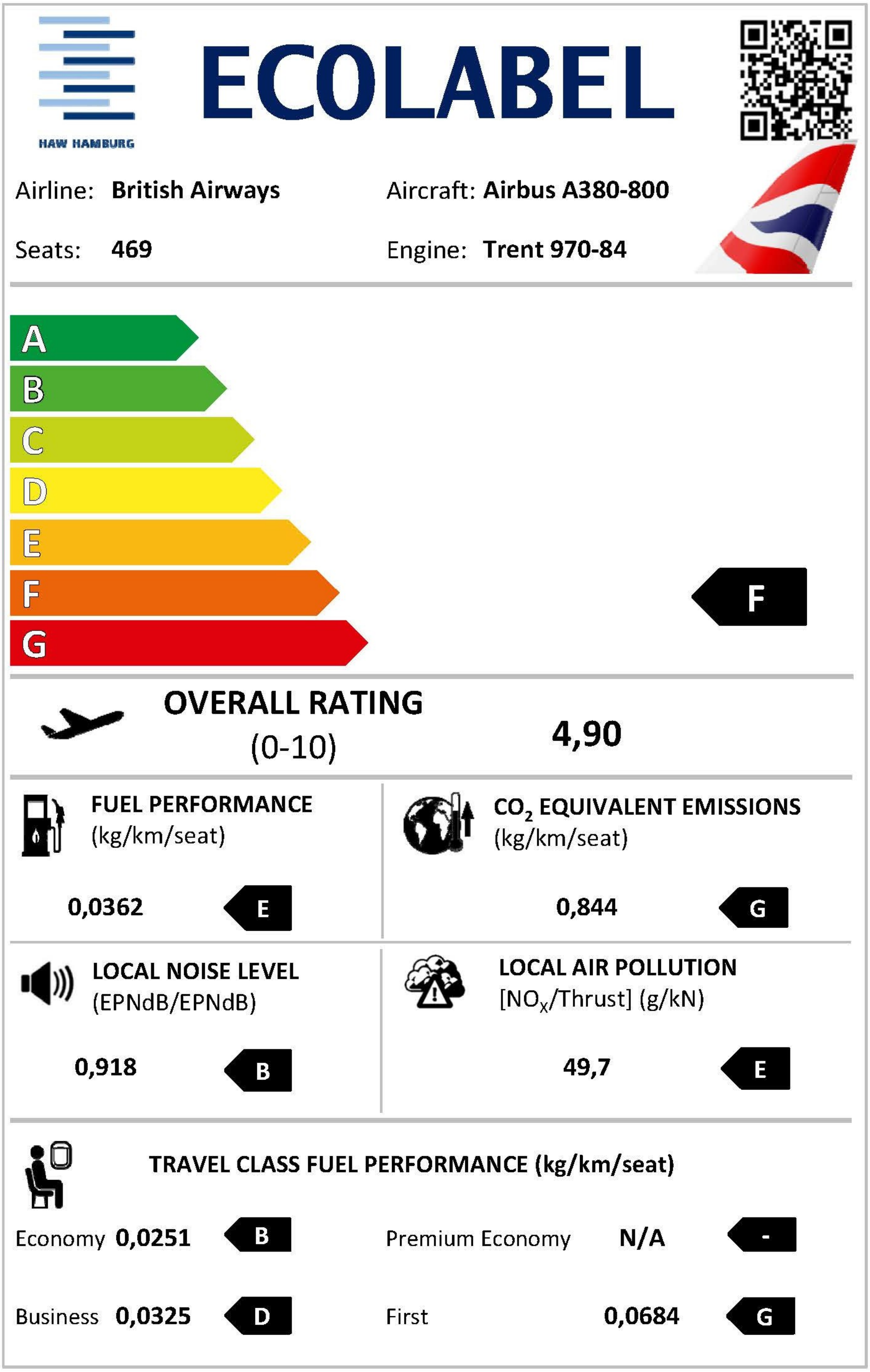

Figure C.22 Ecolabel for Airbus A380-800 of British Airways

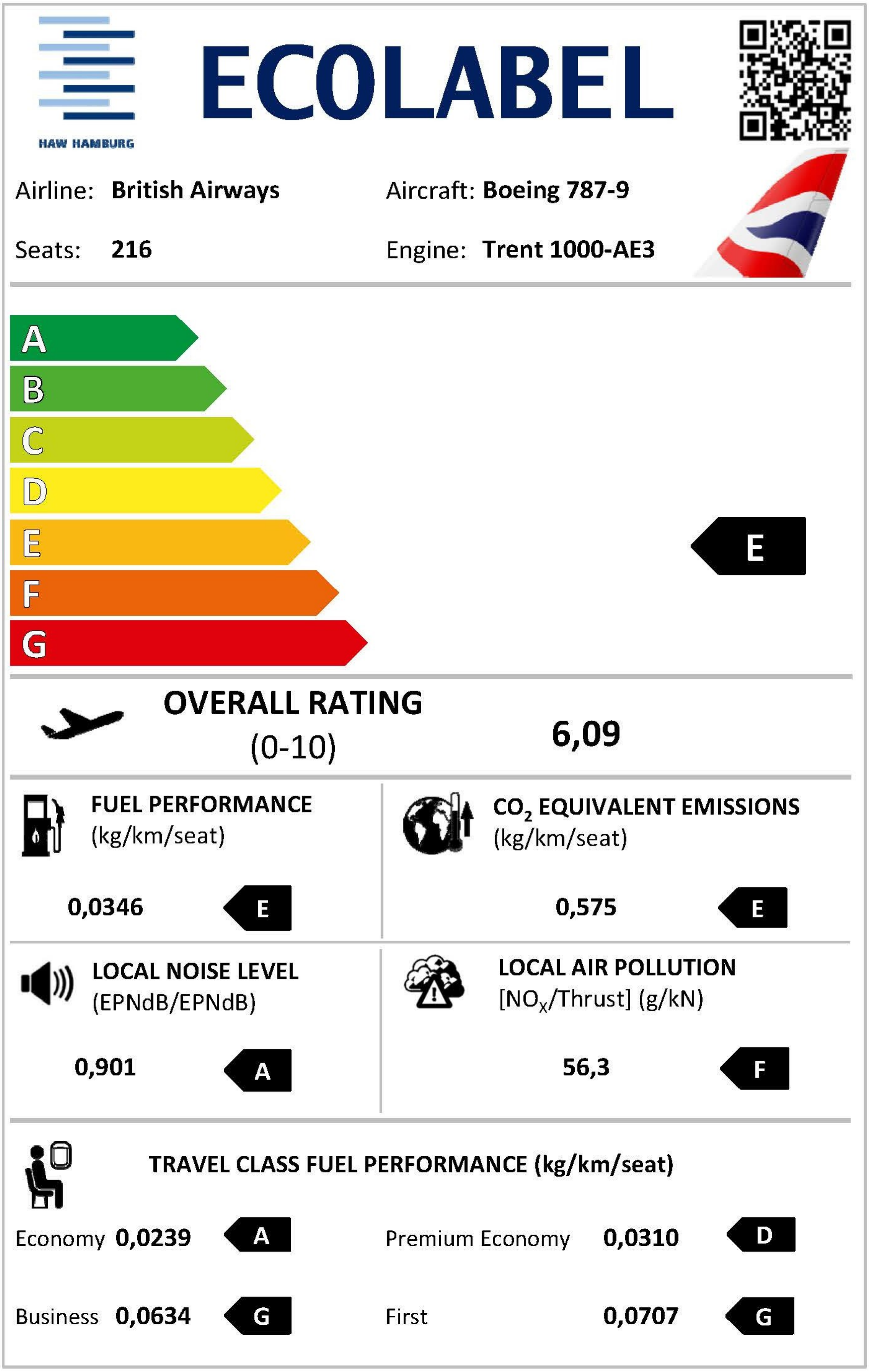

Figure C.23 Ecolabel for Boeing 787-9 of British Airways

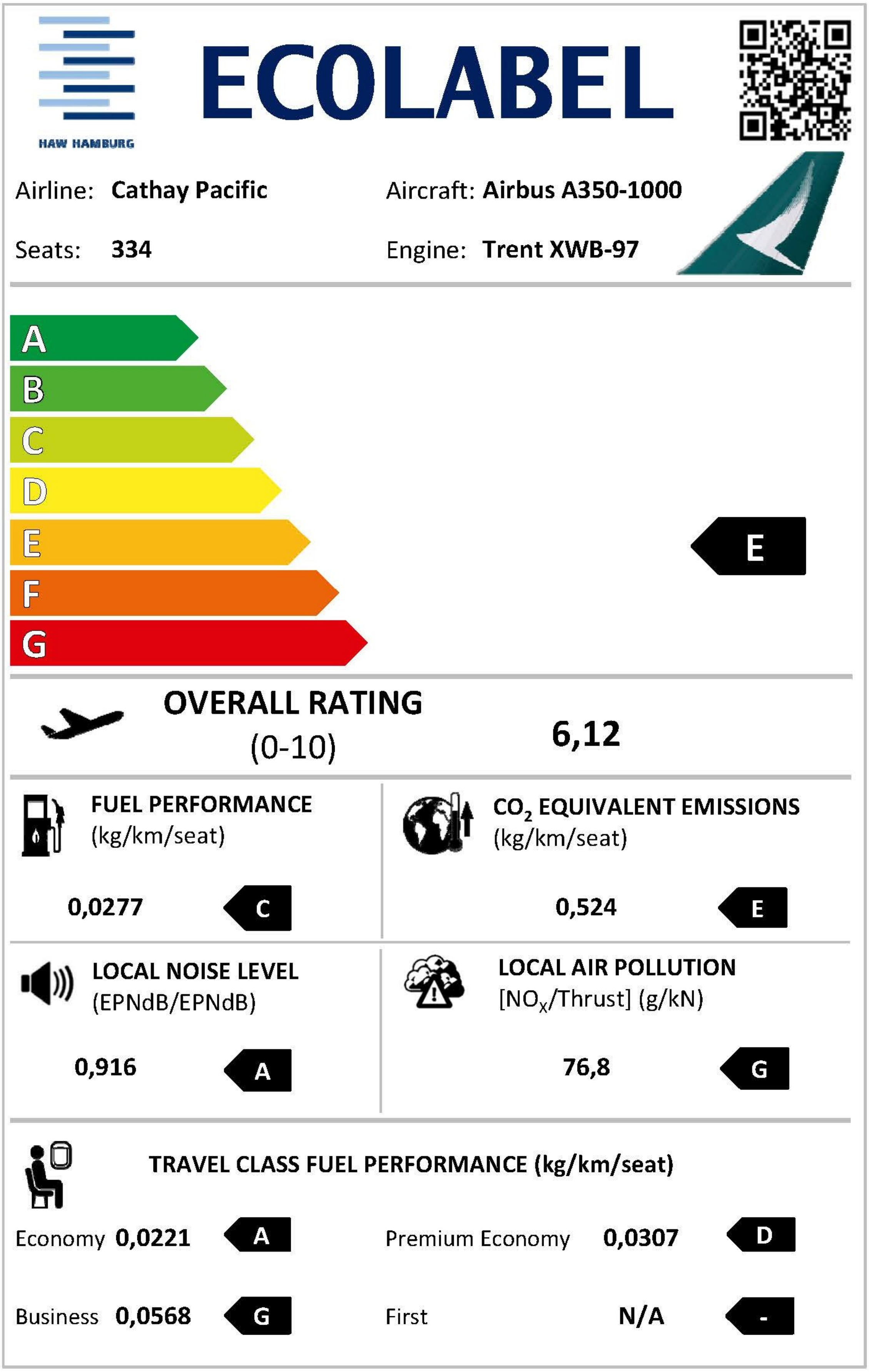

Figure C.24 Ecolabel for Airbus A350-1000 of Cathay Pacific

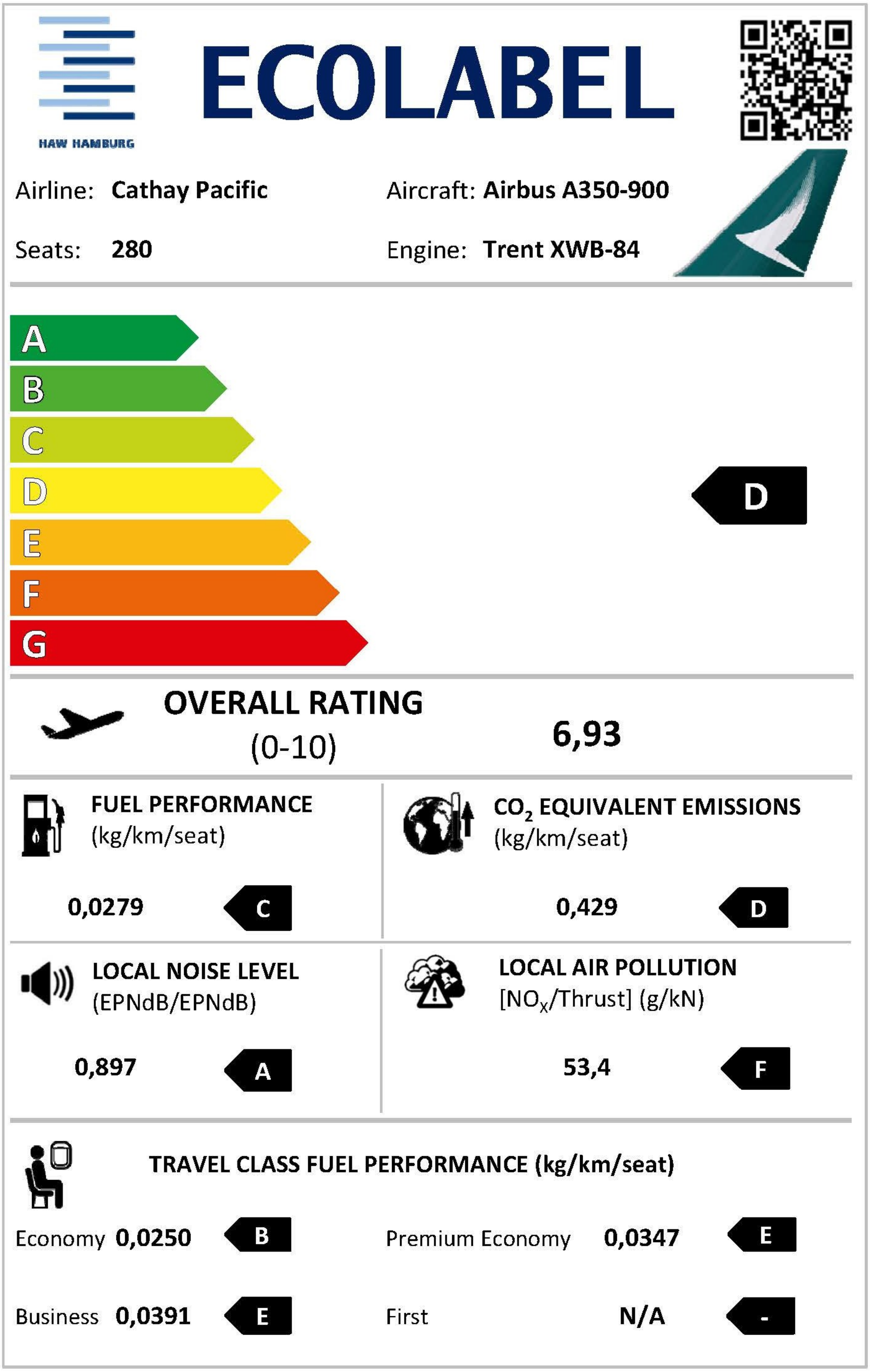

Figure C.25 Ecolabel for Airbus A350-900 of Cathay Pacific

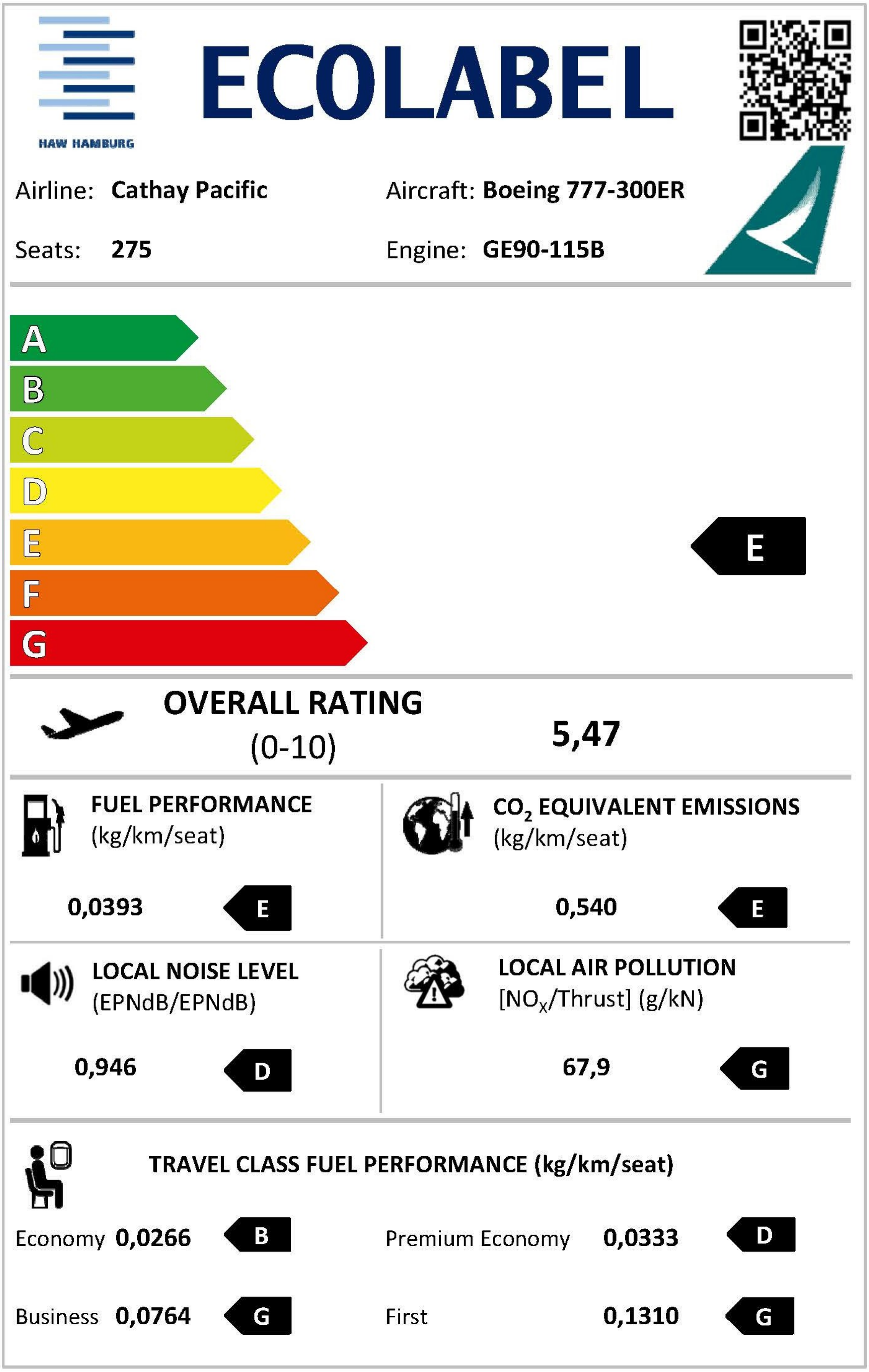

Figure C.26 Ecolabel for Boeing 777-300ER of Cathay Pacific

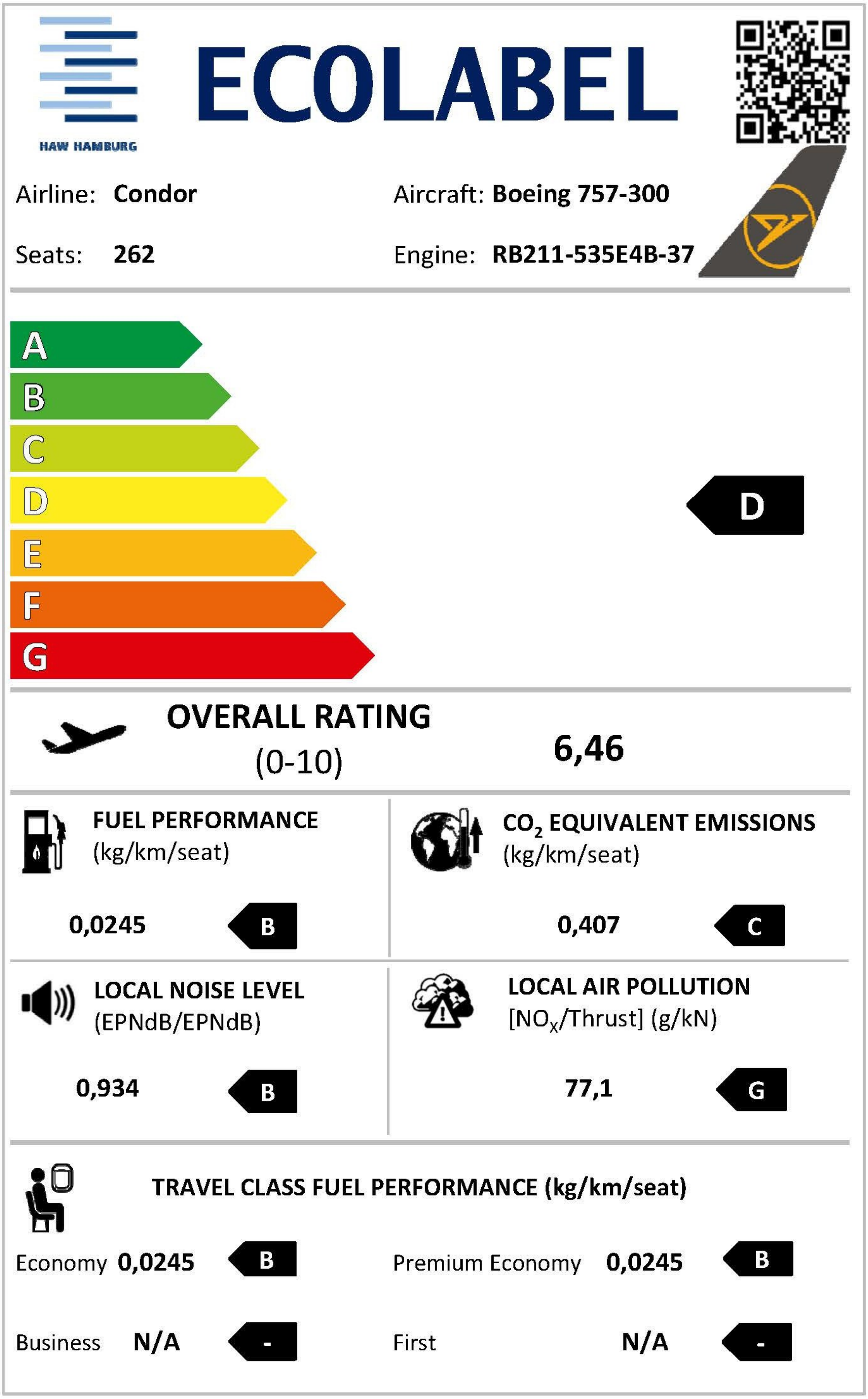

Figure C.27 Ecolabel for Boeing 757-300 of Condor

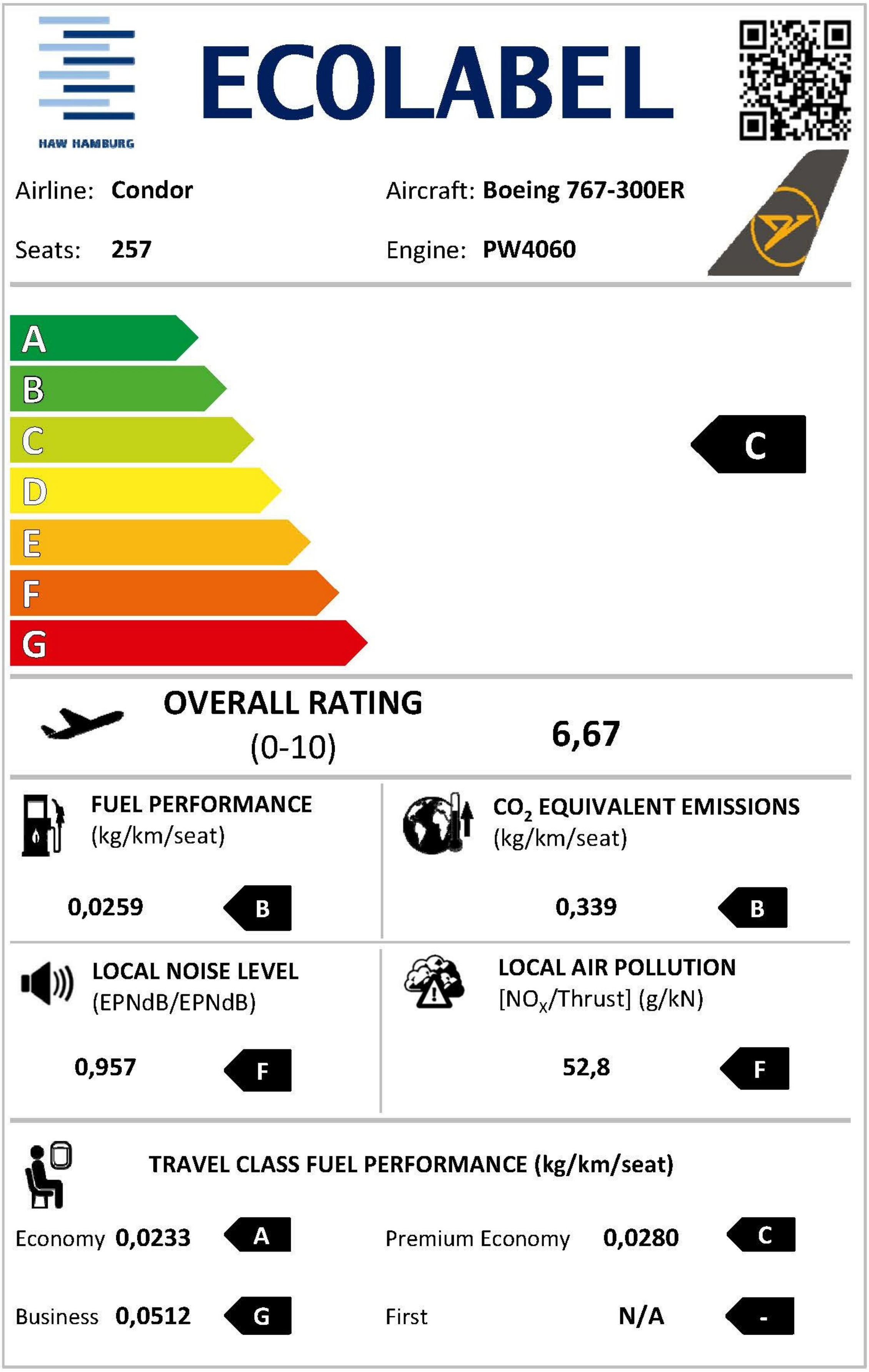

Figure C.28 Ecolabel for Boeing 767-300ER of Condor

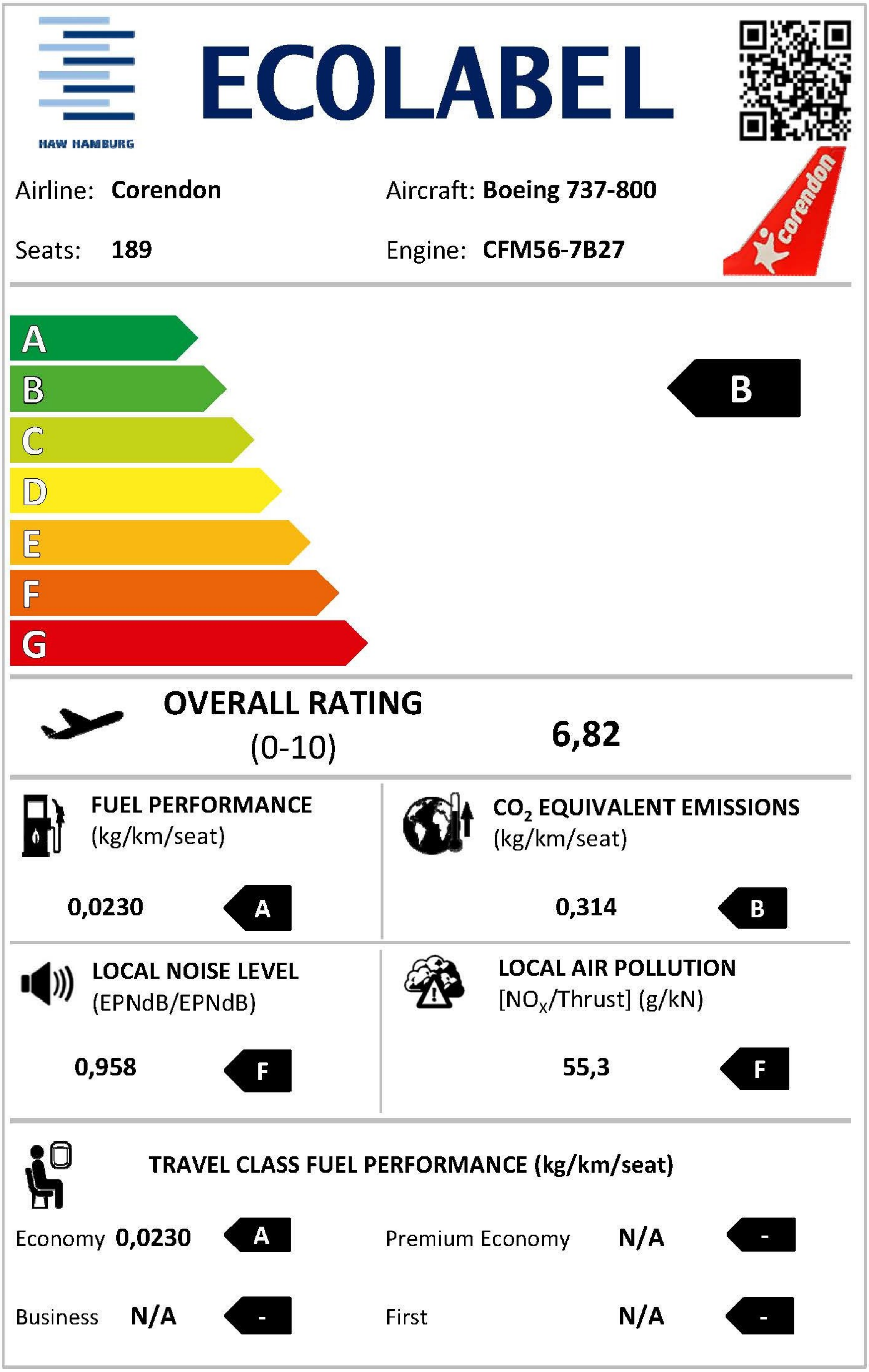

Figure C.29 Ecolabel for Boeing 737-800 of Corendon

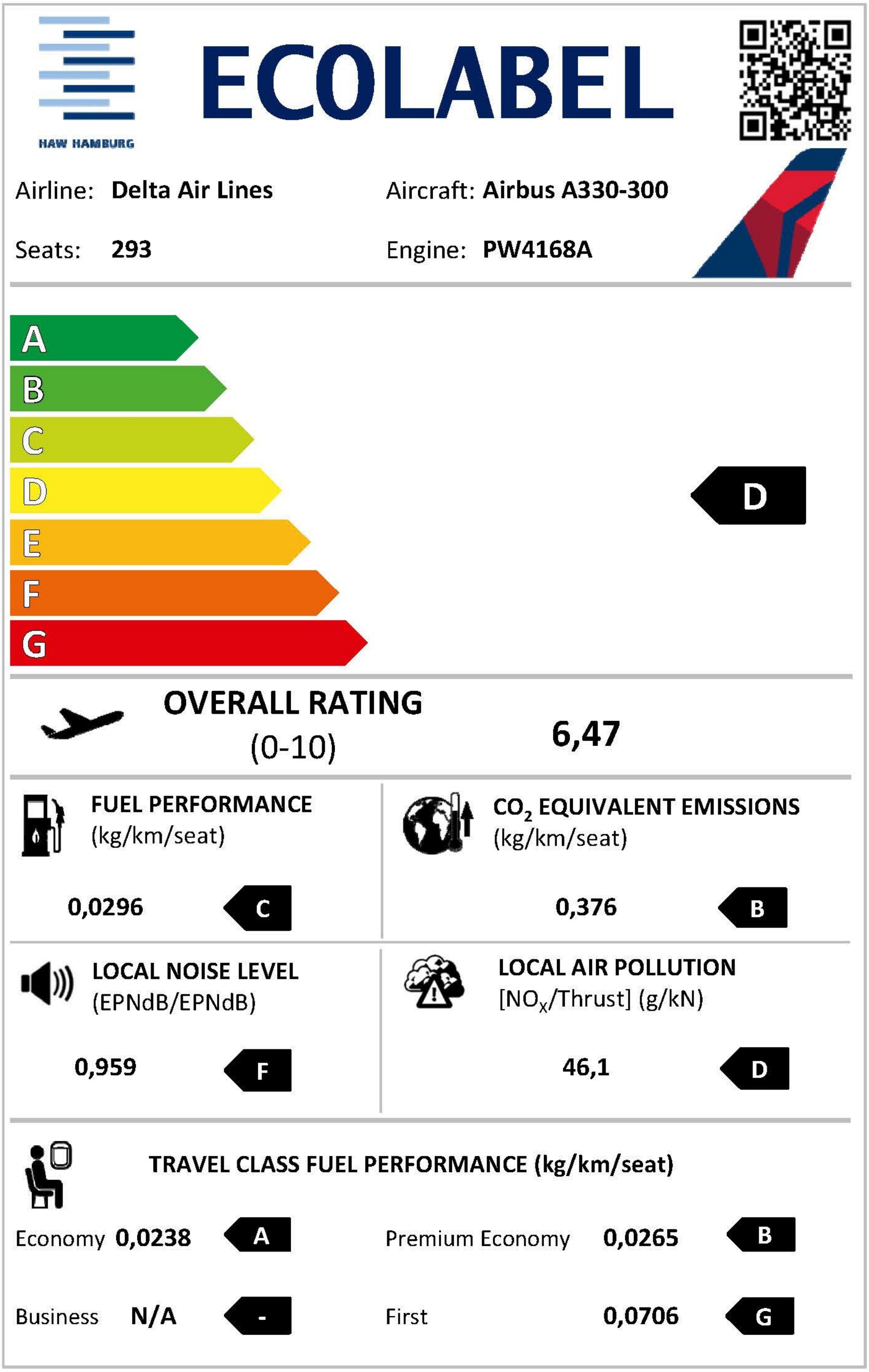

Figure C.30 Ecolabel for Airbus A330-300 of Delta Air Lines

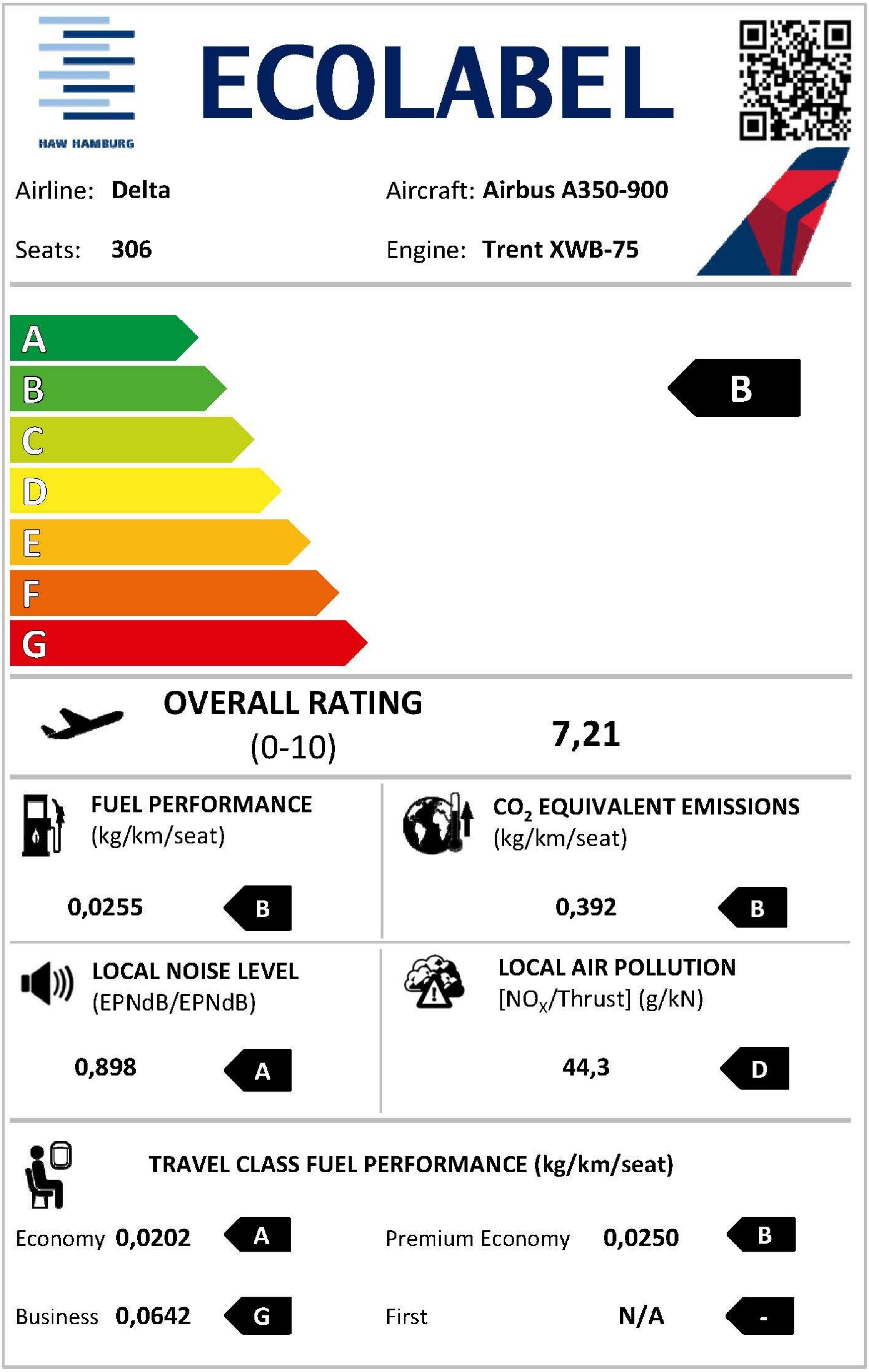

Figure C.31 Ecolabel for Airbus A350-900 of Delta Air Lines

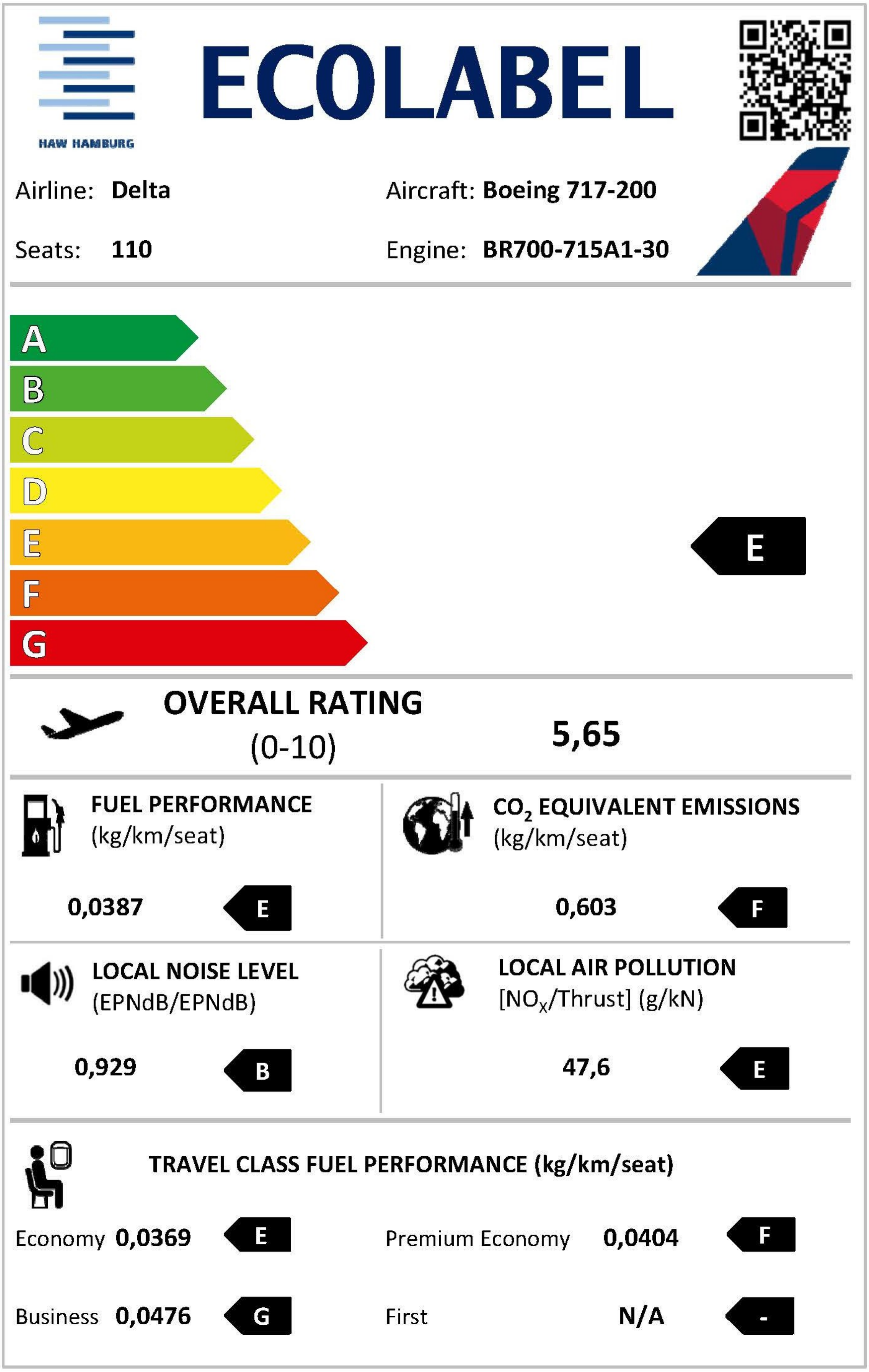

Figure C.32 Ecolabel for Boeing 717-200 of Delta Air Lines

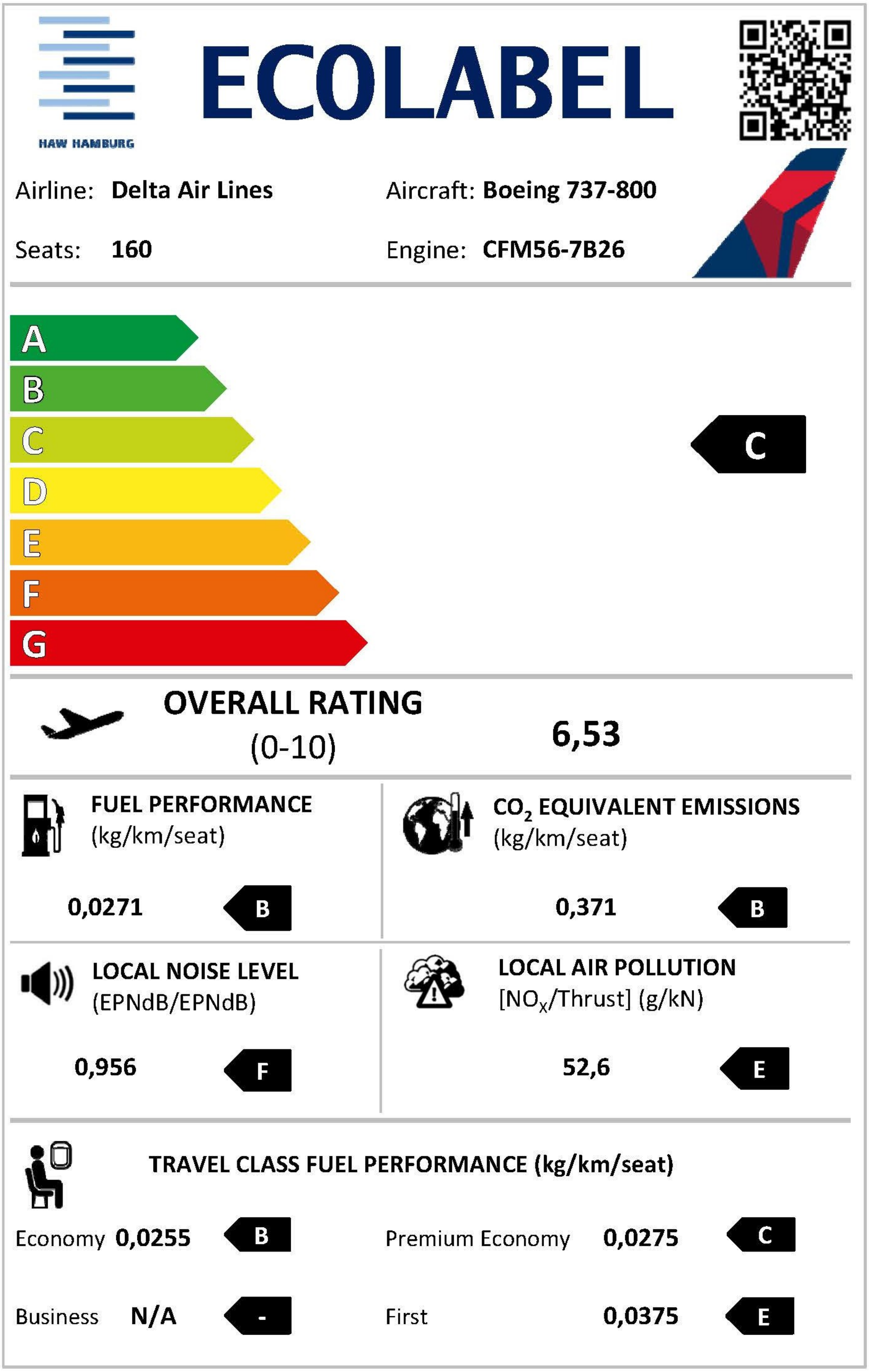

Figure C.33 Ecolabel for Boeing 737-800 of Delta Air Lines

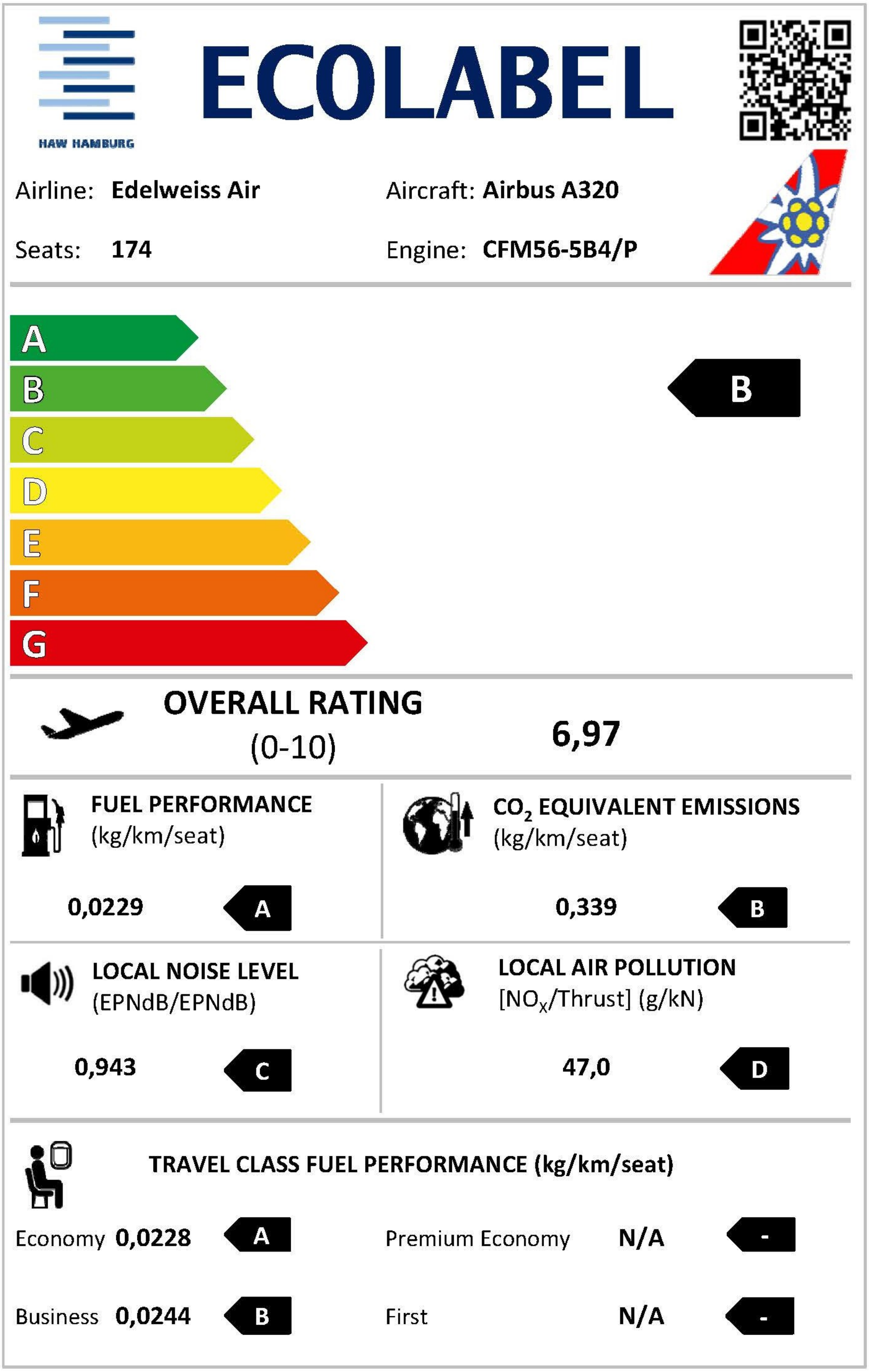

Figure C.34 Ecolabel for Airbus A320 of Edelweiss Air

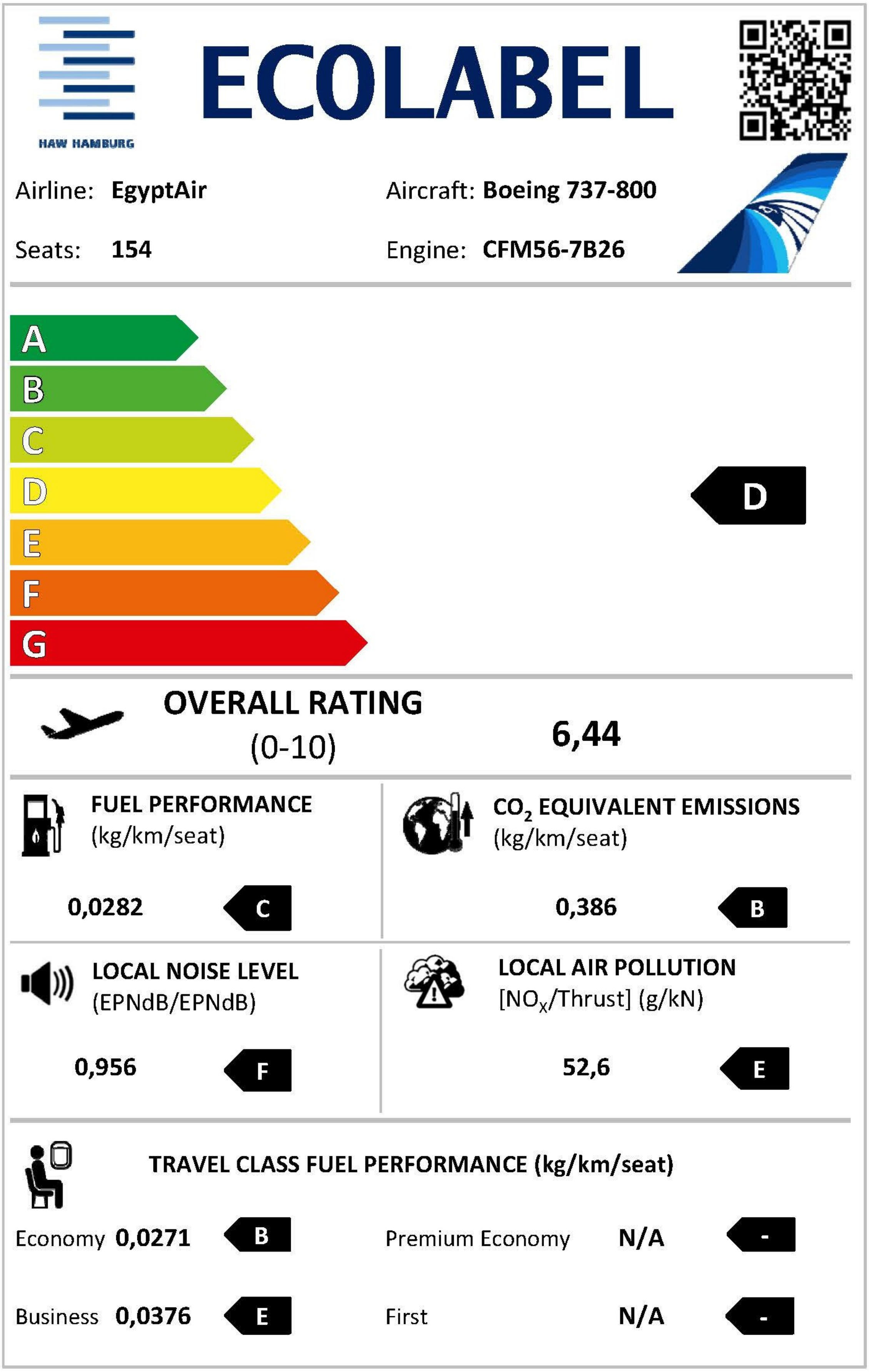

Figure C.35 Ecolabel for Boeing 737-800 of EgyptAir

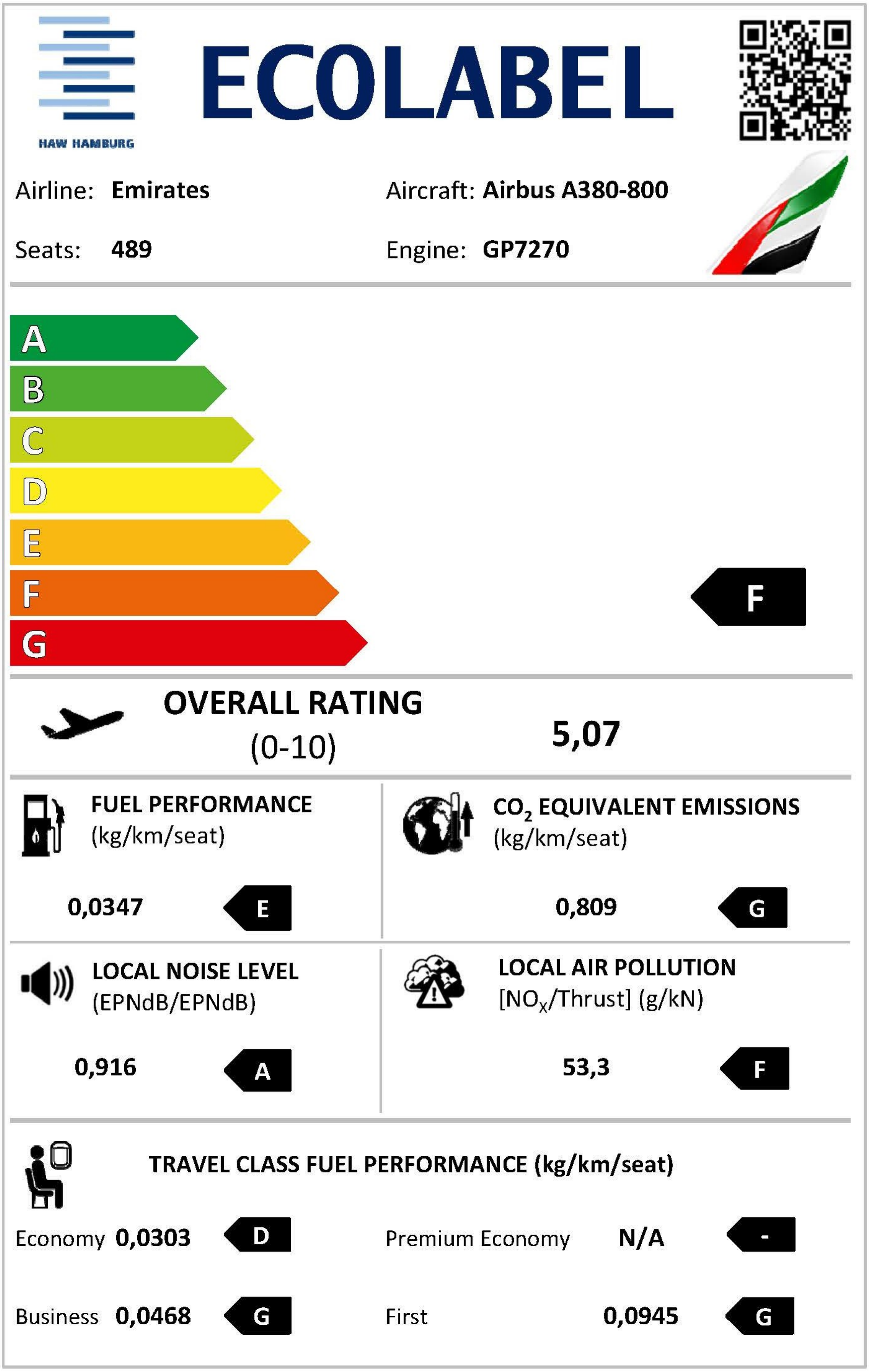

Figure C.36 Ecolabel for Airbus A380-800 of Emirates

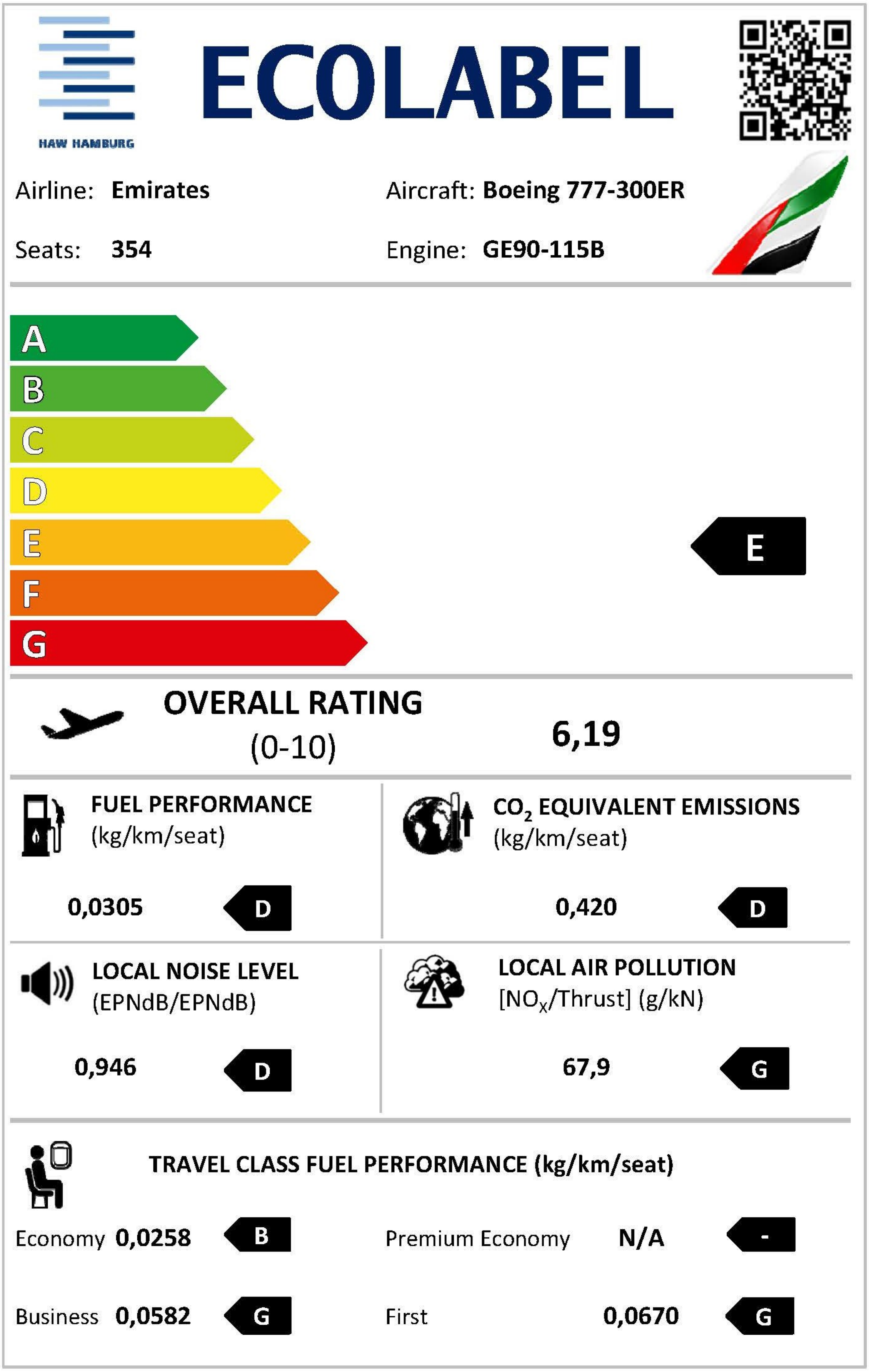

Figure C.37 Ecolabel for Boeing 777-300ER of Emirates

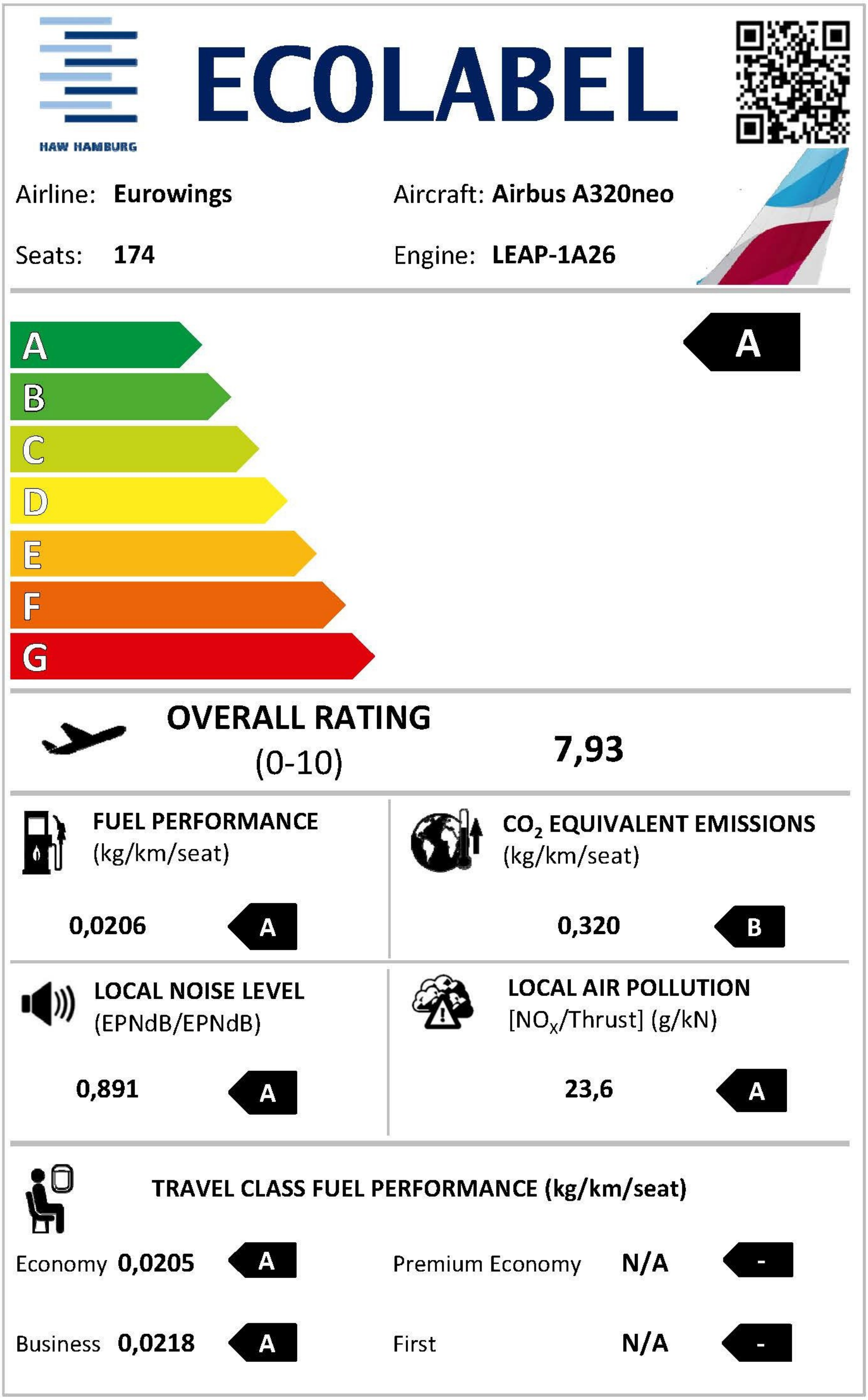

Figure C.38 Ecolabel for Airbus A320neo of Eurowings

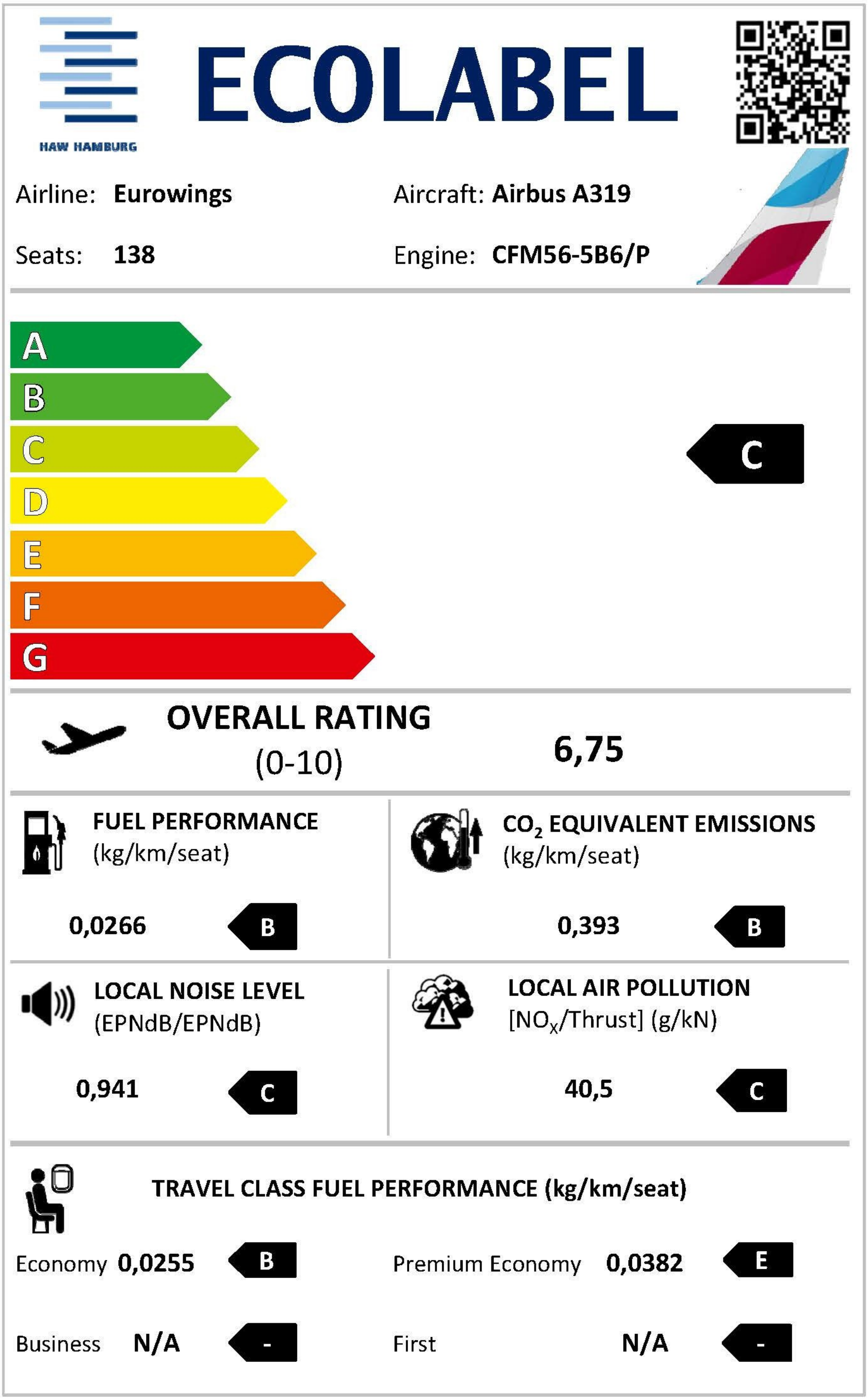

Figure C.39 Ecolabel for Airbus A319 of Eurowings

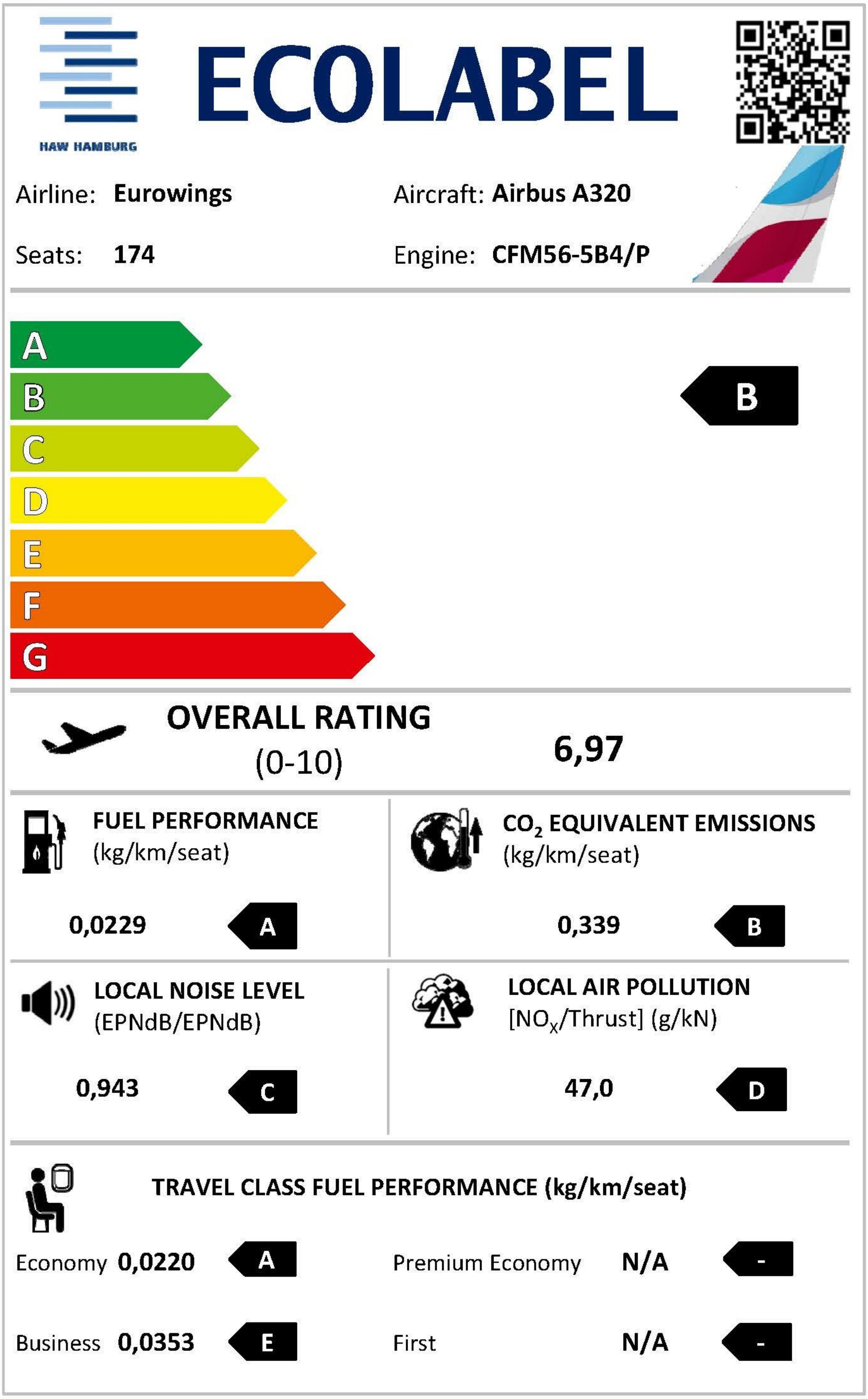

Figure C.40 Ecolabel for Airbus A320 of Eurowings

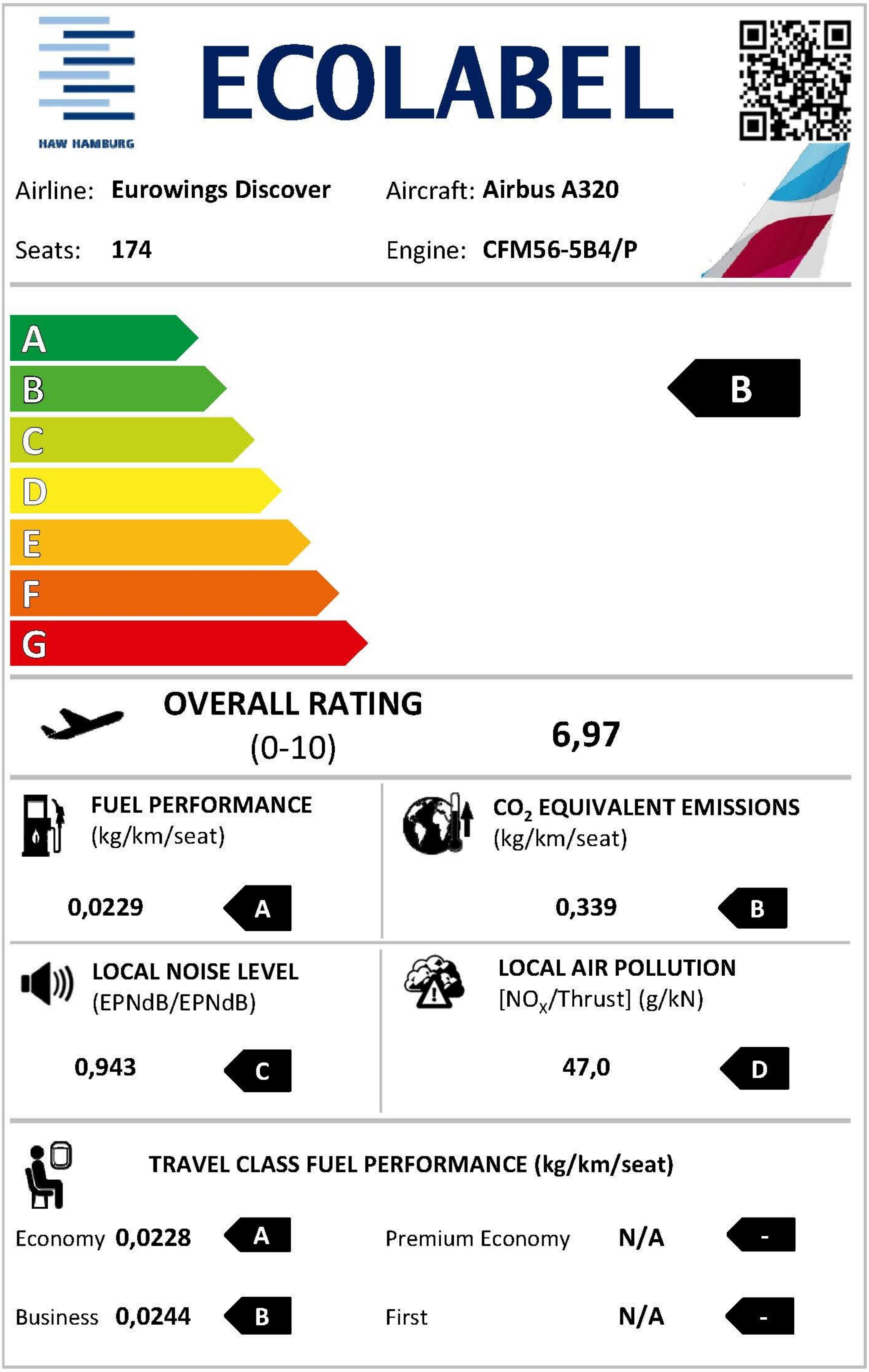

Figure C.41 Ecolabel for Airbus A320 of Eurowings Discover

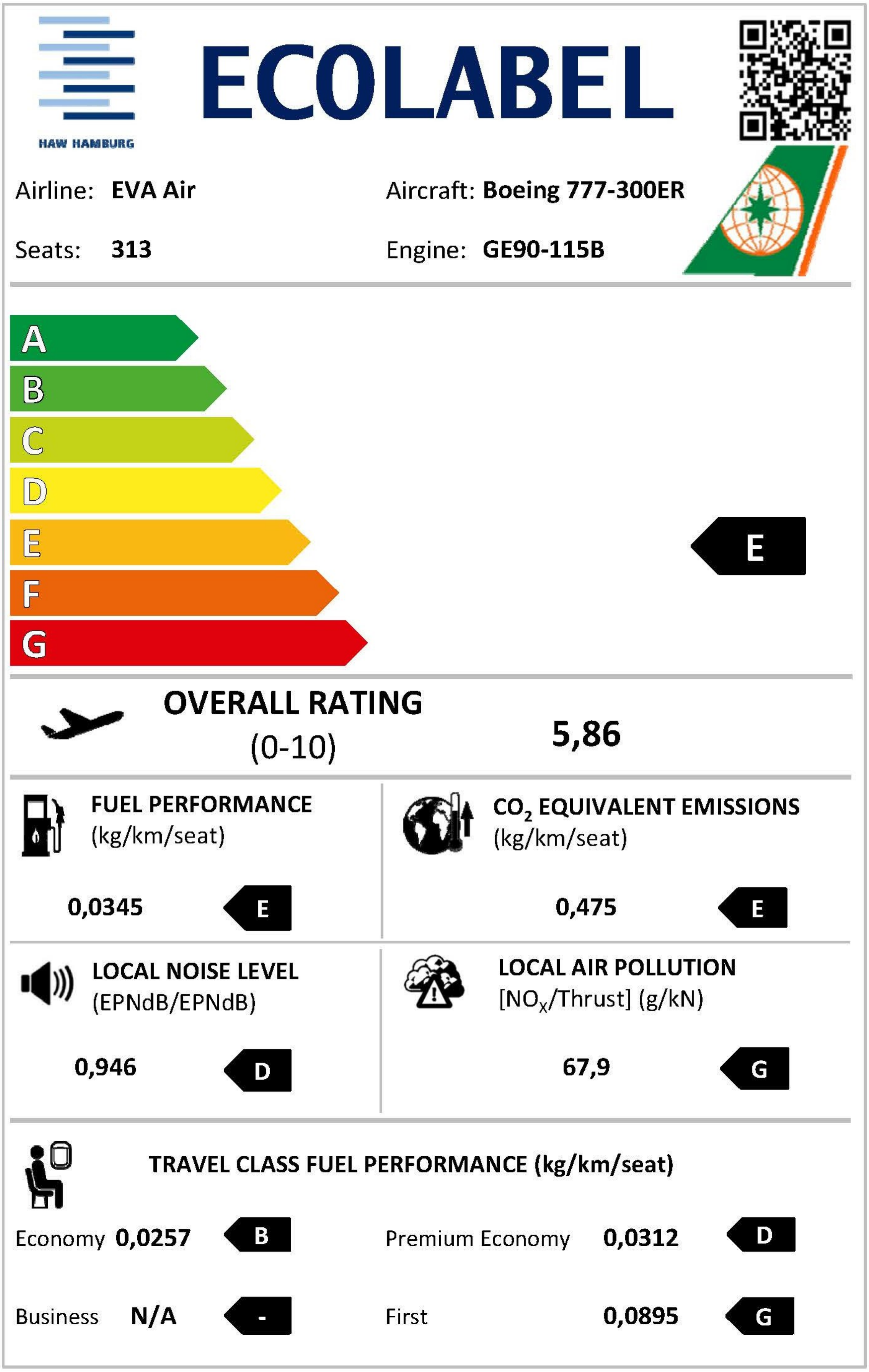

Figure C.42 Ecolabel for Boeing 777-300ER of EVA Air

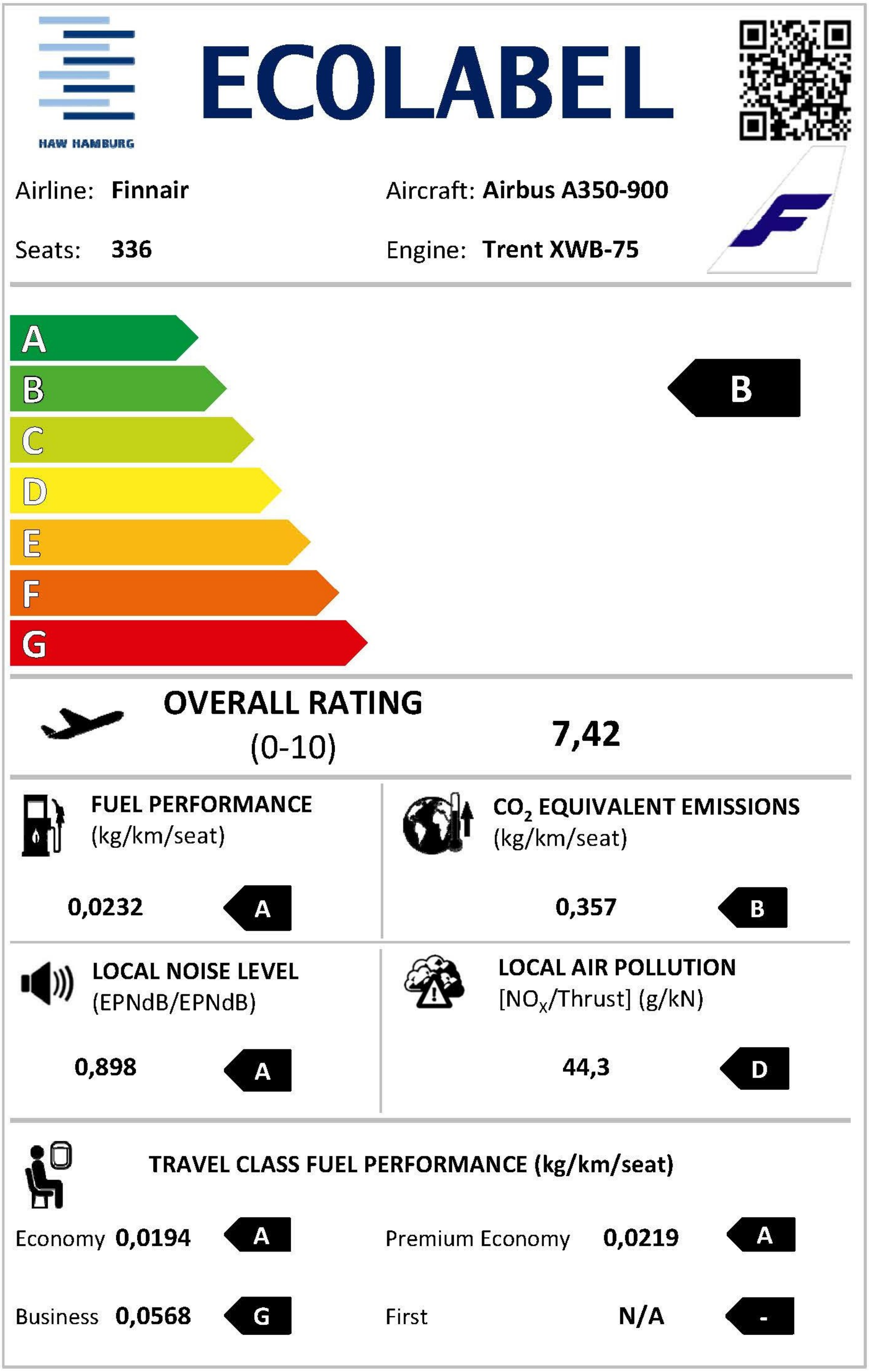

Figure C.43 Ecolabel for Airbus A350-900 of Finnair

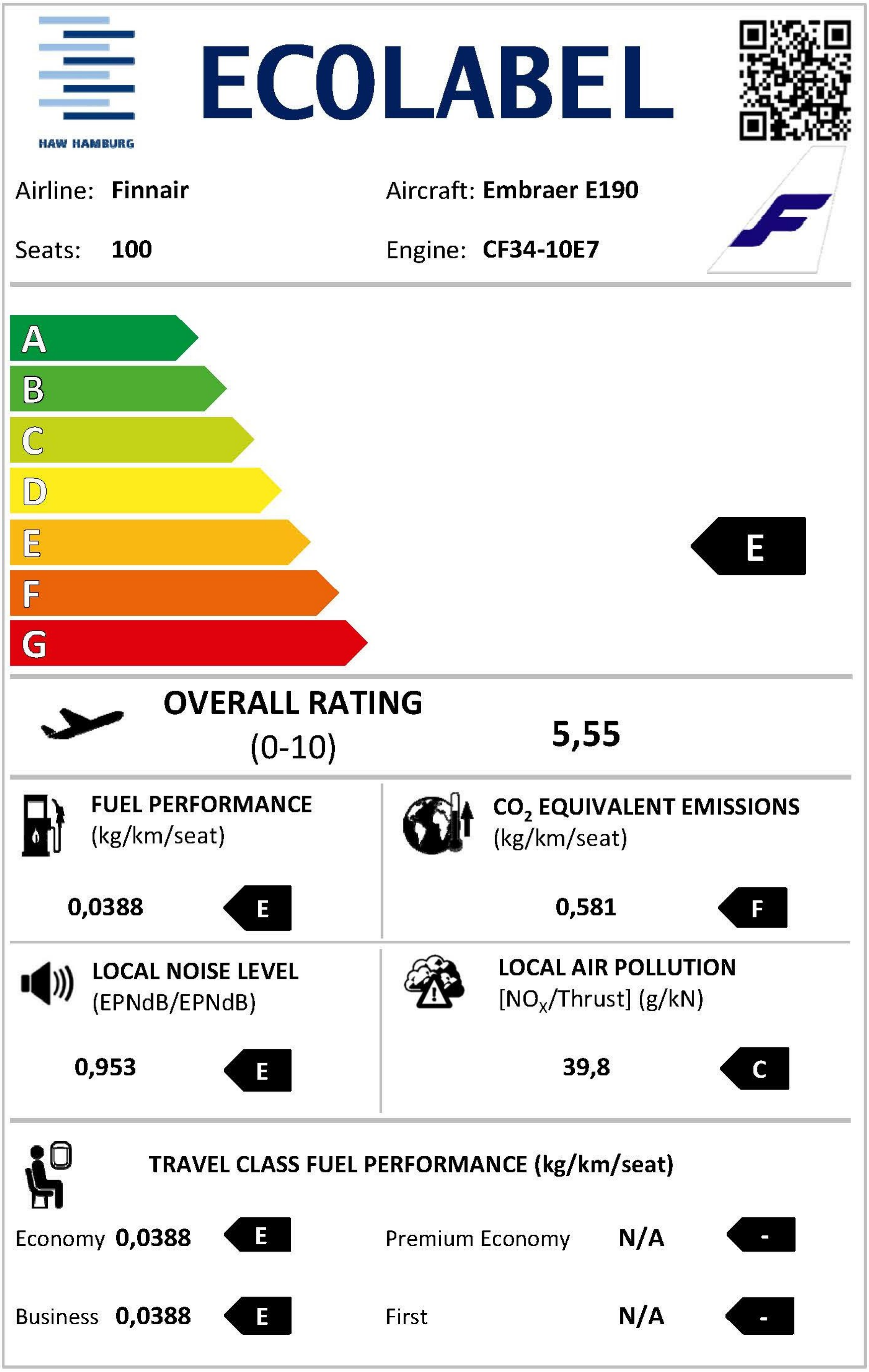

Figure C.44 Ecolabel for Embraer 190 of Finnair

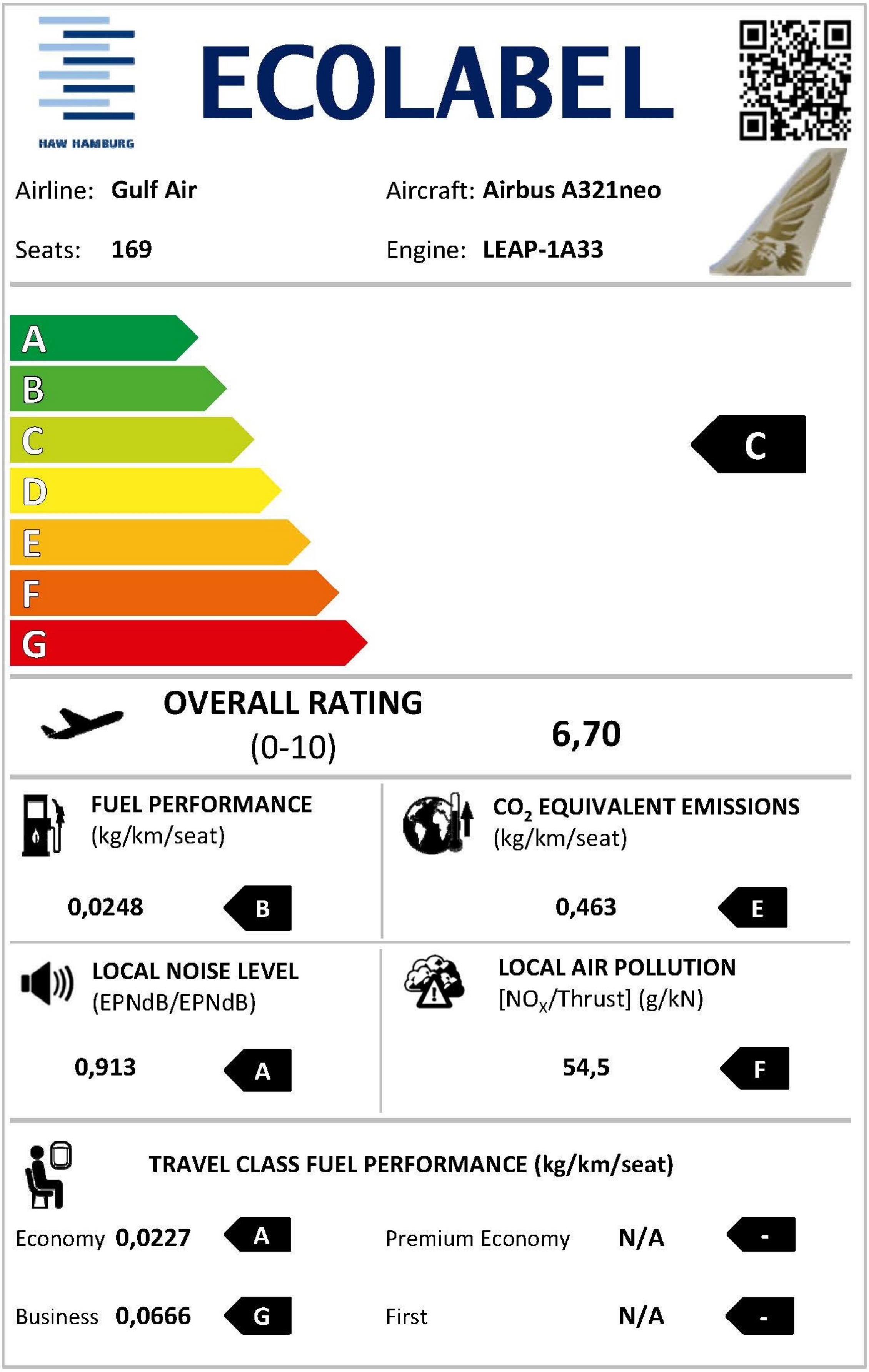

Figure C.45 Ecolabel for Airbus A321neo of Gulf Air

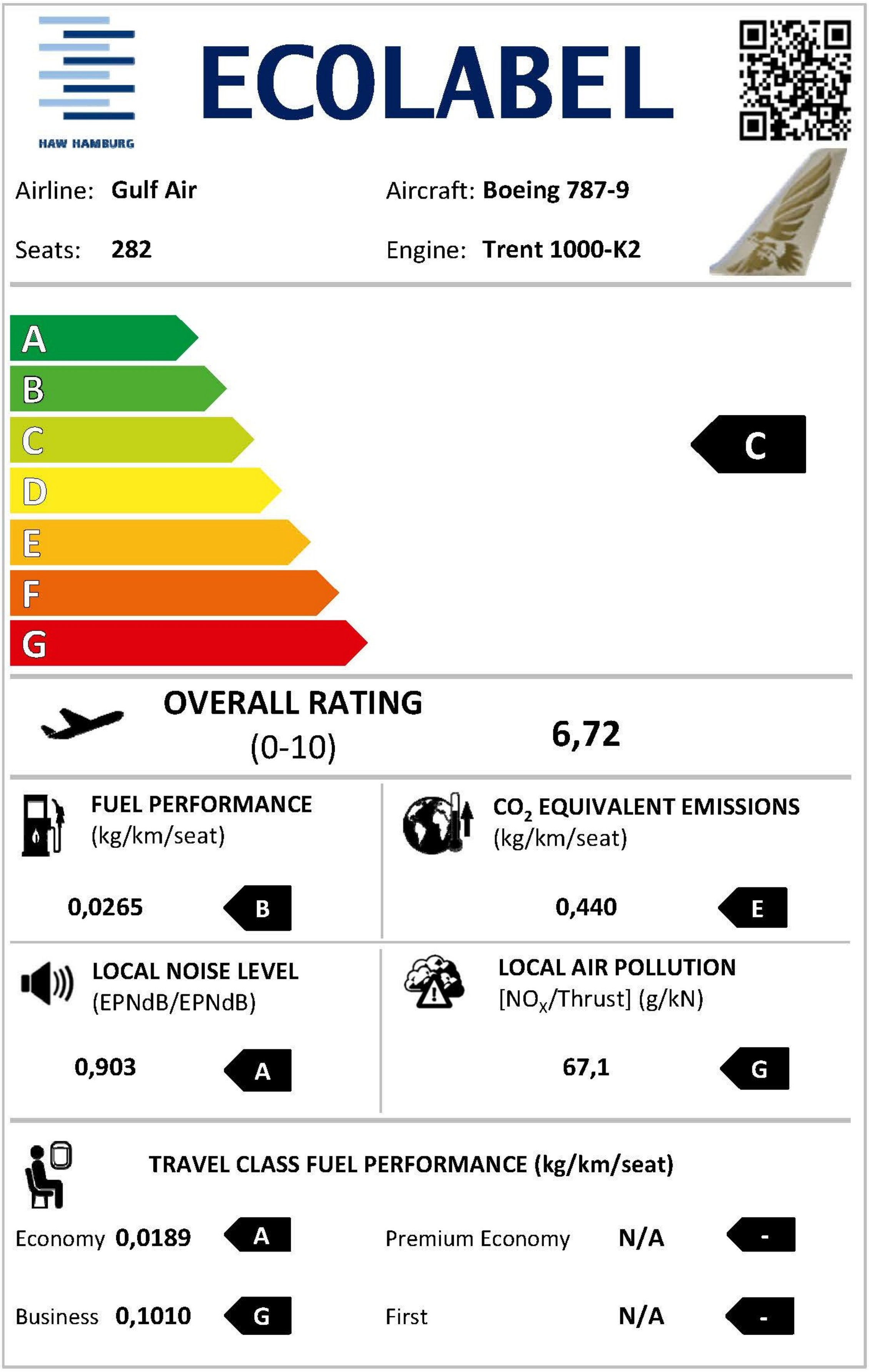

Figure C.46 Ecolabel for Boeing 787-9 of Gulf Air

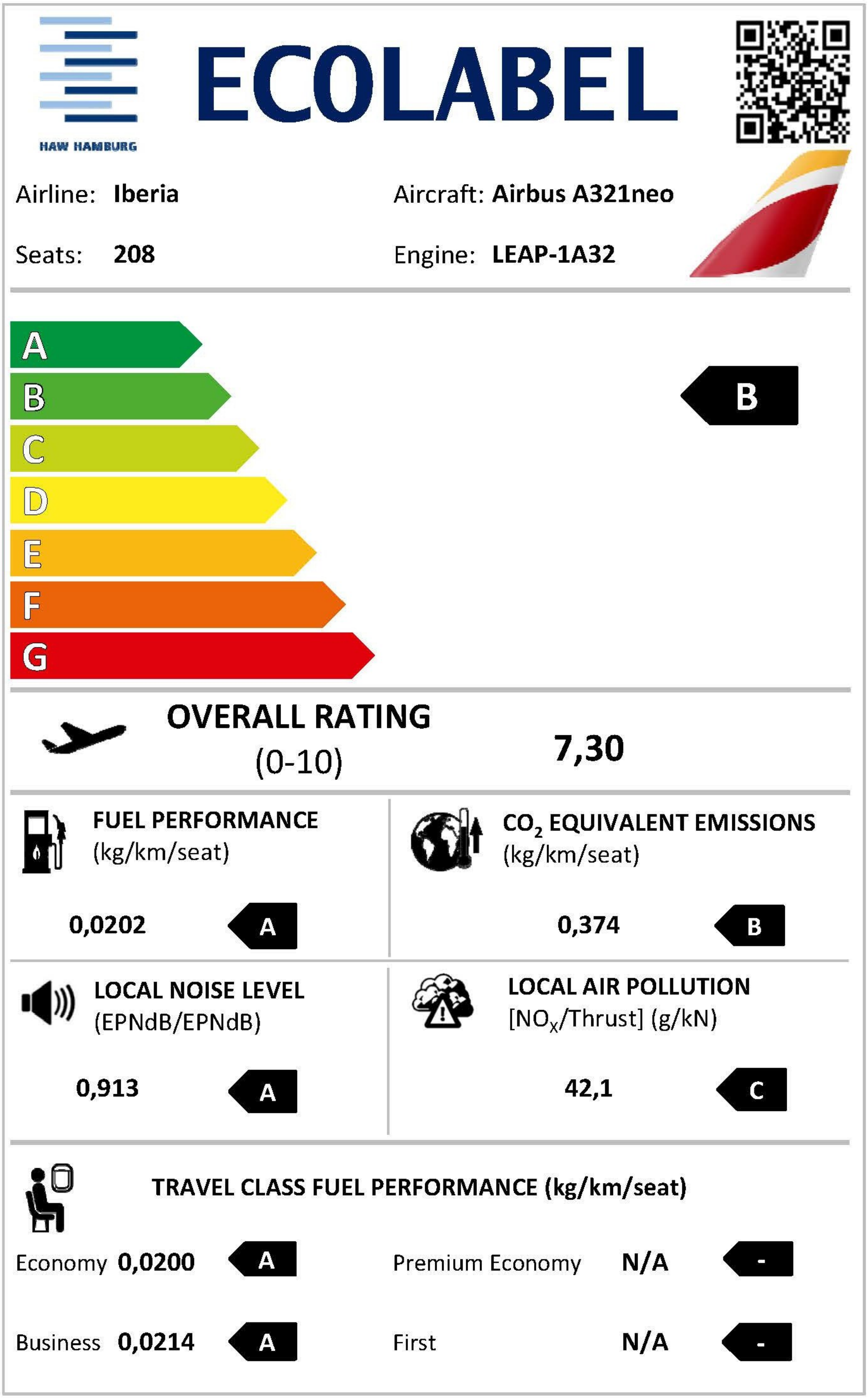

Figure C.47 Ecolabel for Airbus A321neo of Iberia

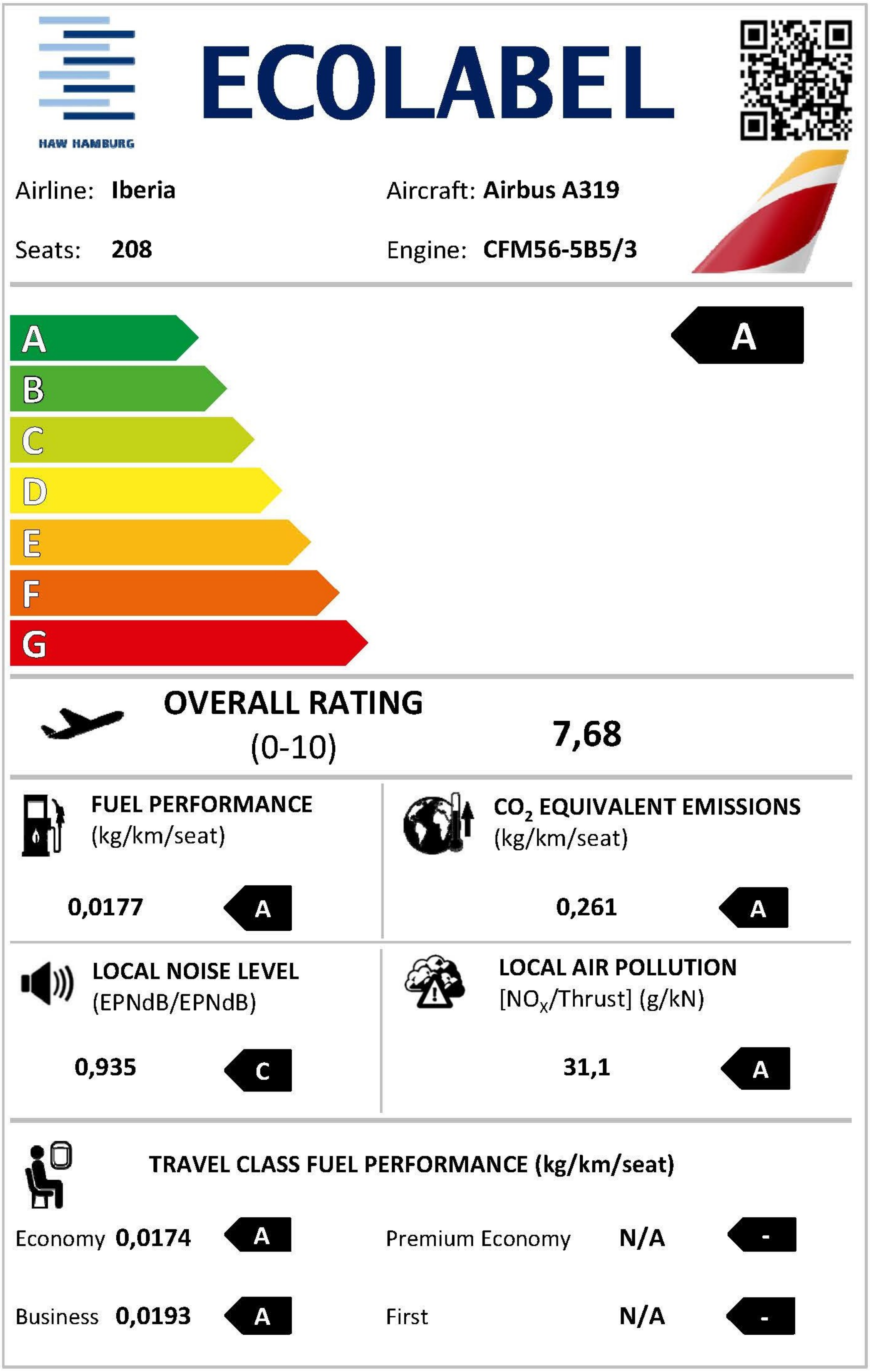

Figure C.48 Ecolabel for Airbus A319 of Iberia

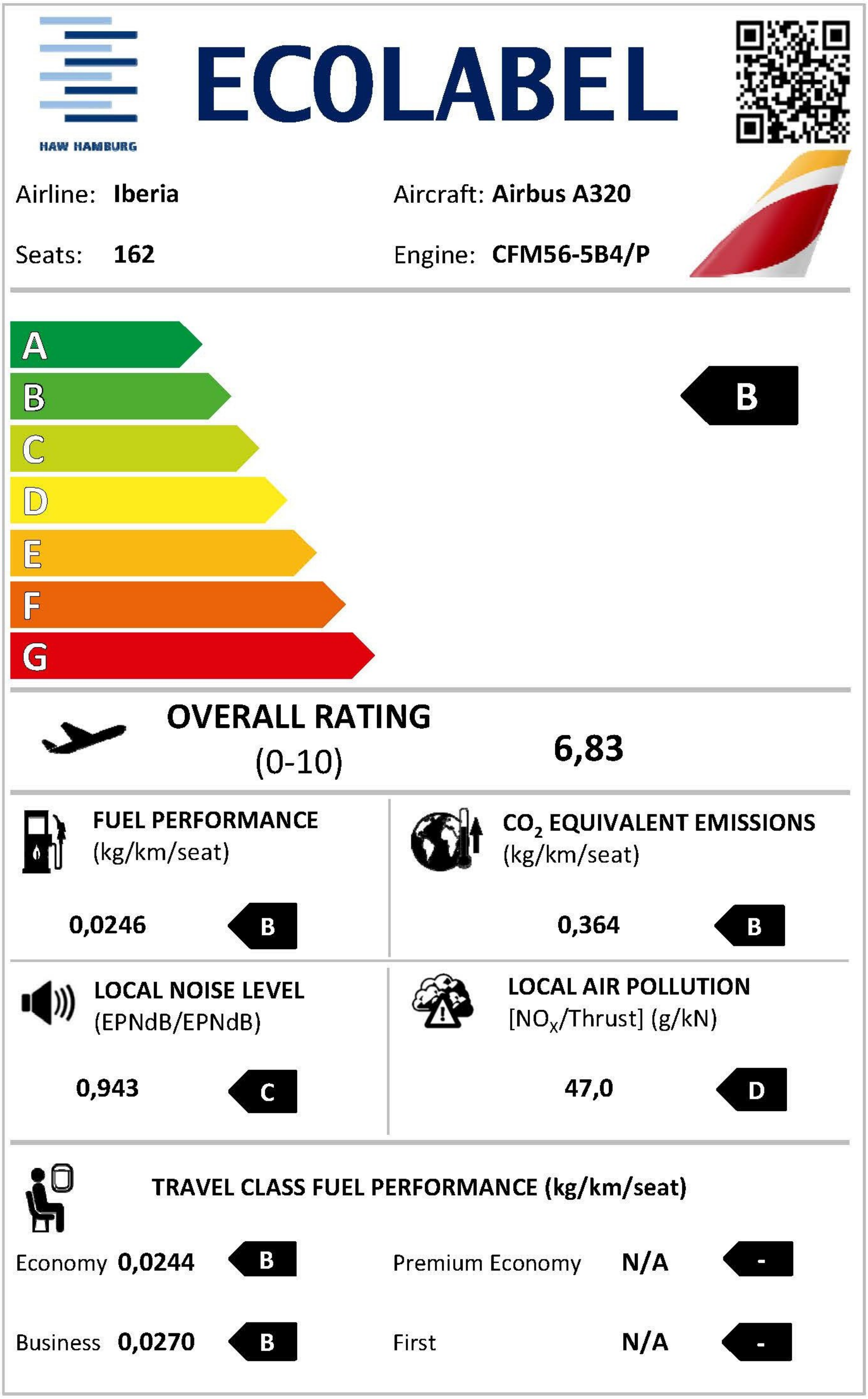

Figure C.49 Ecolabel for Airbus A320 of Iberia

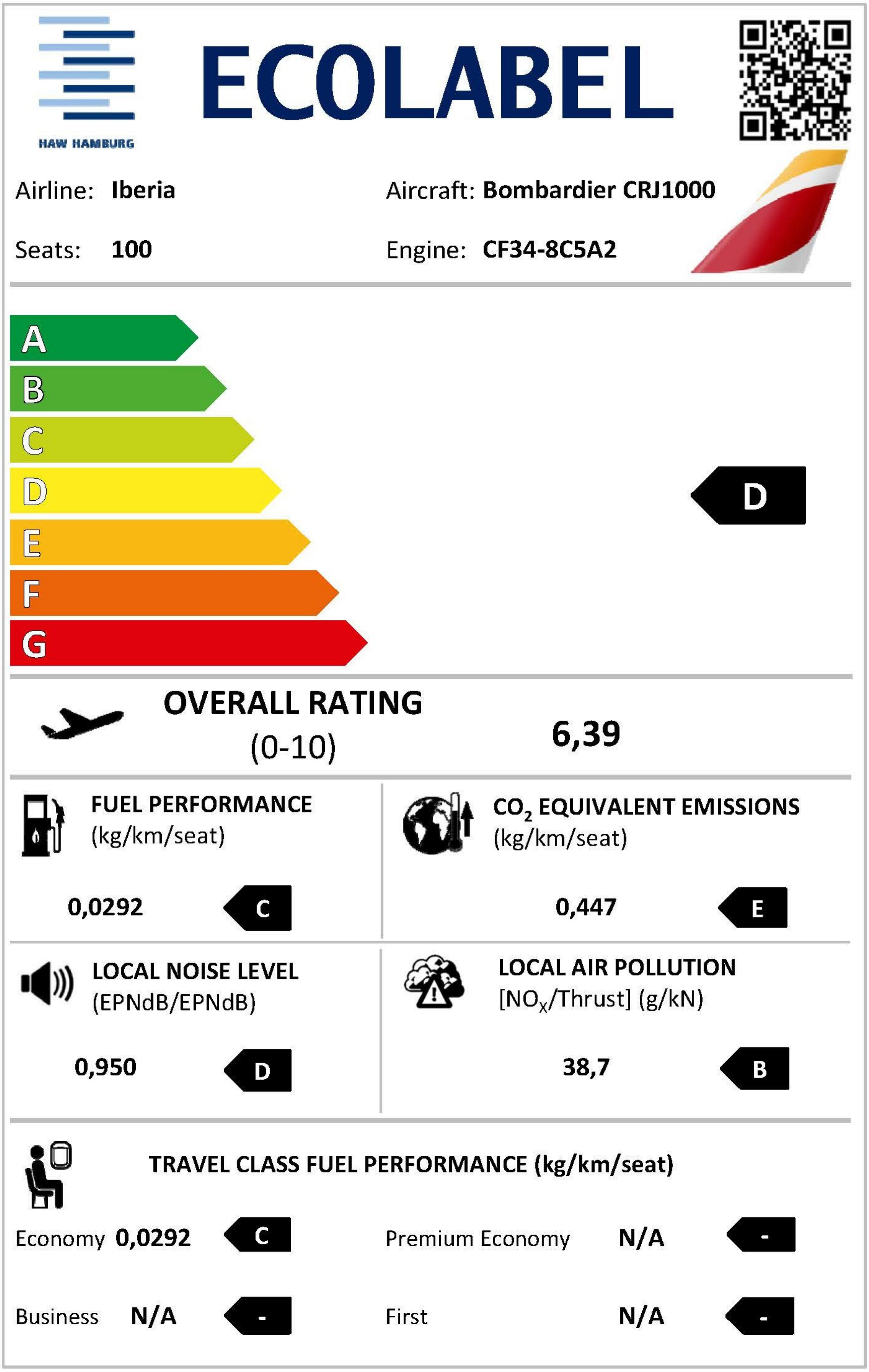

Figure C.50 Ecolabel for Bombardier CRJ1000 of Iberia

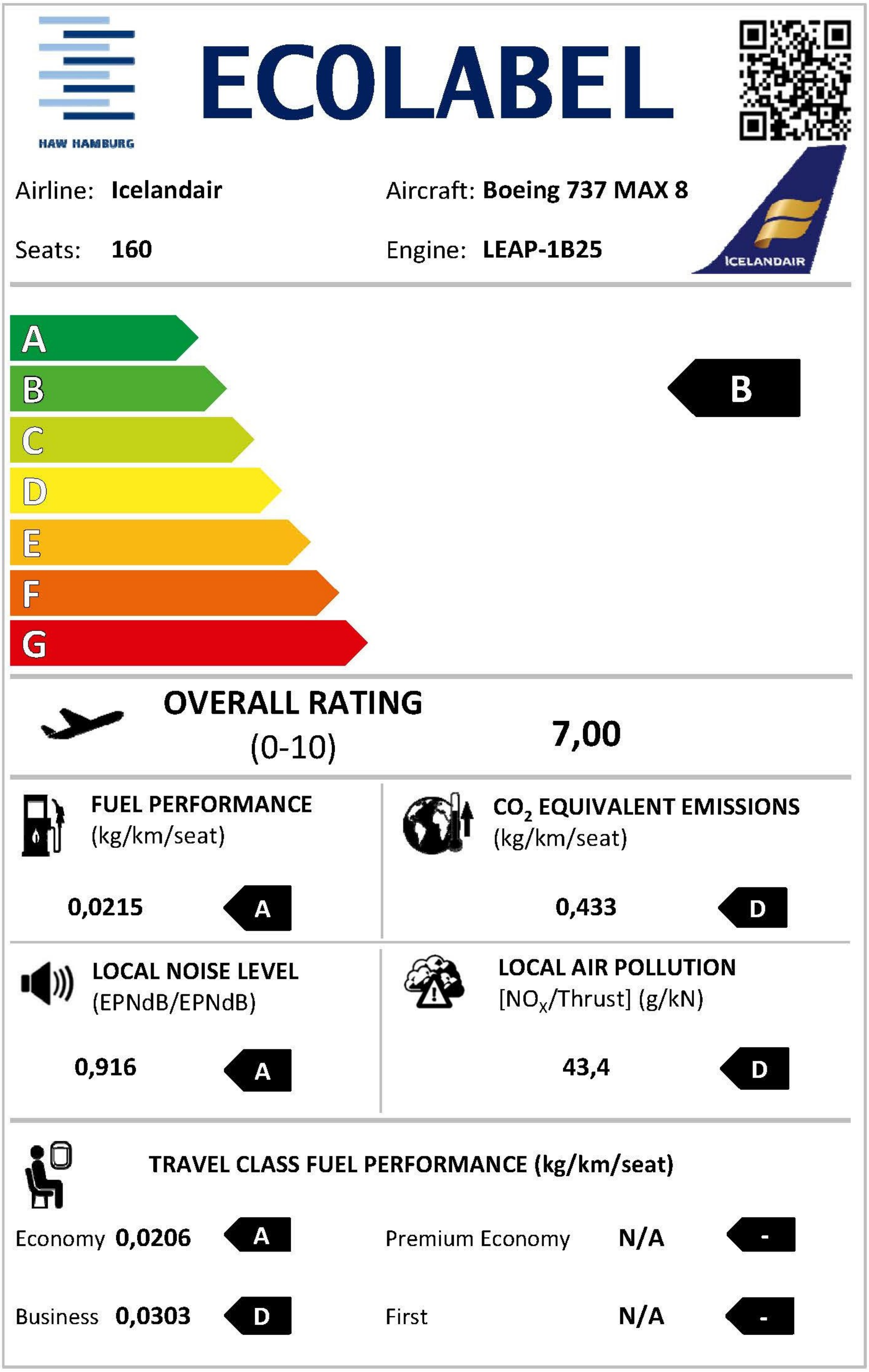

Figure C.51 Ecolabel for Boeing 737 MAX 8 of Icelandair

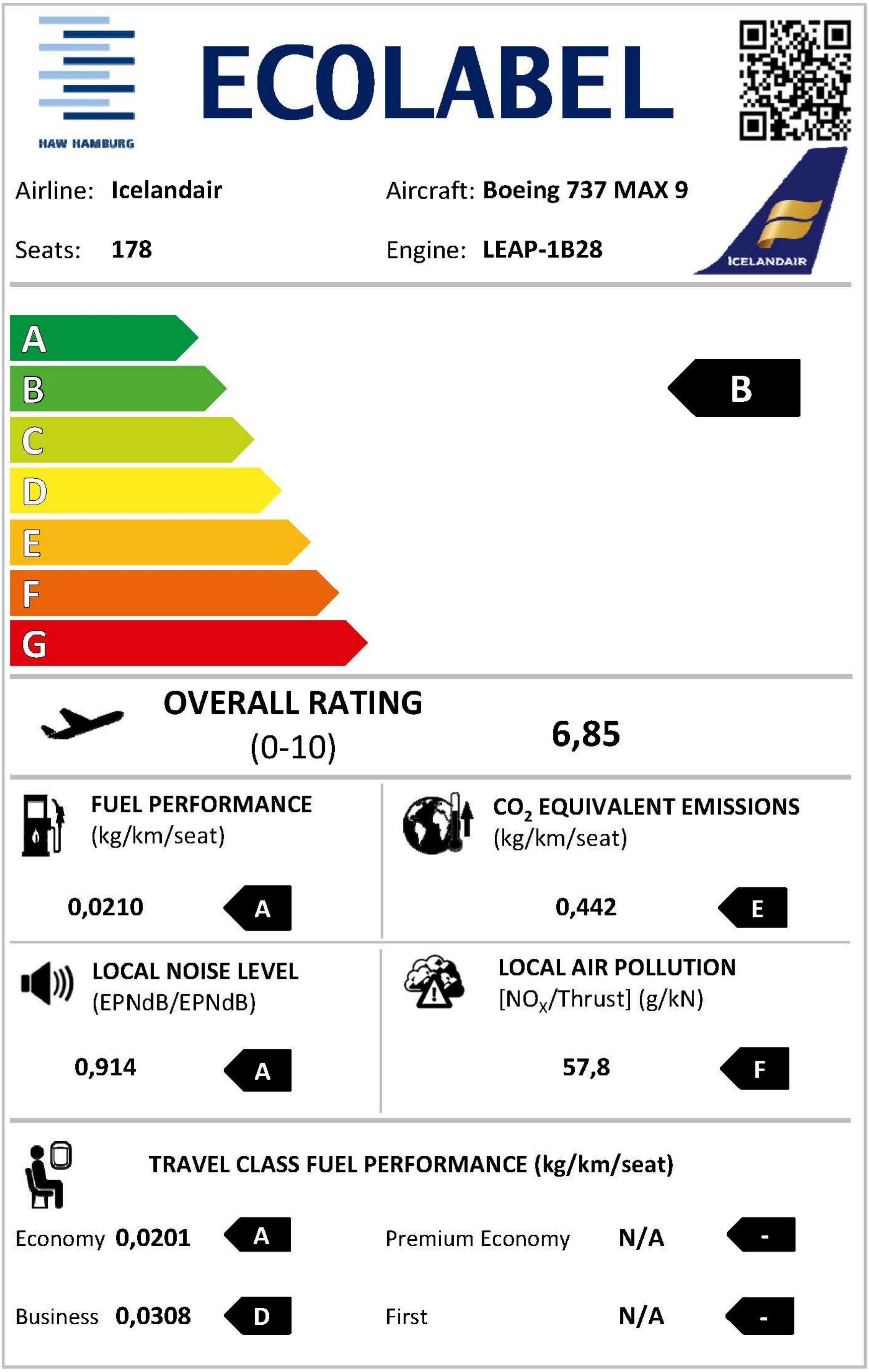

Figure C.52 Ecolabel for Boeing 737 MAX 9 of Icelandair

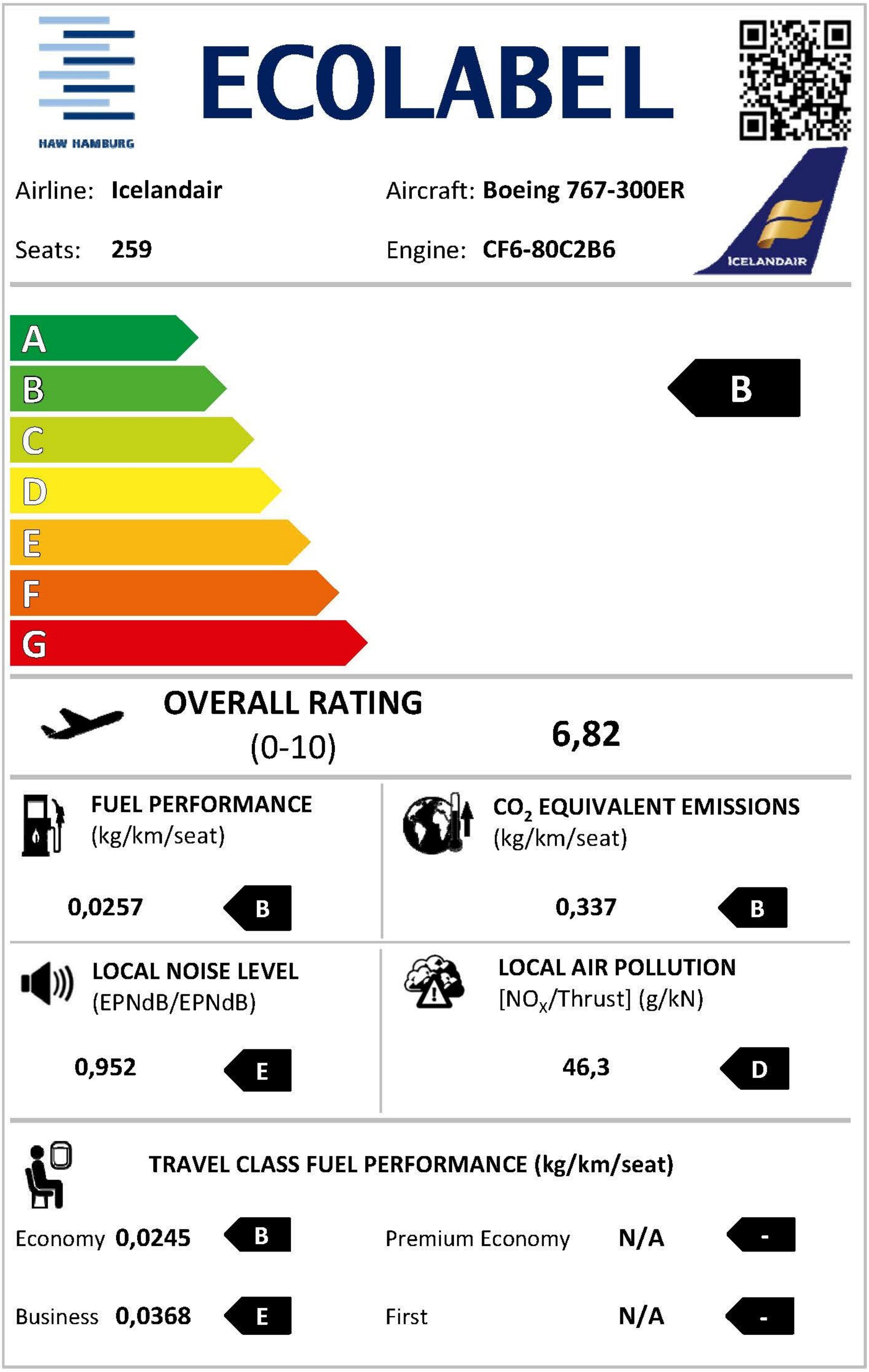

Figure C.53 Ecolabel for Boeing 767-300ER of Icelandair

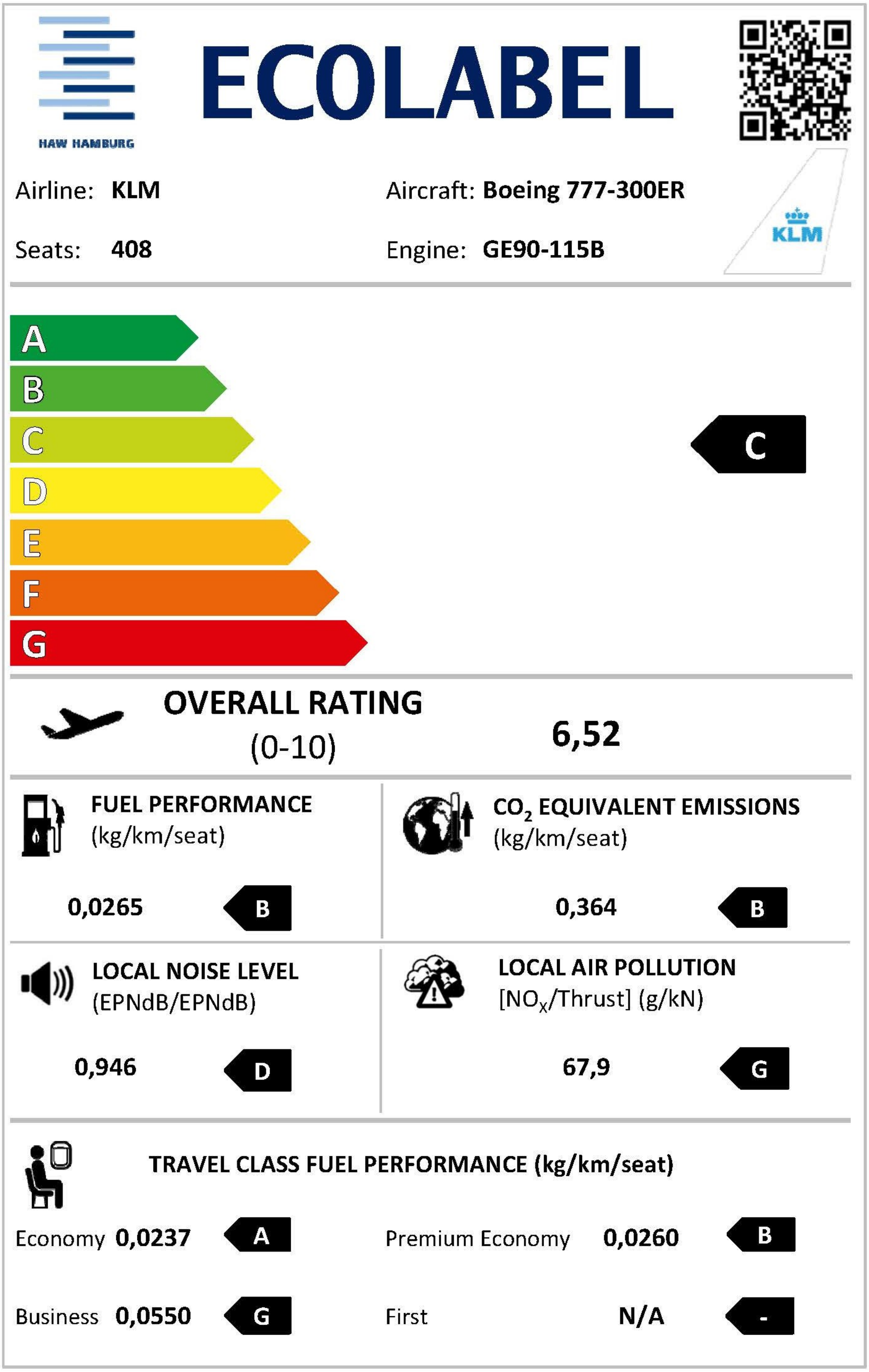

Figure C.54 Ecolabel for Boeing 777-300ER of KLM

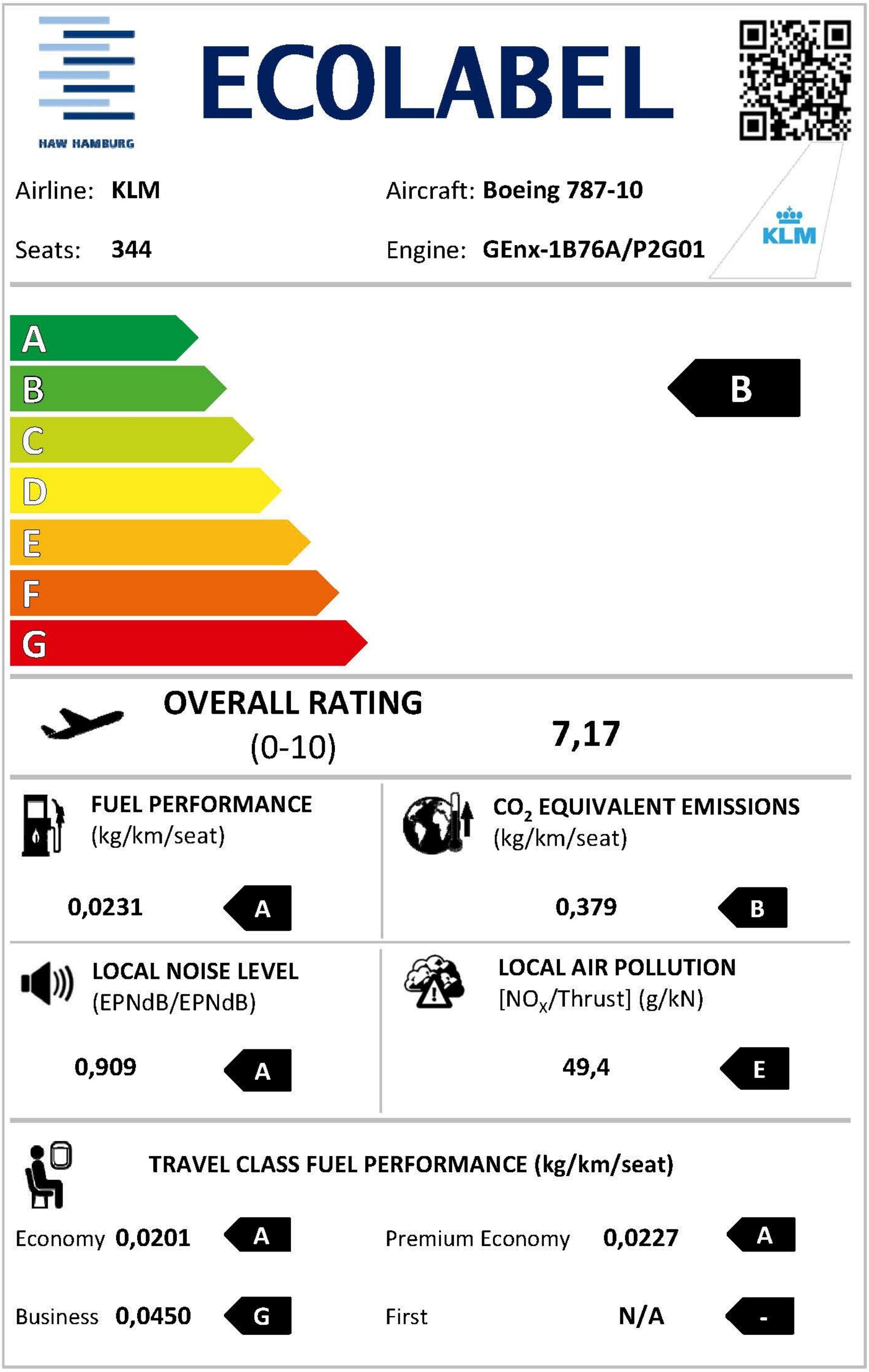

Figure C.55 Ecolabel for Boeing 787-10 of KLM

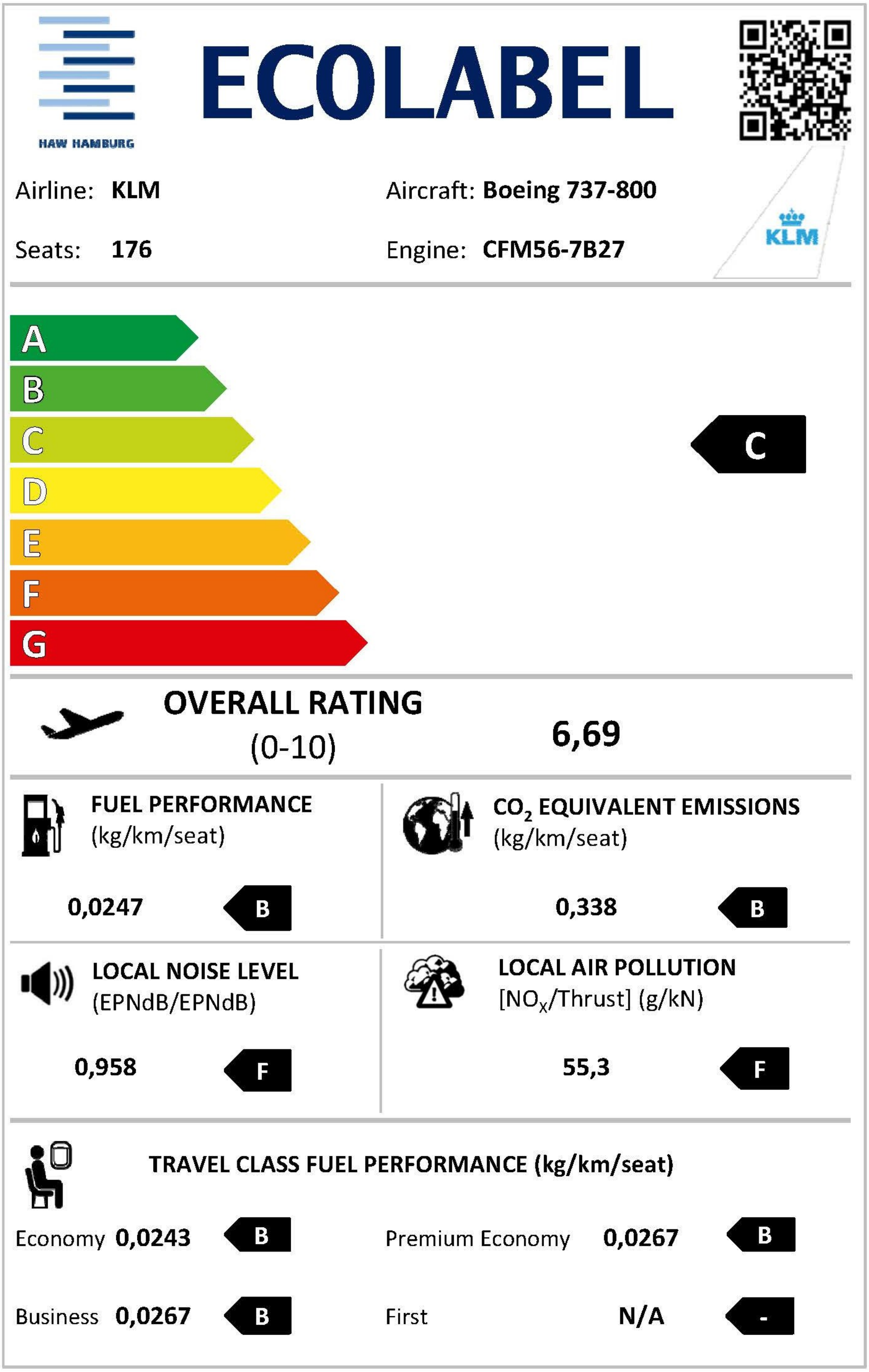

Figure C.56 Ecolabel for Boeing 737-800 of KLM

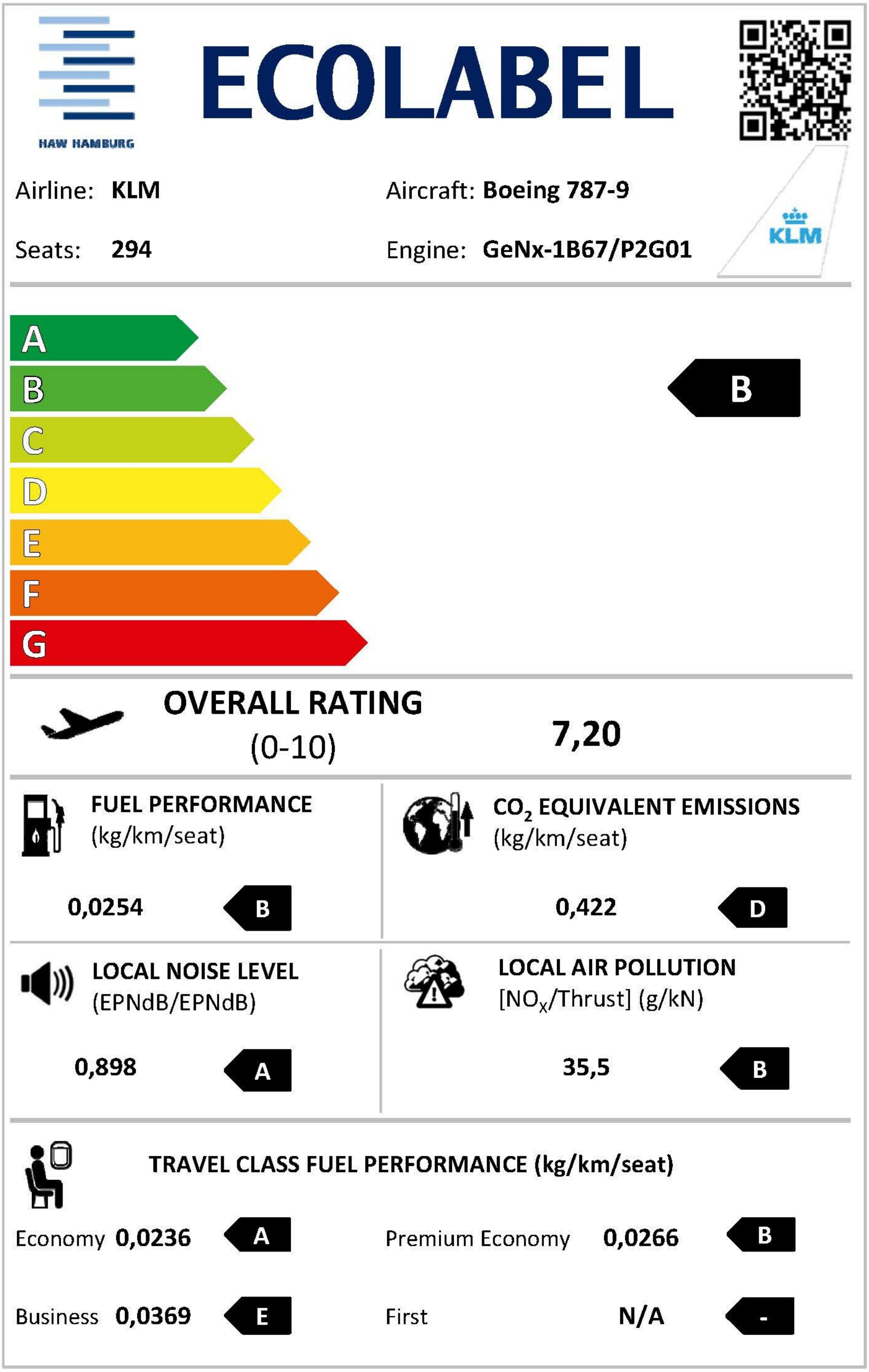

Figure C.57 Ecolabel for Boeing 787-9 of KLM

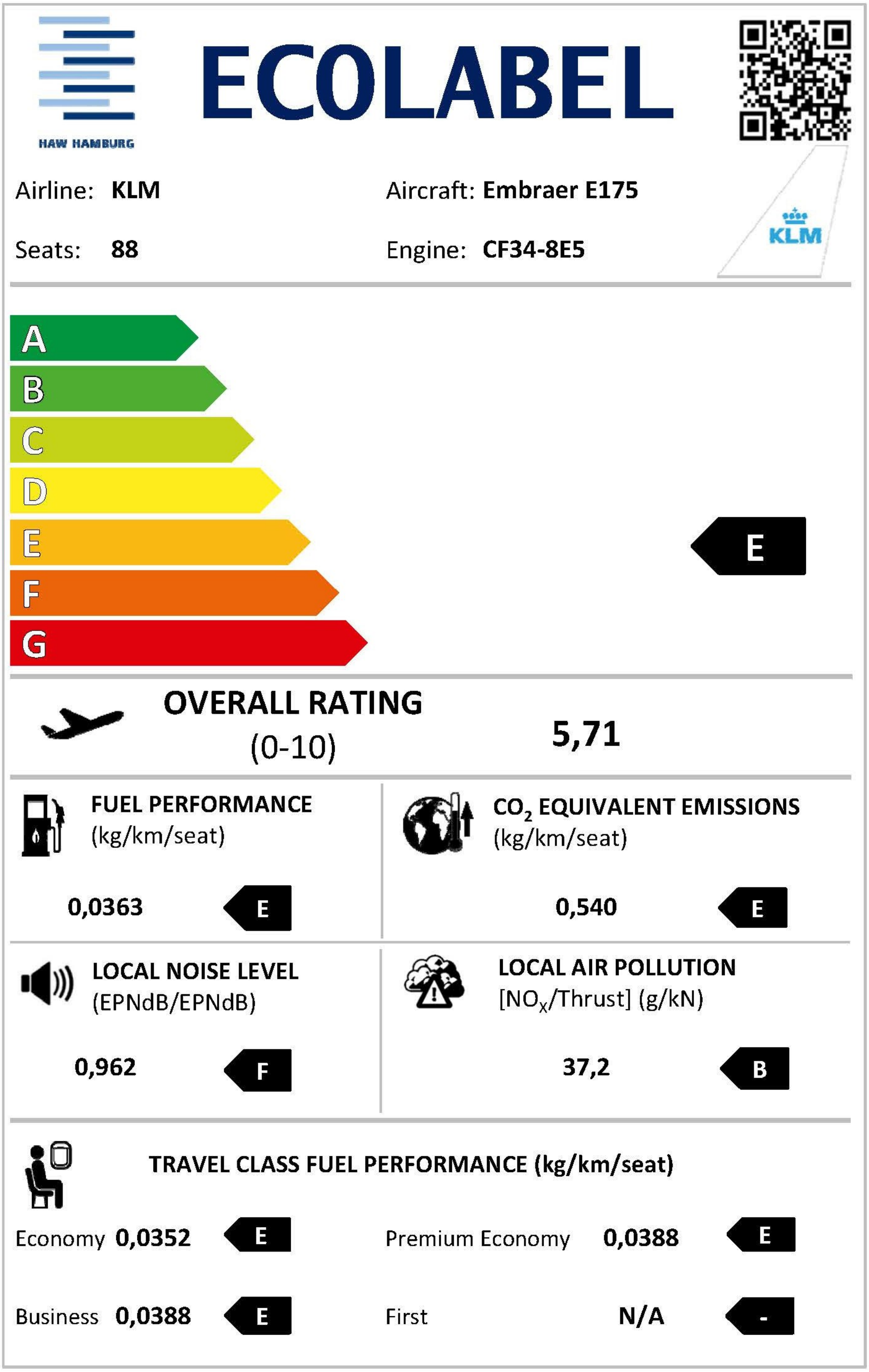

Figure C.58 Ecolabel for Embraer E175 of KLM

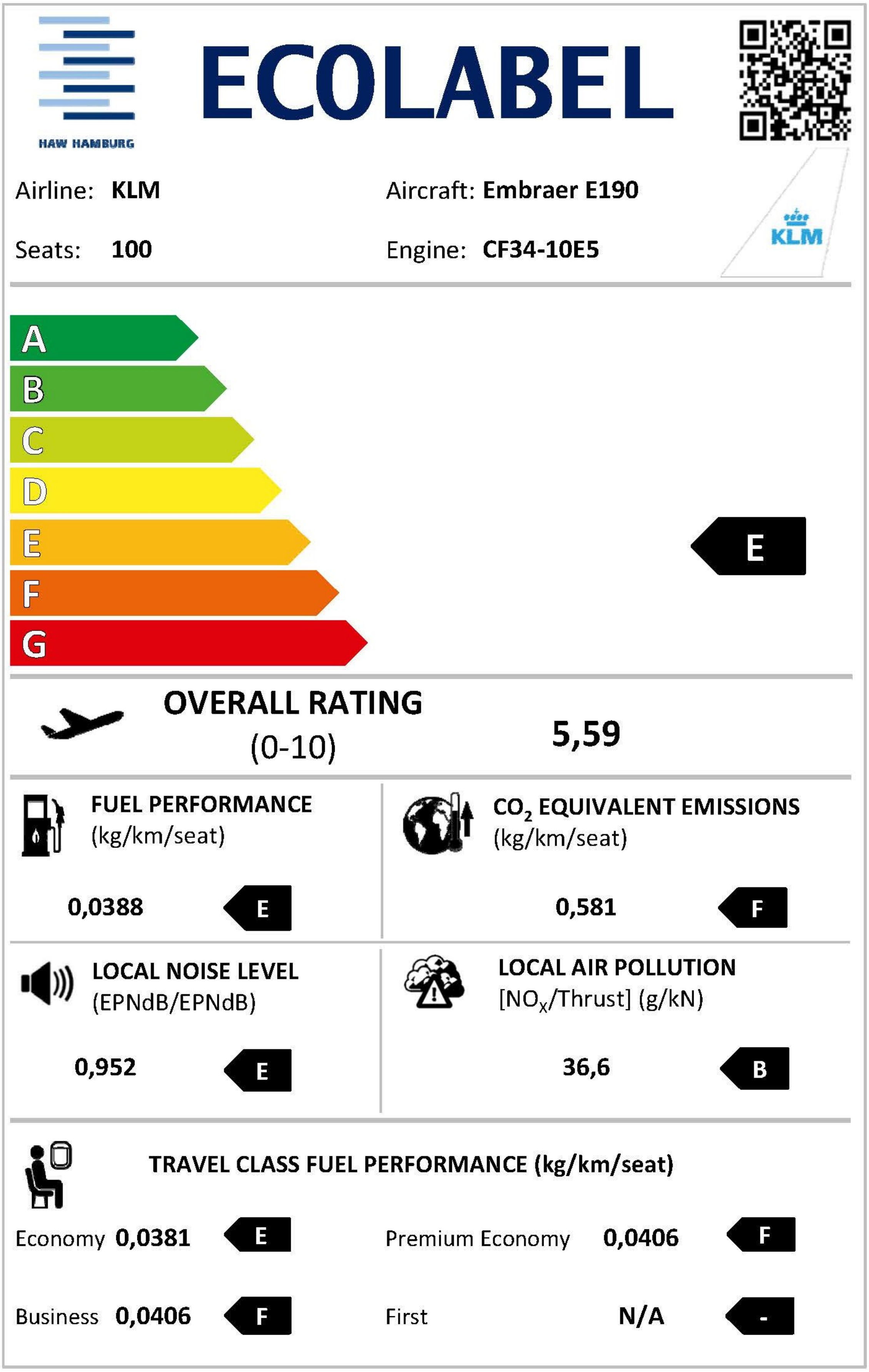

Figure C.59 Ecolabel for Embraer E190 of KLM

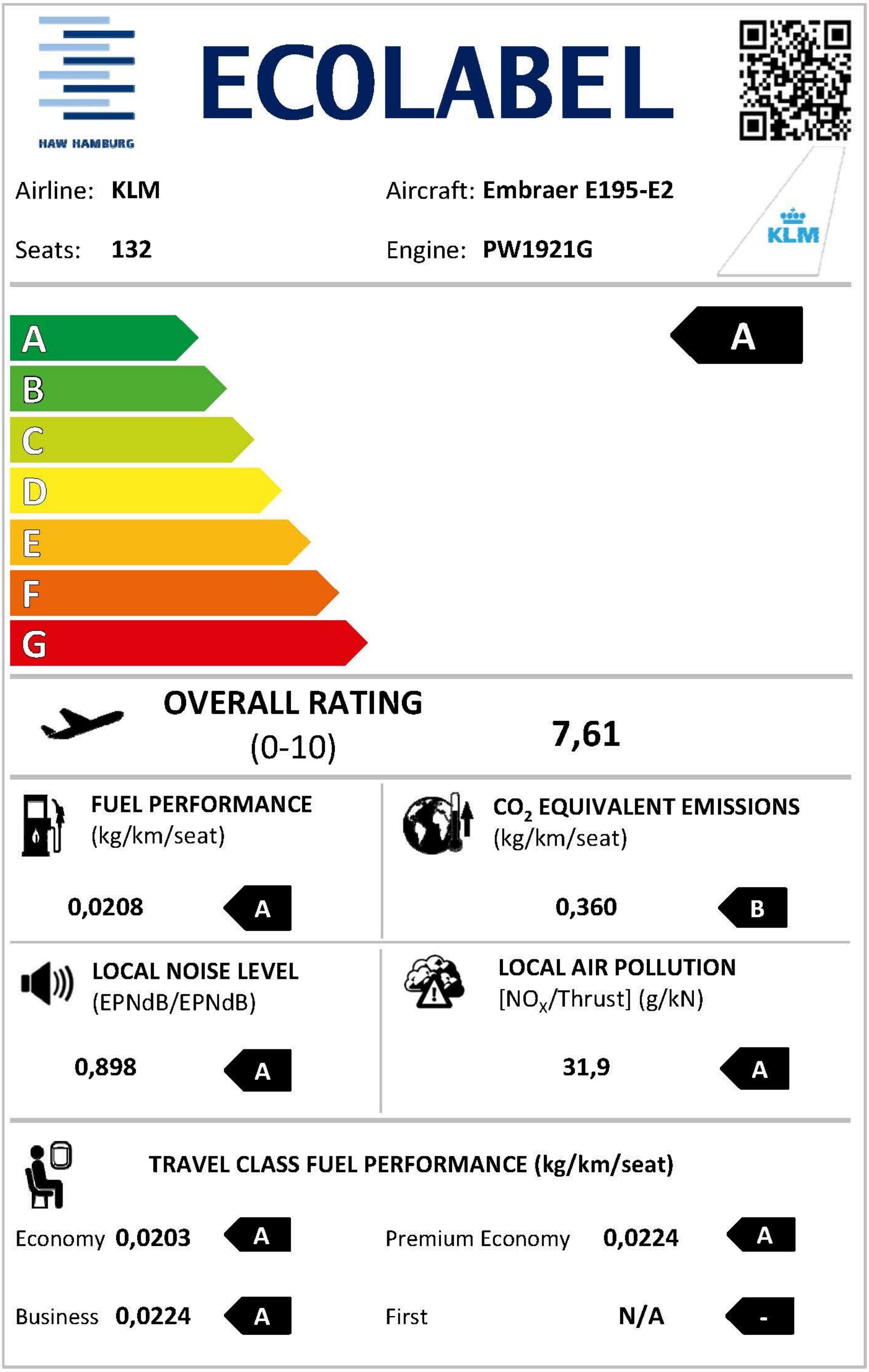

Figure C.60 Ecolabel for Embraer E195-E2 of KLM

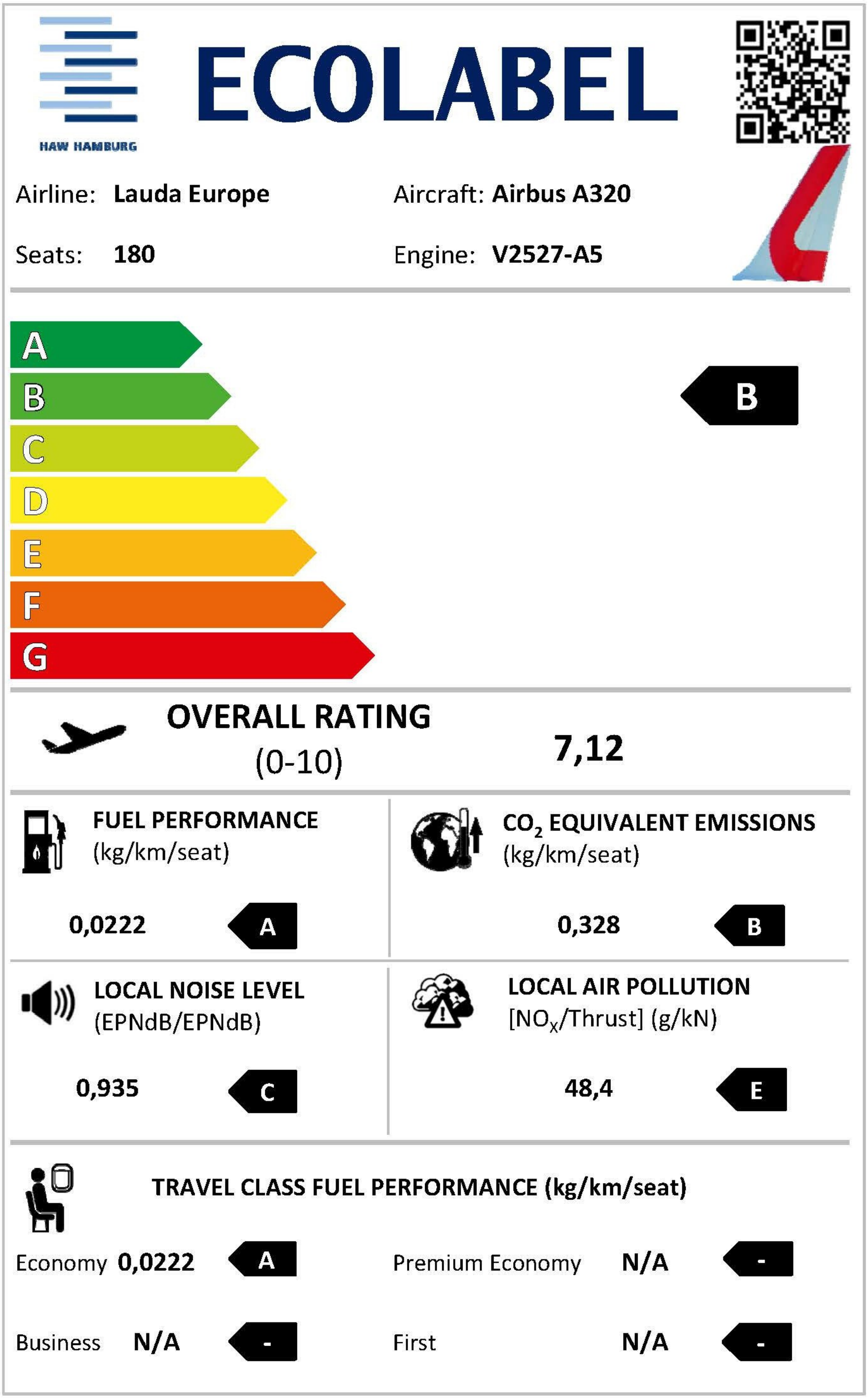

Figure C.61 Ecolabel for Airbus A320 of Lauda Europe

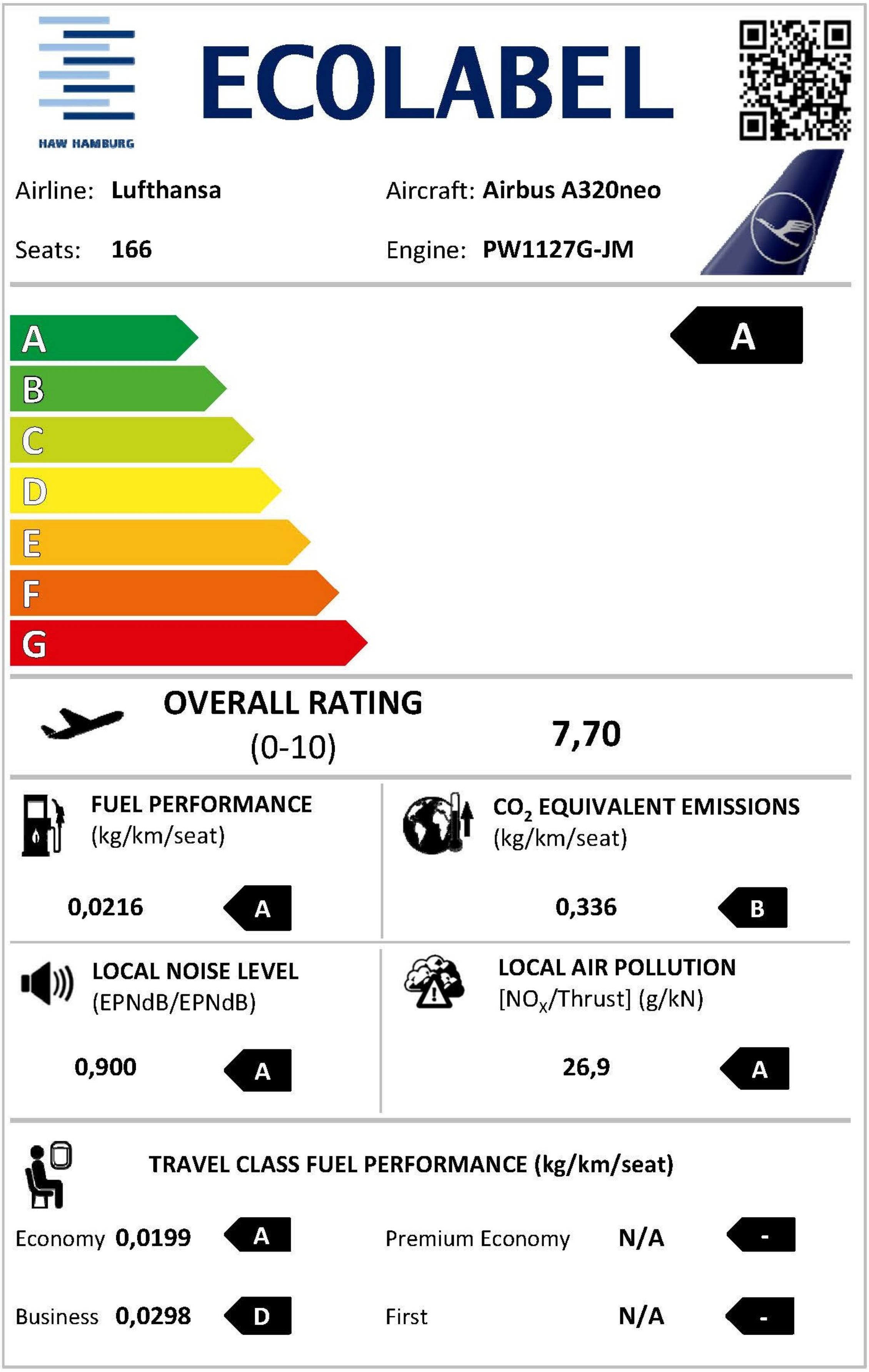

Figure C.62 Ecolabel for Airbus A320neo of Lufthansa

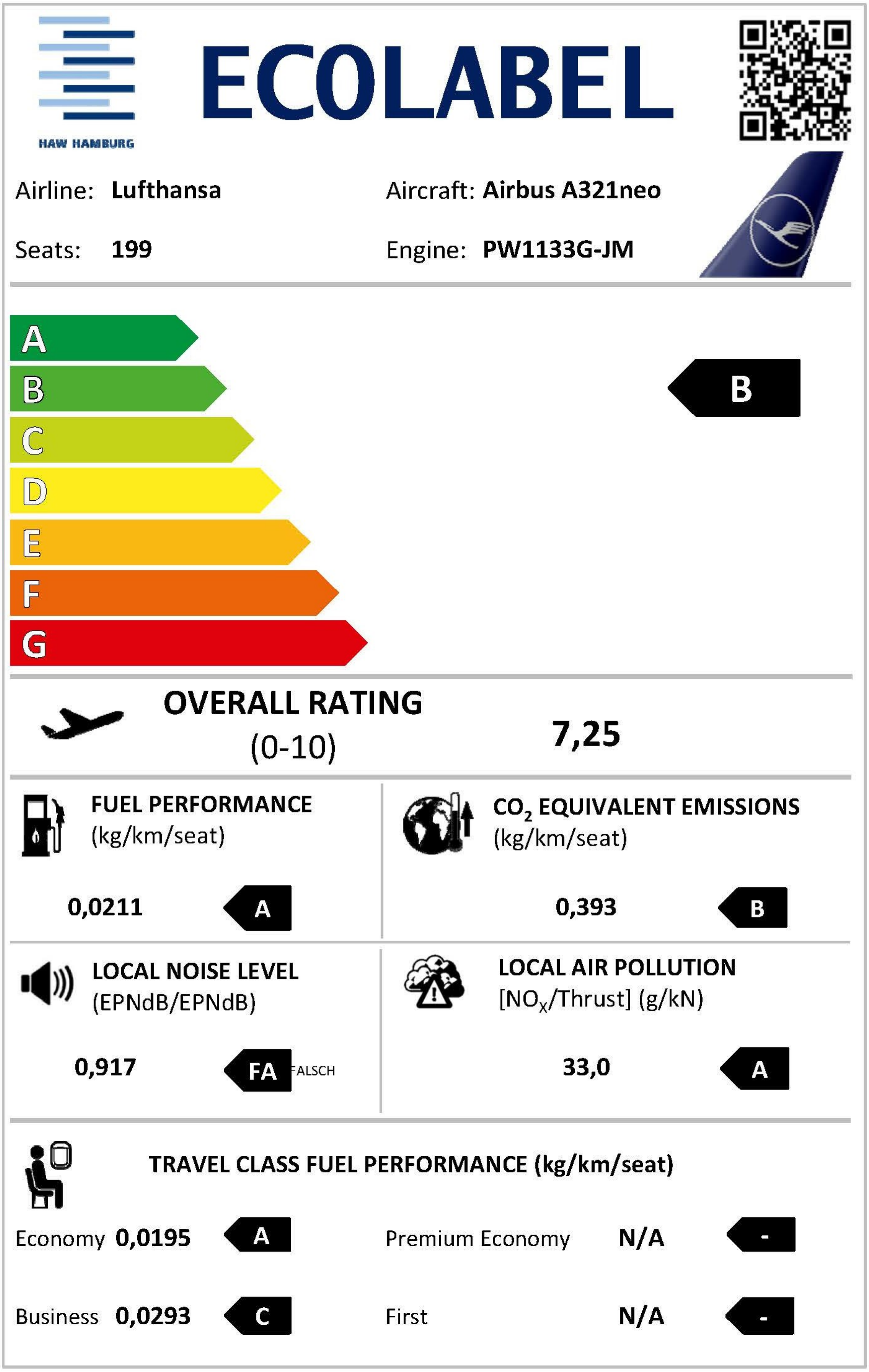

Figure C.63 Ecolabel for Airbus A321neo of Lufthansa

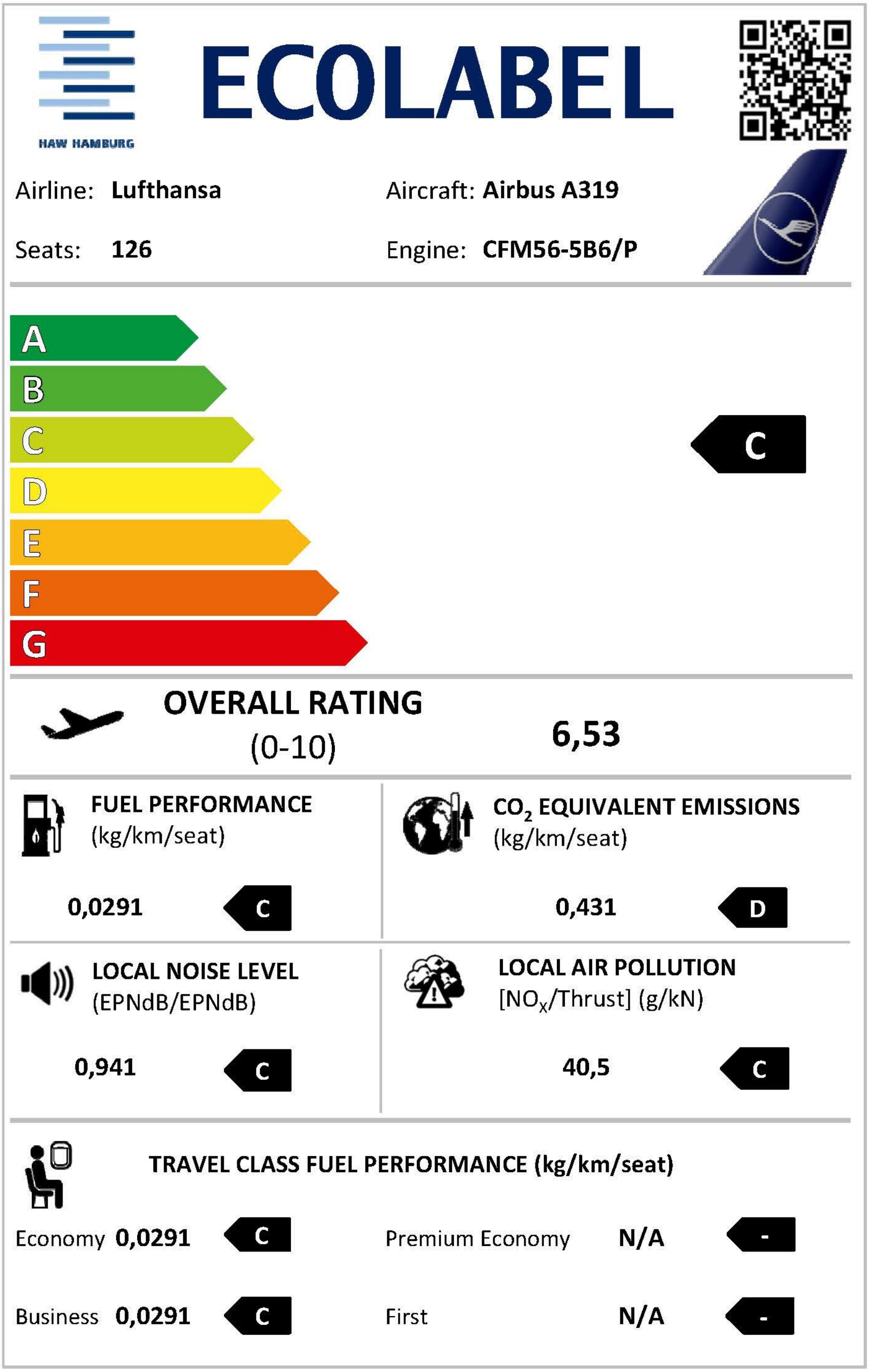

Figure C.64 Ecolabel for Airbus A319 of Lufthansa

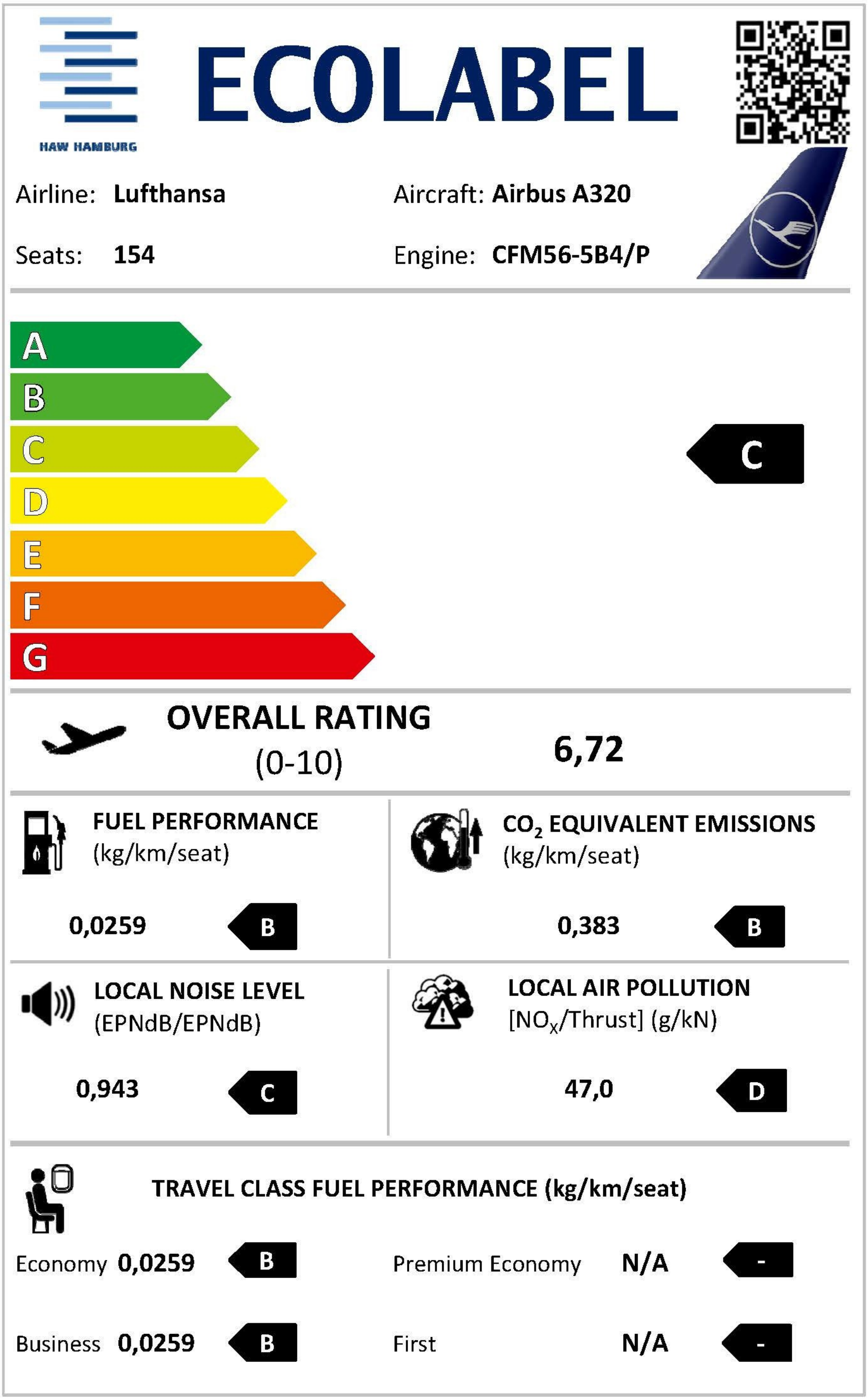

Figure C.65 Ecolabel for Airbus A320 of Lufthansa

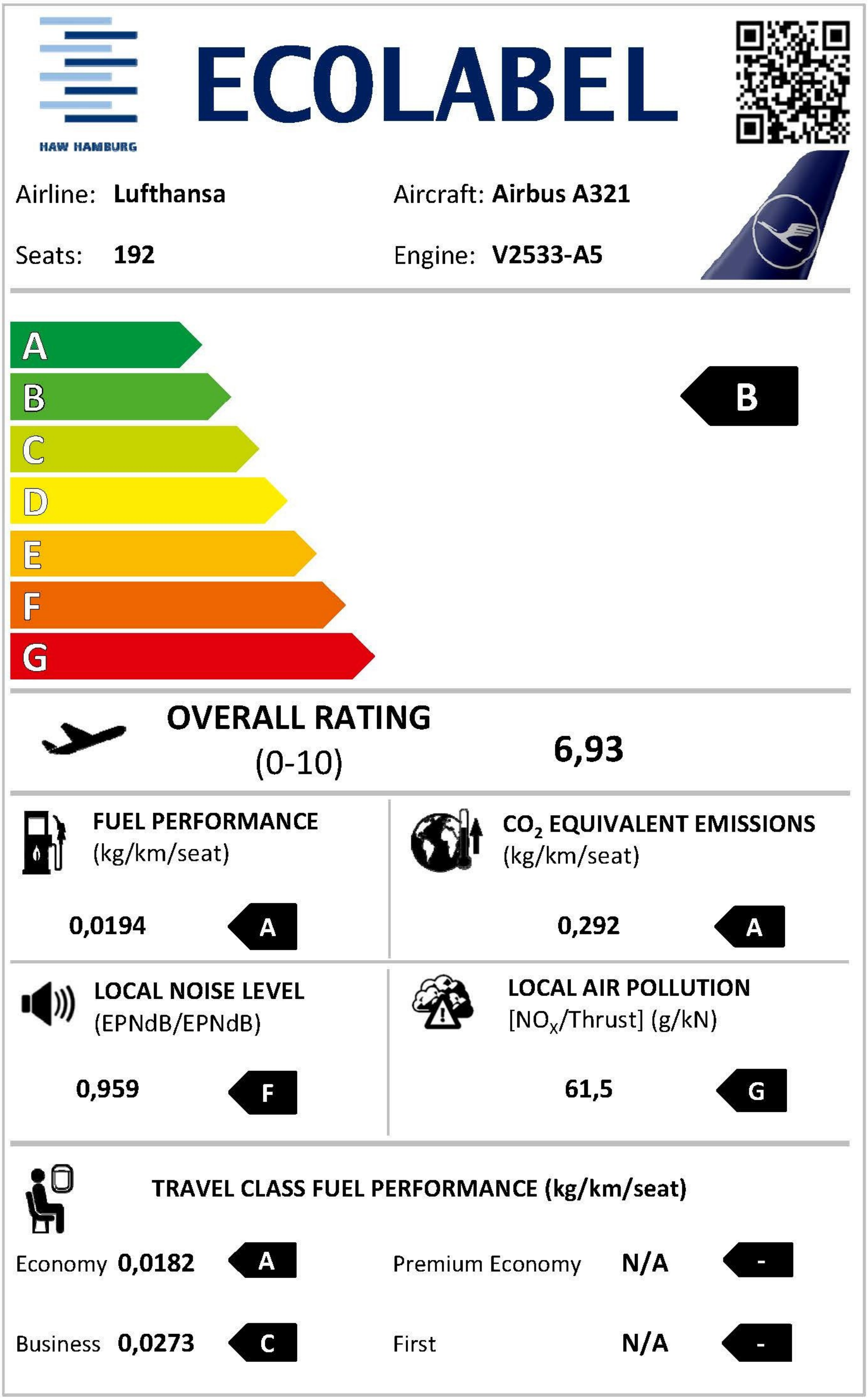

Figure C.66 Ecolabel for Airbus A321 of Lufthansa

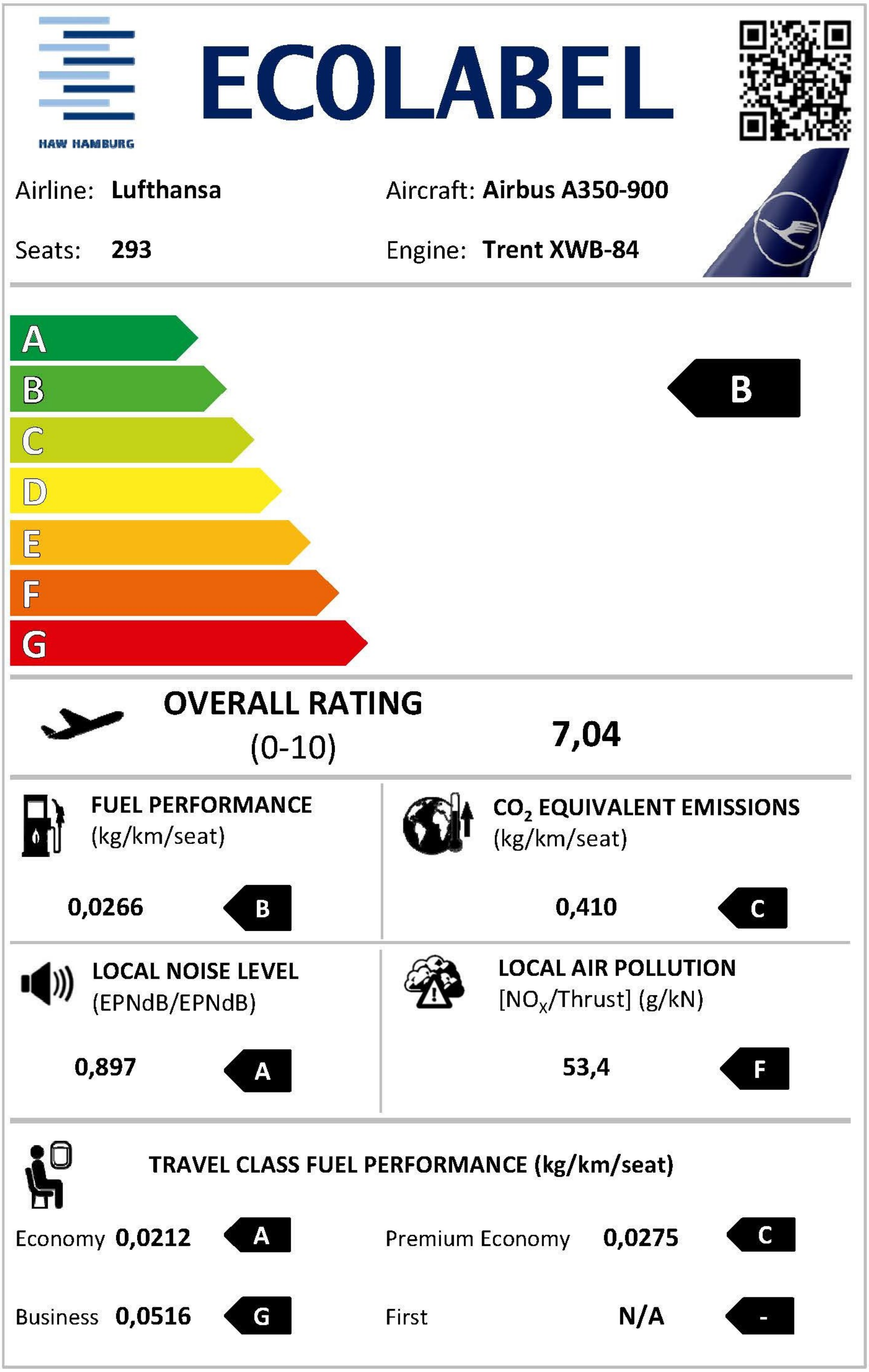

Figure C.67 Ecolabel for Airbus A350-900 of Lufthansa

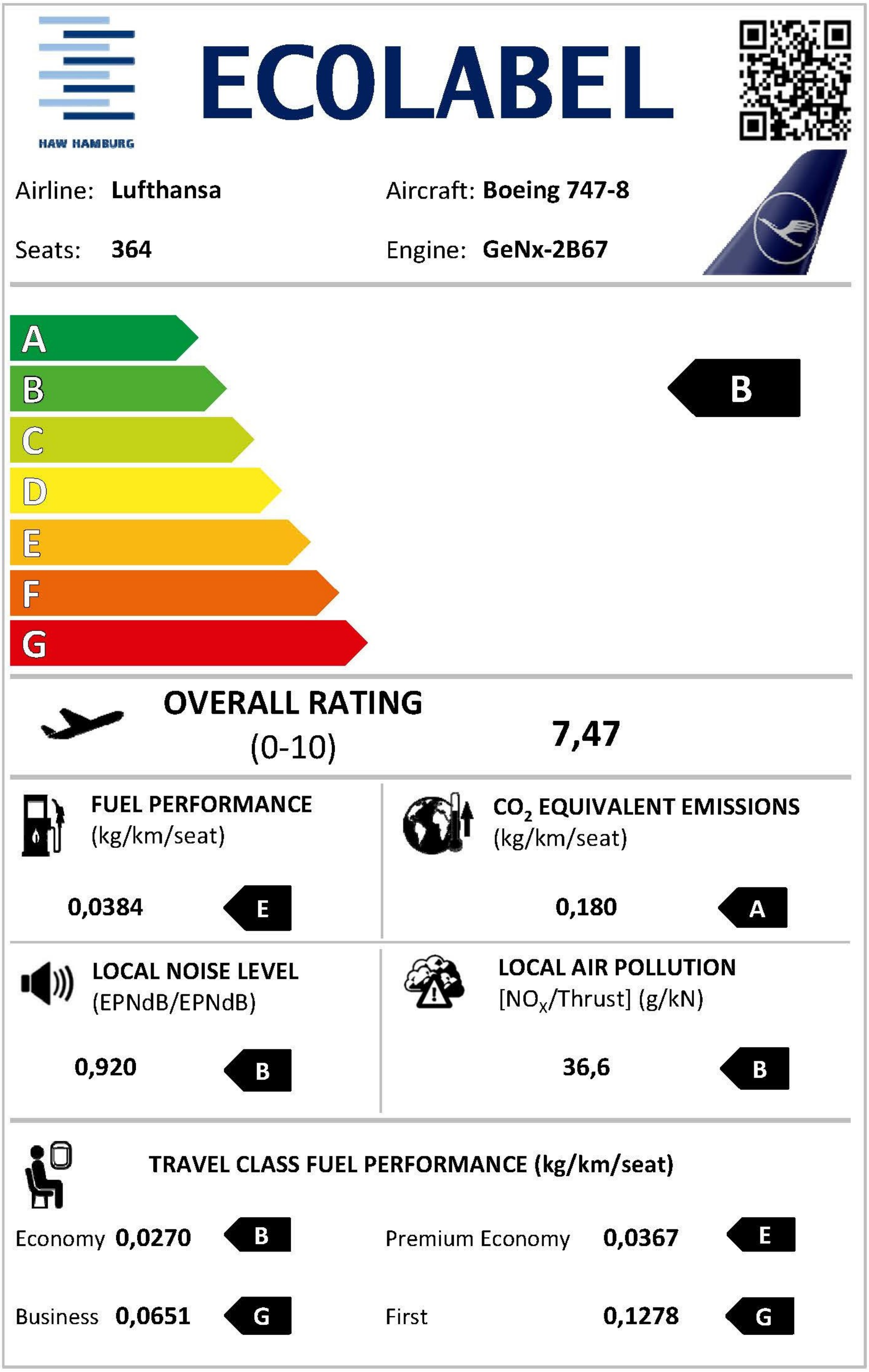

Figure C.68 Ecolabel for Boeing 747-8 of Lufthansa

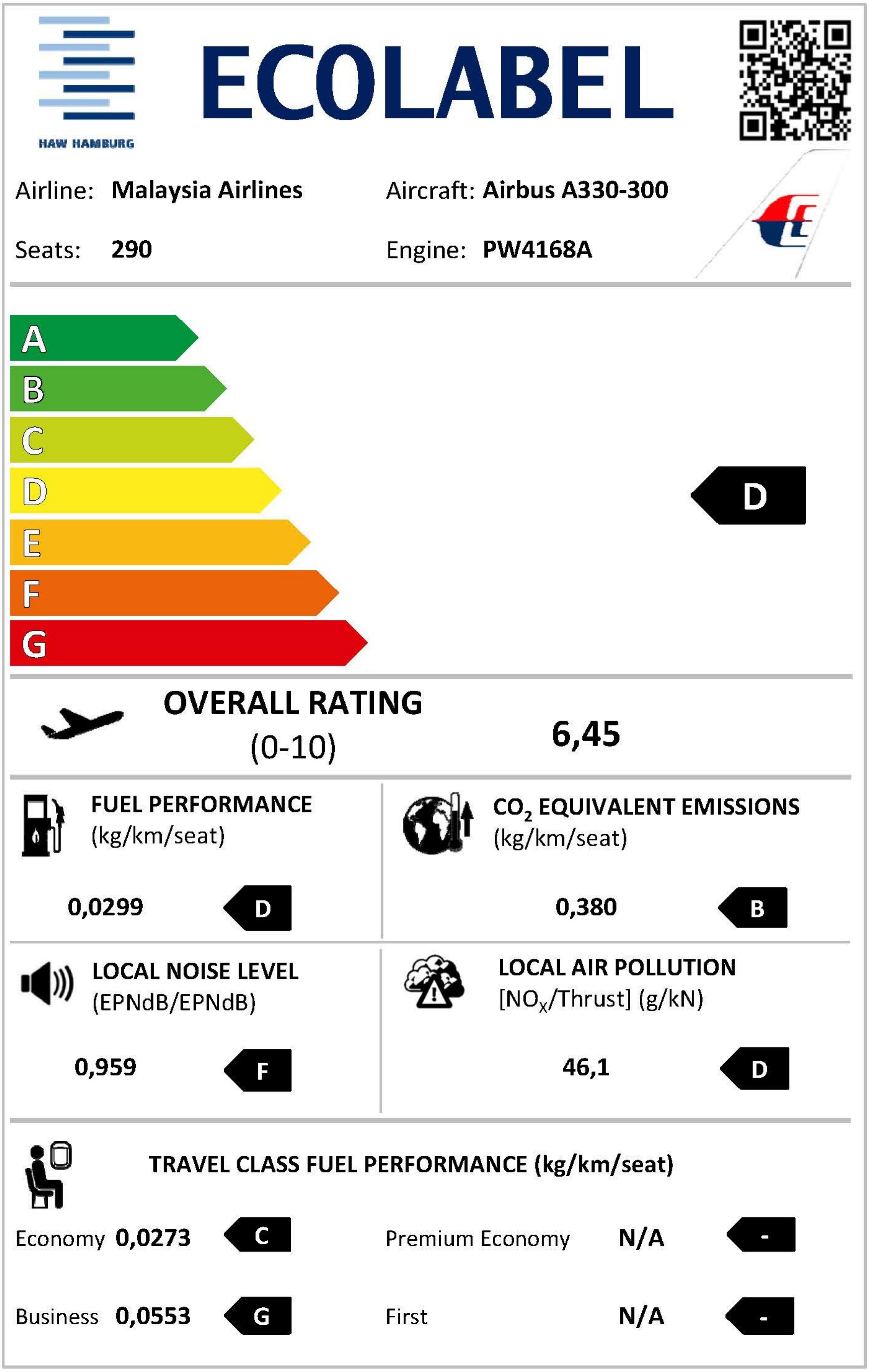

Figure C.69 Ecolabel for Airbus A330-300 of Malaysia Airlines

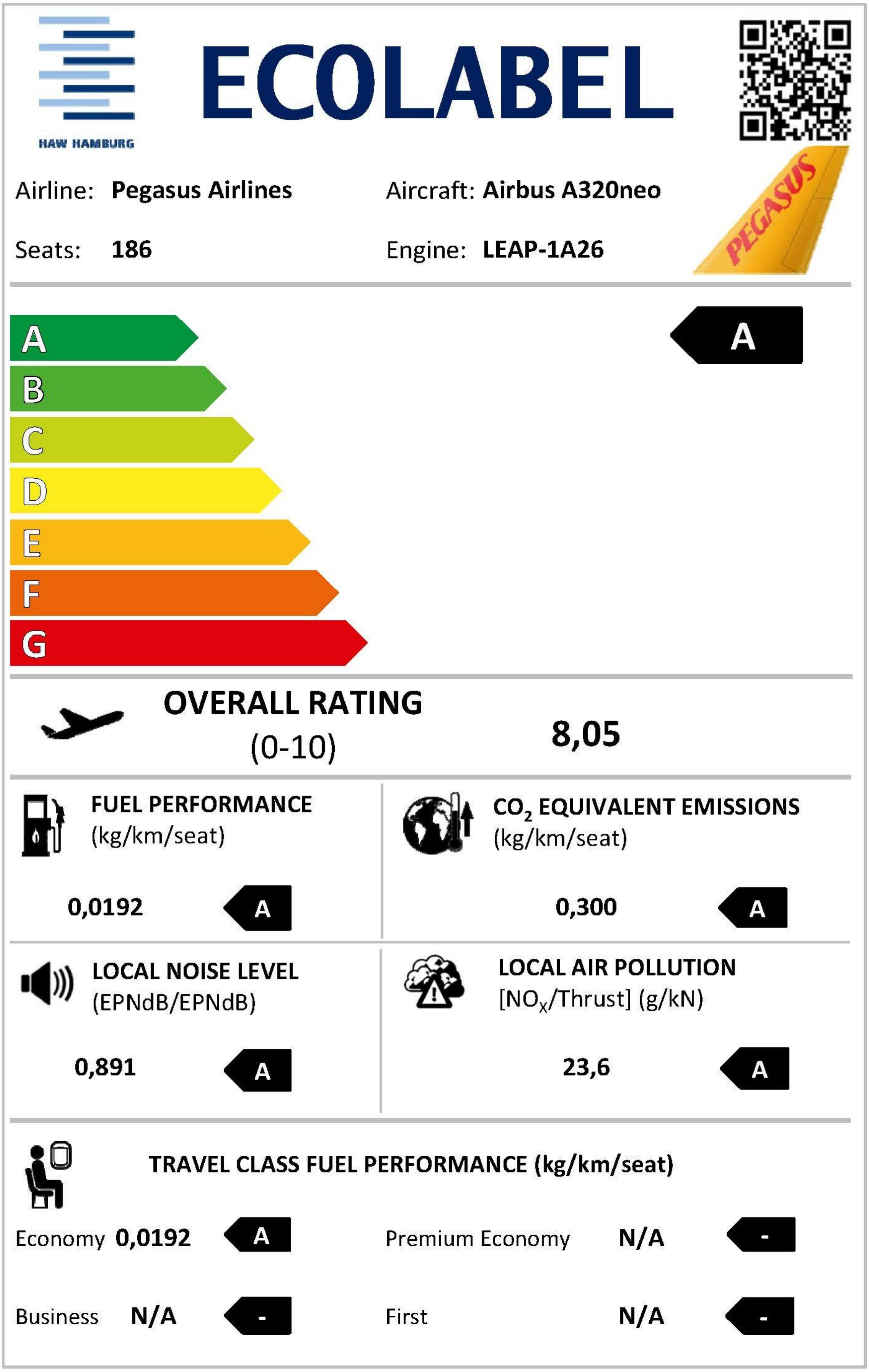

Figure C.70 Ecolabel for Airbus A320neo of Pegasus Airlines

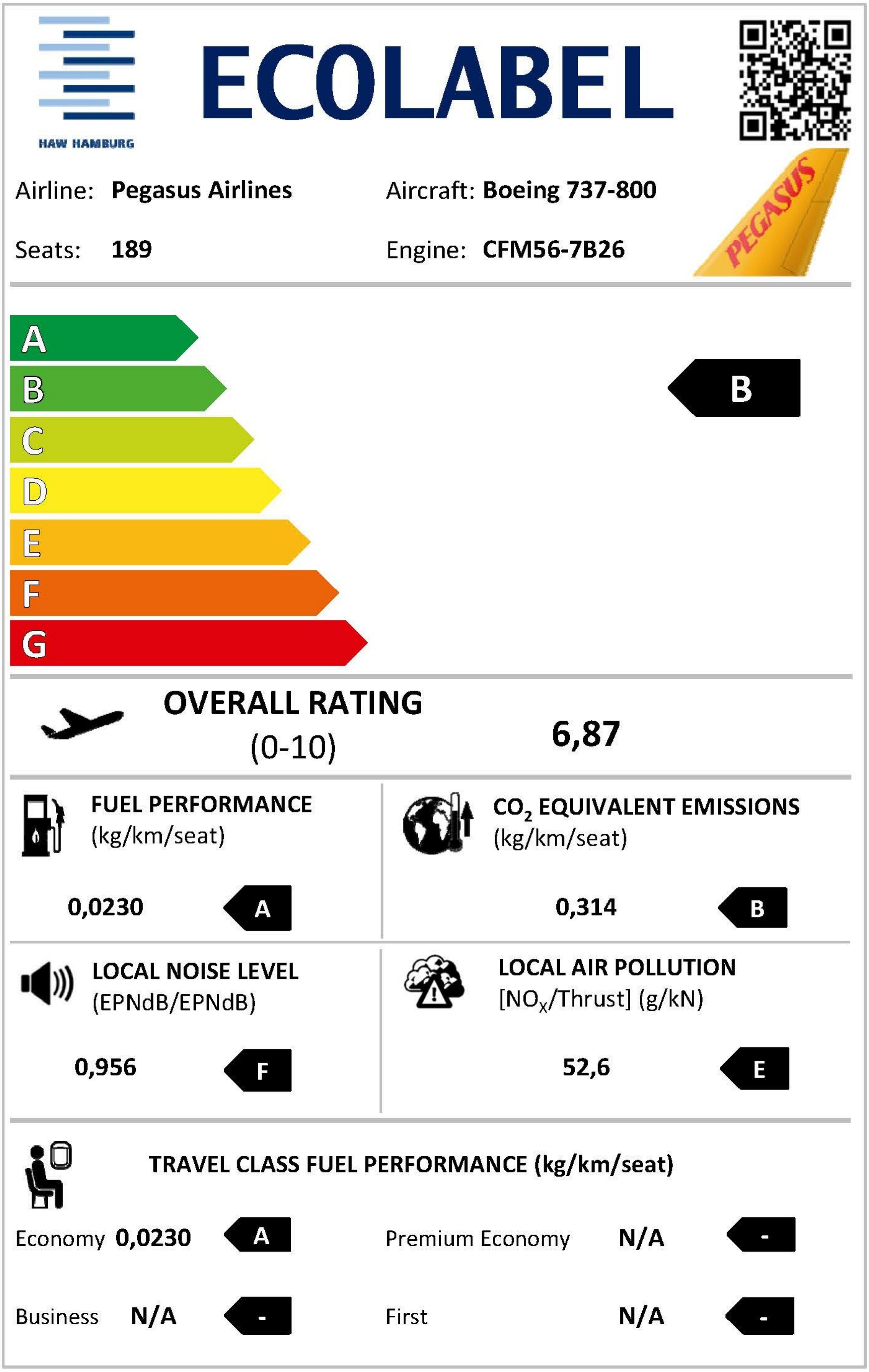

Figure C.71 Ecolabel for Boeing 737-800 of Pegasus Airlines

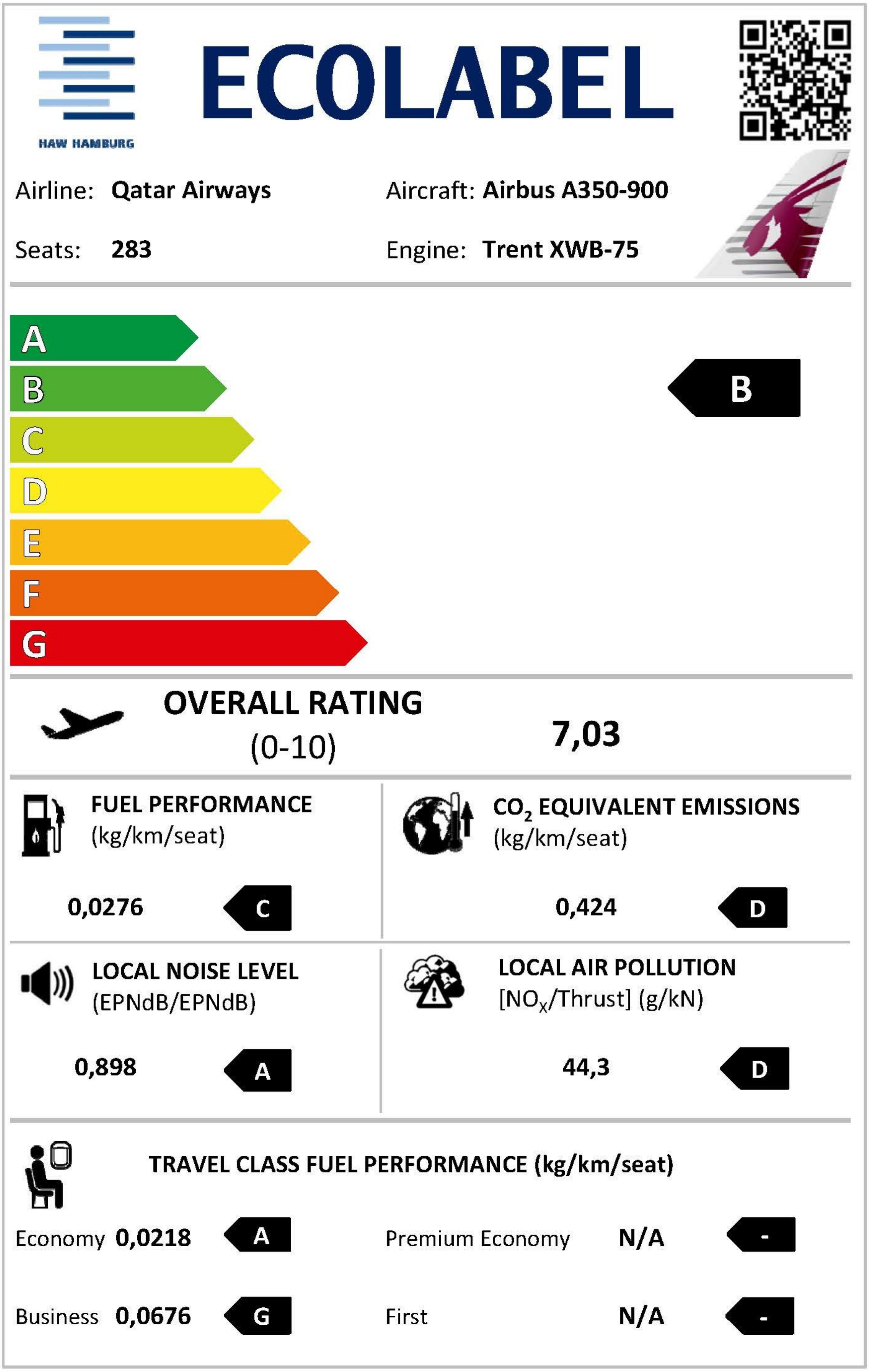

Figure C.72 Ecolabel for Airbus A350-900 of Qatar Airways

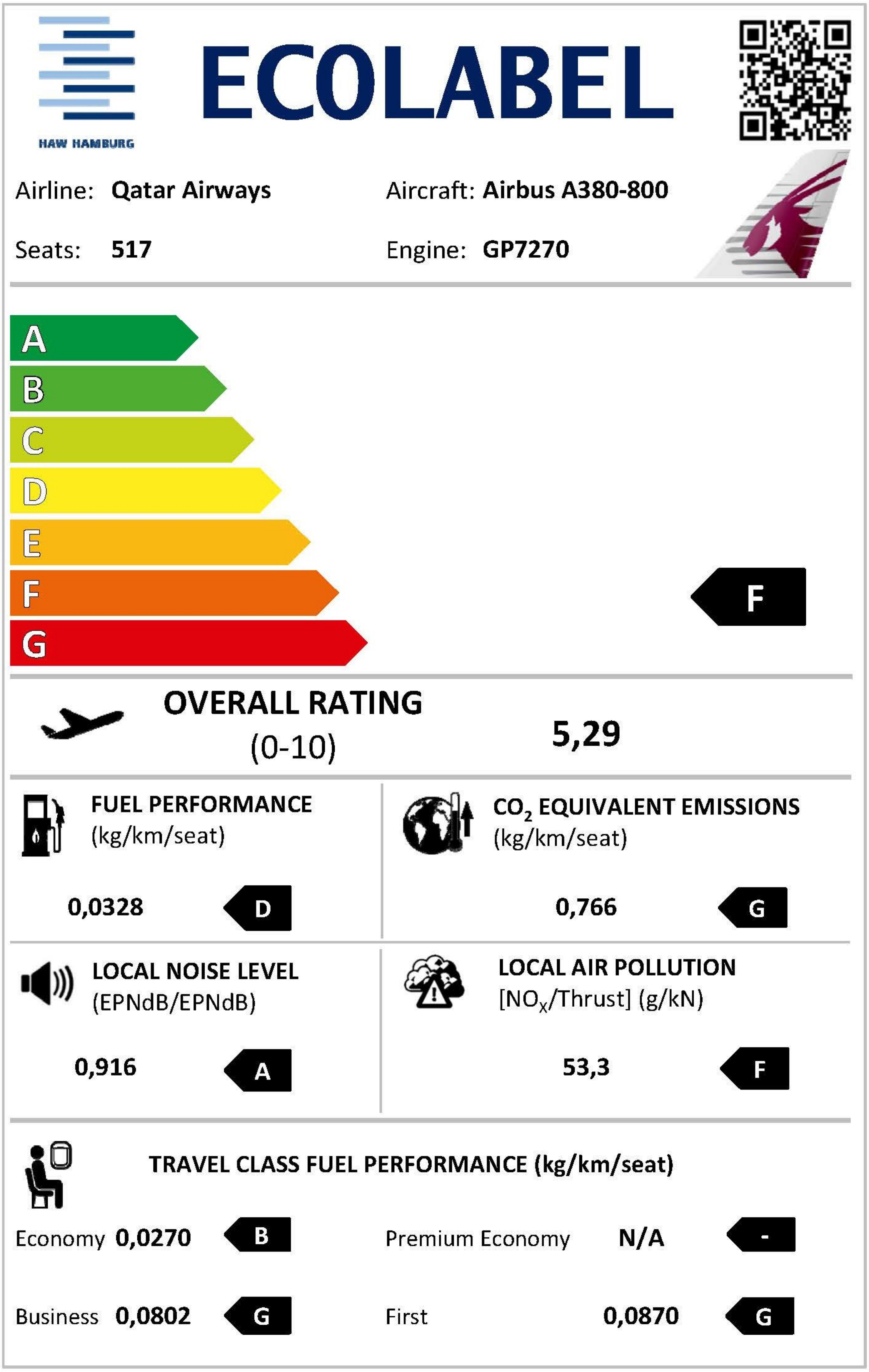

Figure C.73 Ecolabel for Airbus A380-800 of Qatar Airways

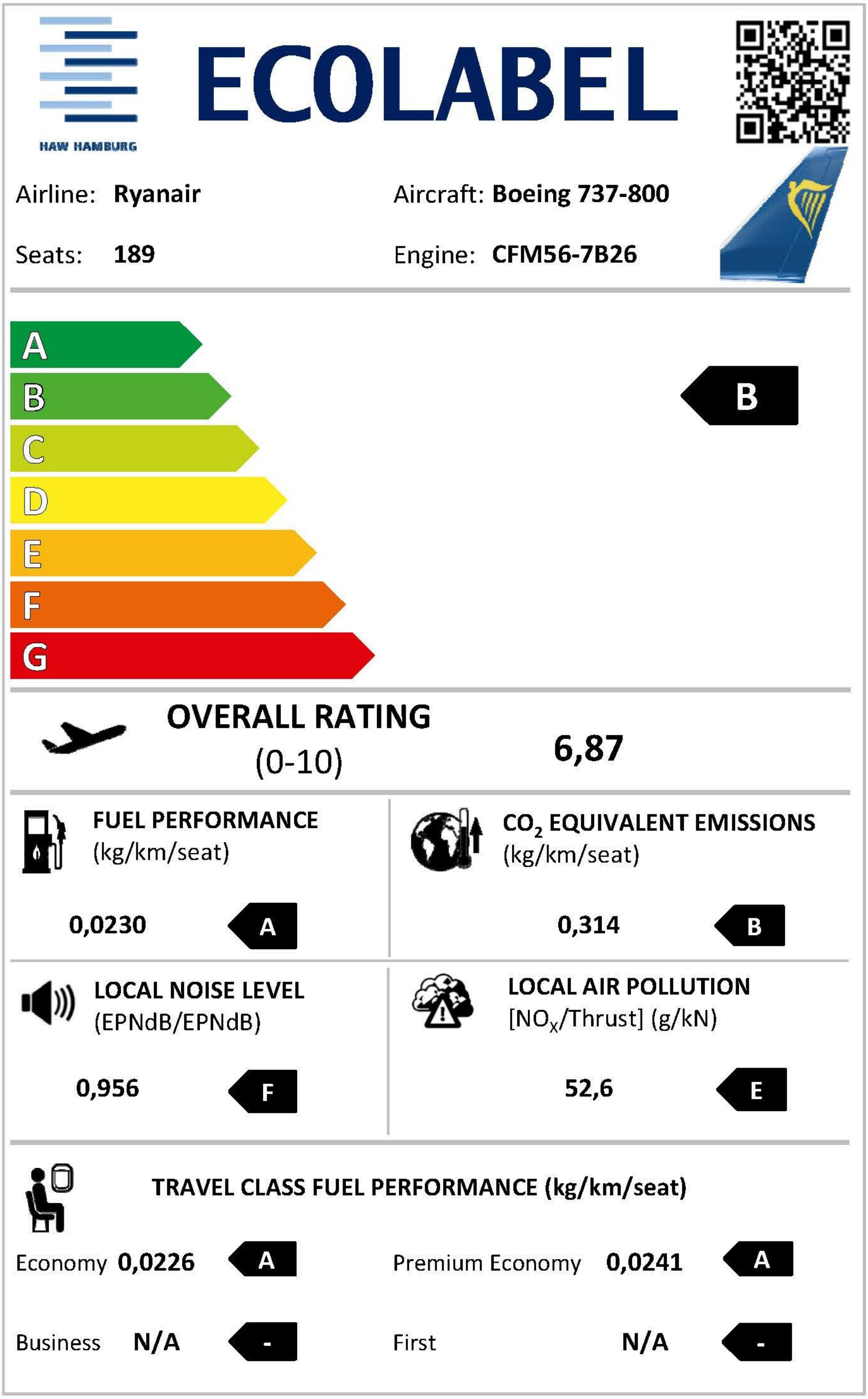

Figure C.74 Ecolabel for Boeing 737-800 of Ryanair

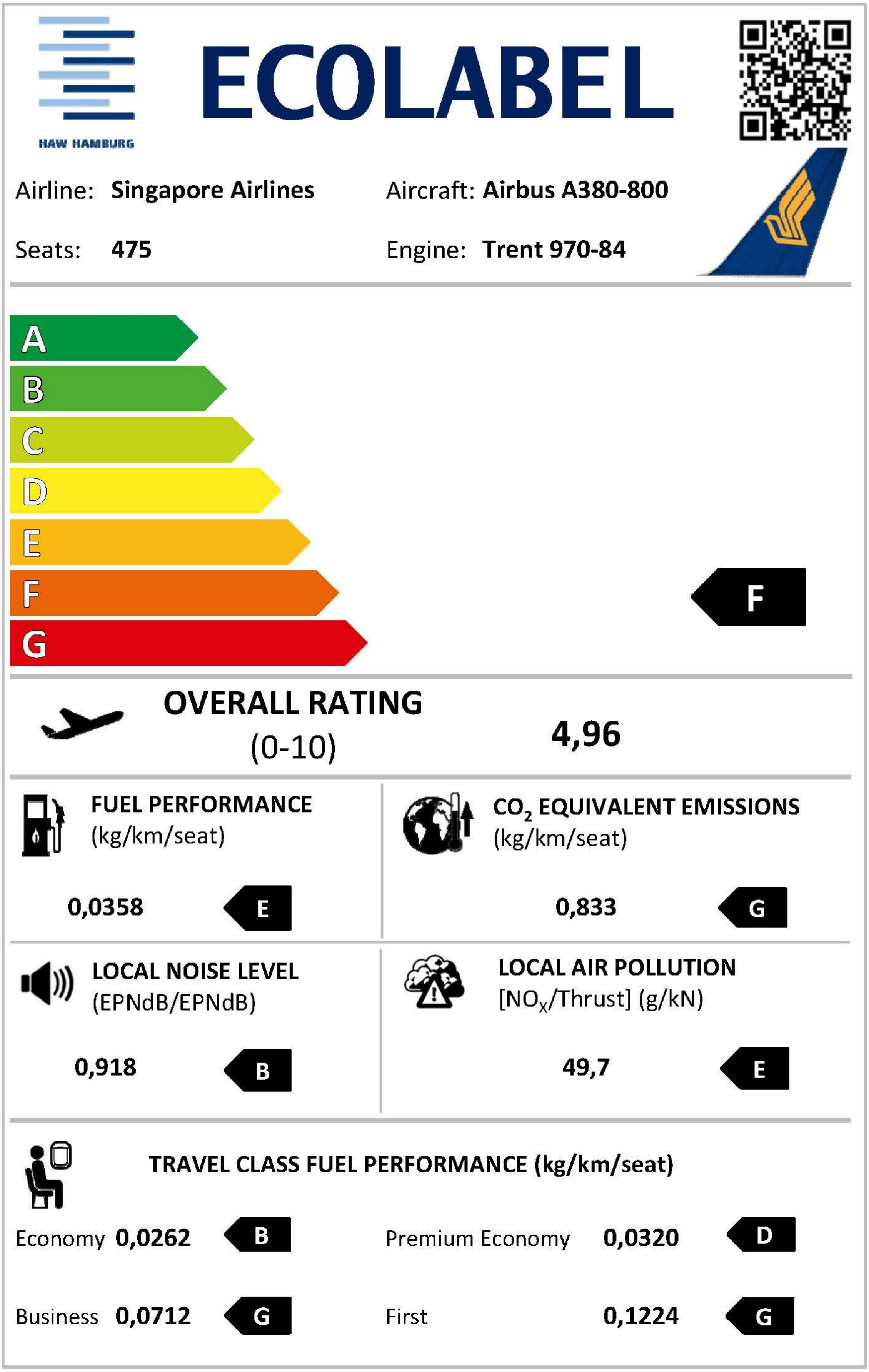

Figure C.75 Ecolabel for Airbus A380-800 of Singapore Airlines

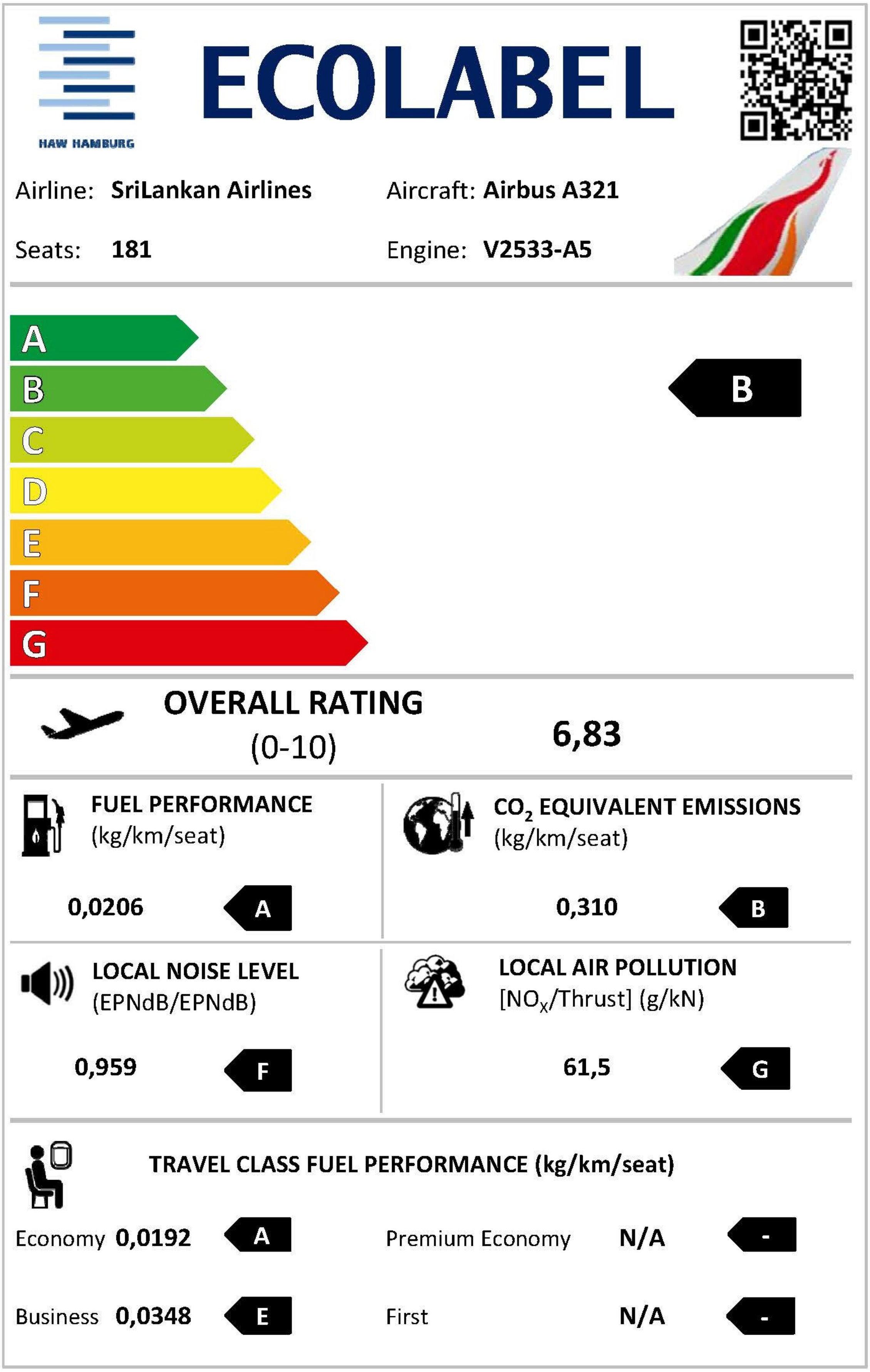

Figure C.76 Ecolabel for Airbus A321 of SriLankan Airlines

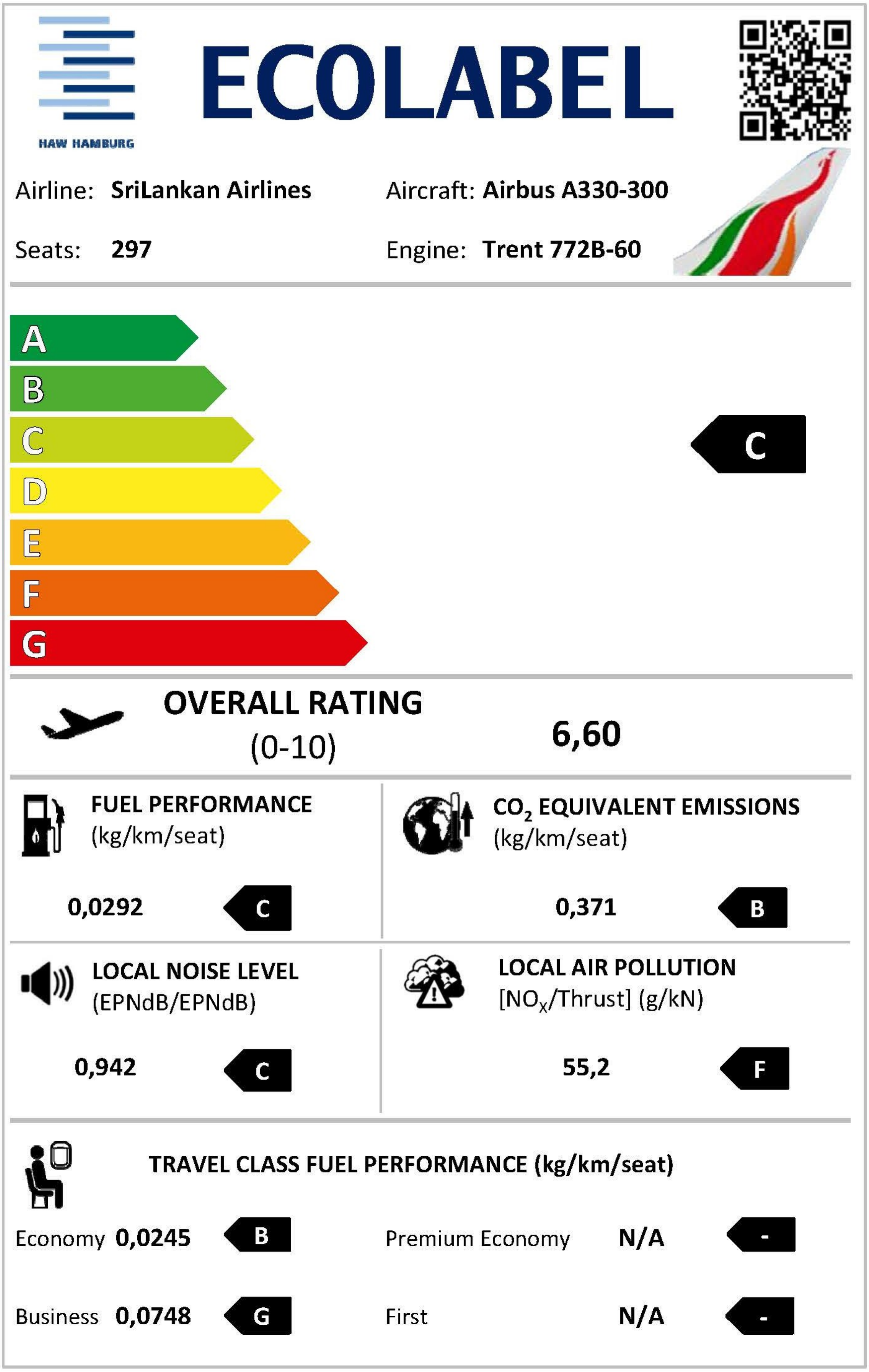

Figure C.77 Ecolabel for Airbus A330-300 of SriLankan Airlines

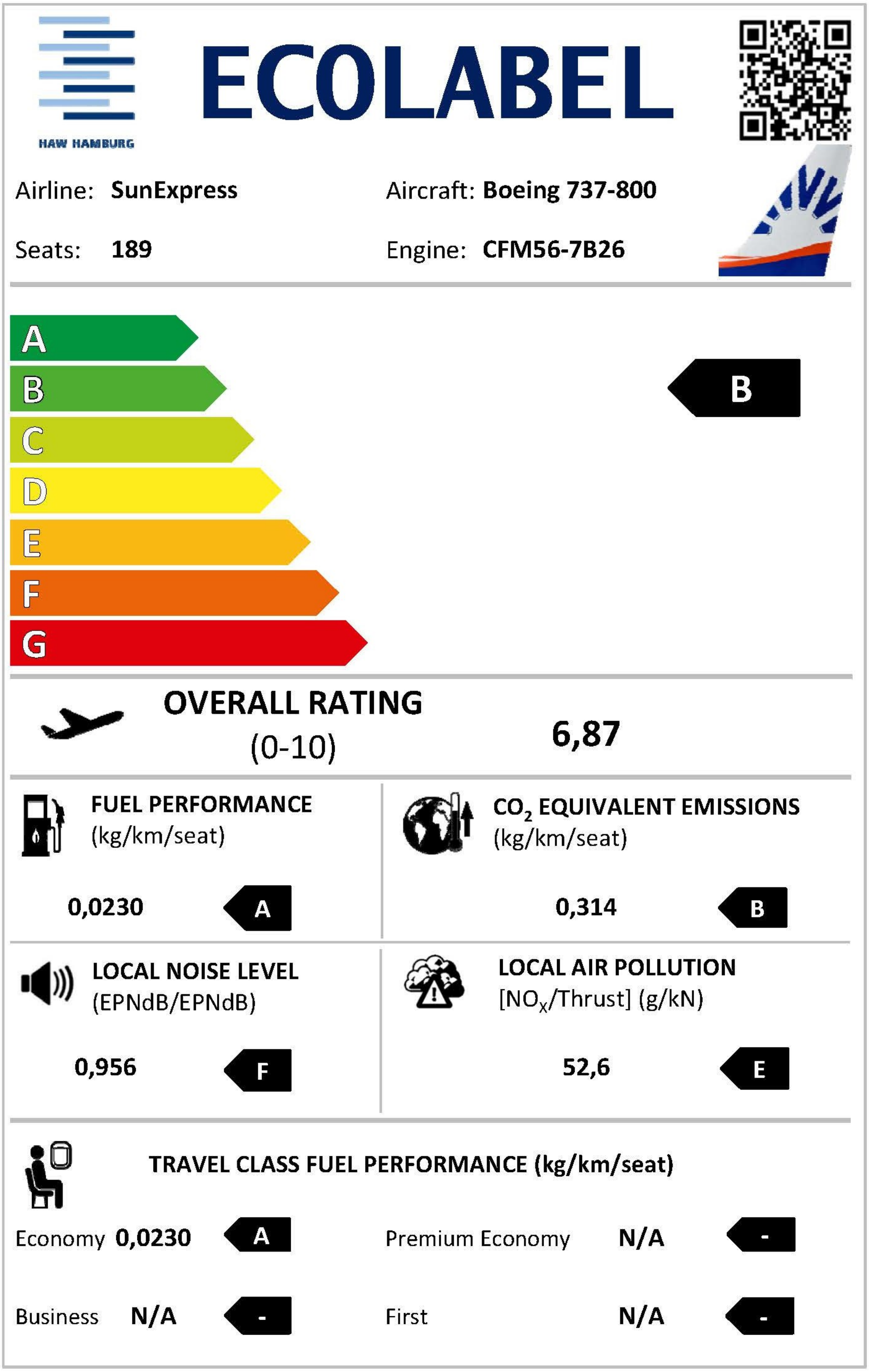

Figure C.78 Ecolabel for Boeing 737-800 of SunExpress

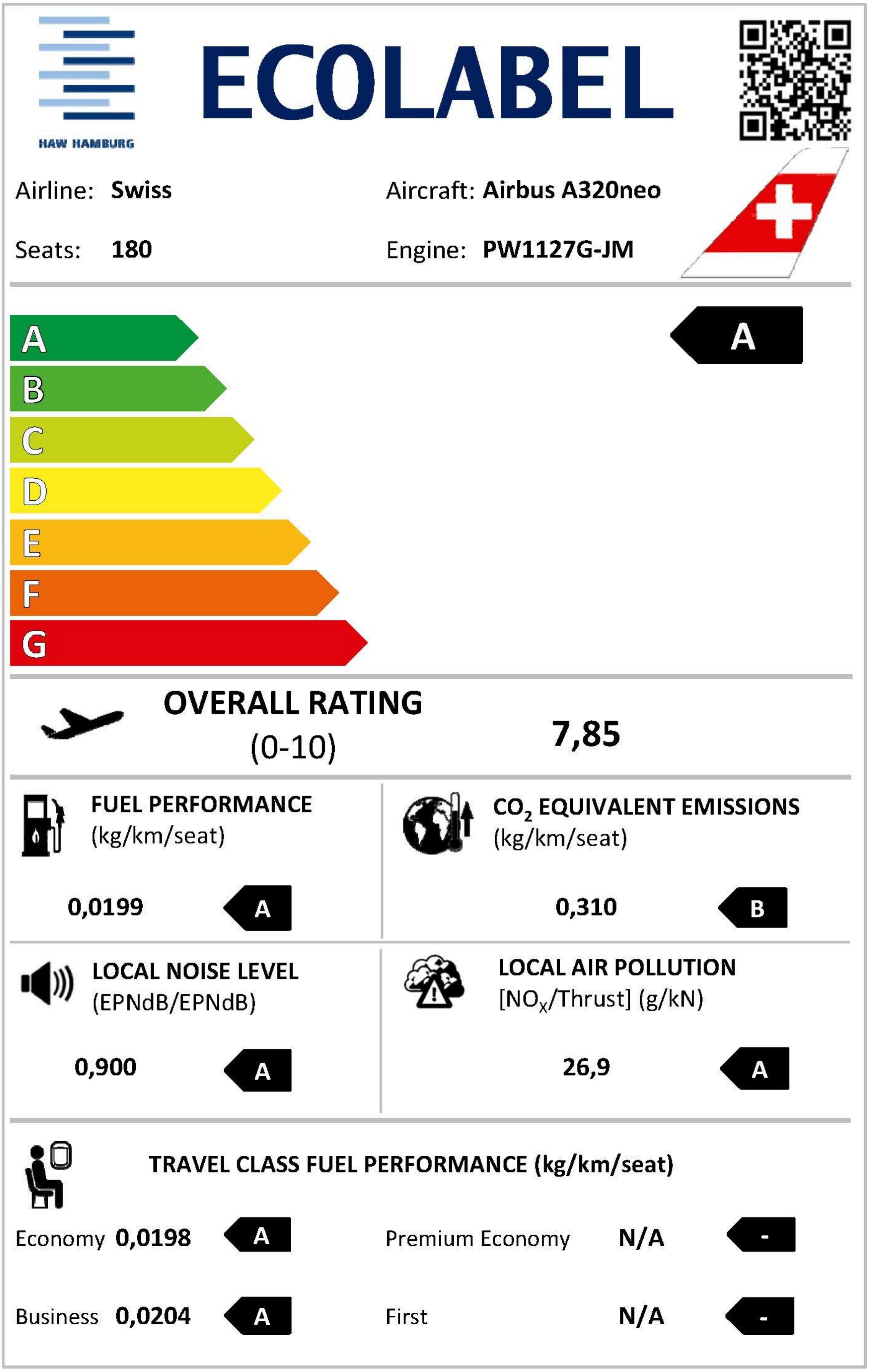

Figure C.79 Ecolabel for Airbus A320neo of Swiss

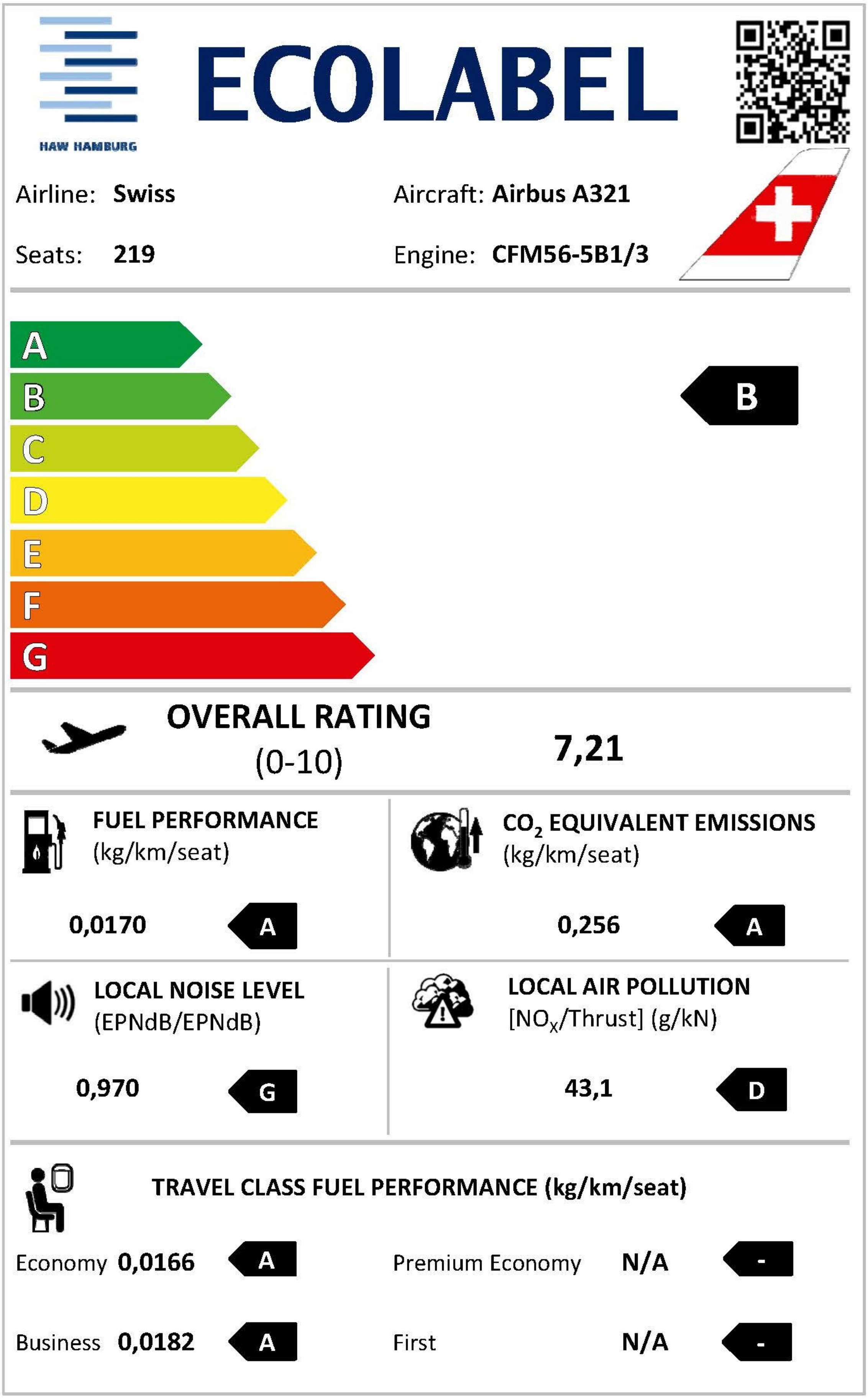

Figure C.80 Ecolabel for Airbus A321 of Swiss

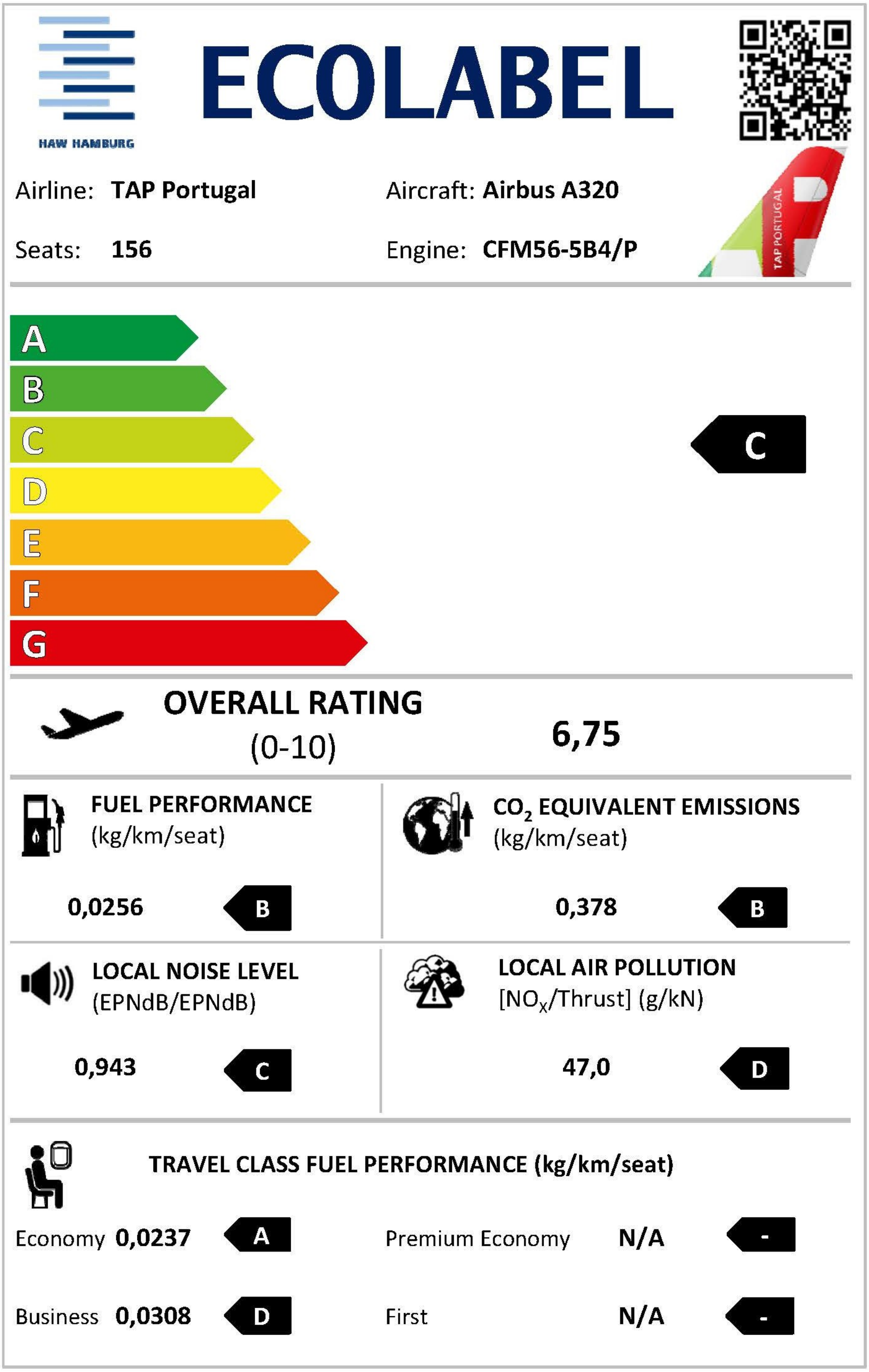

Figure C.81 Ecolabel for Airbus A320 of TAP Portugal

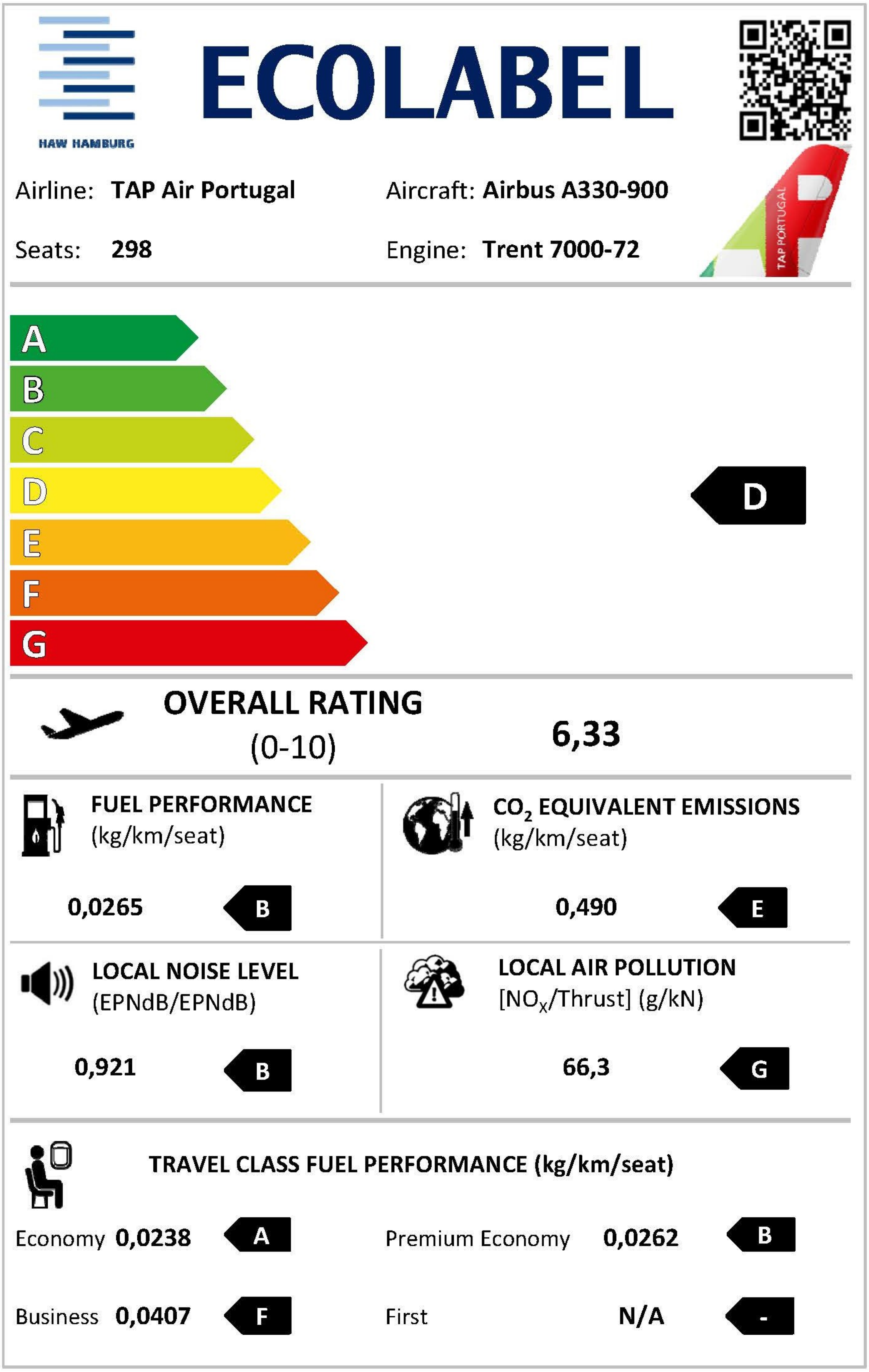

Figure C.82 Ecolabel for Airbus A330-900 of TAP Portugal

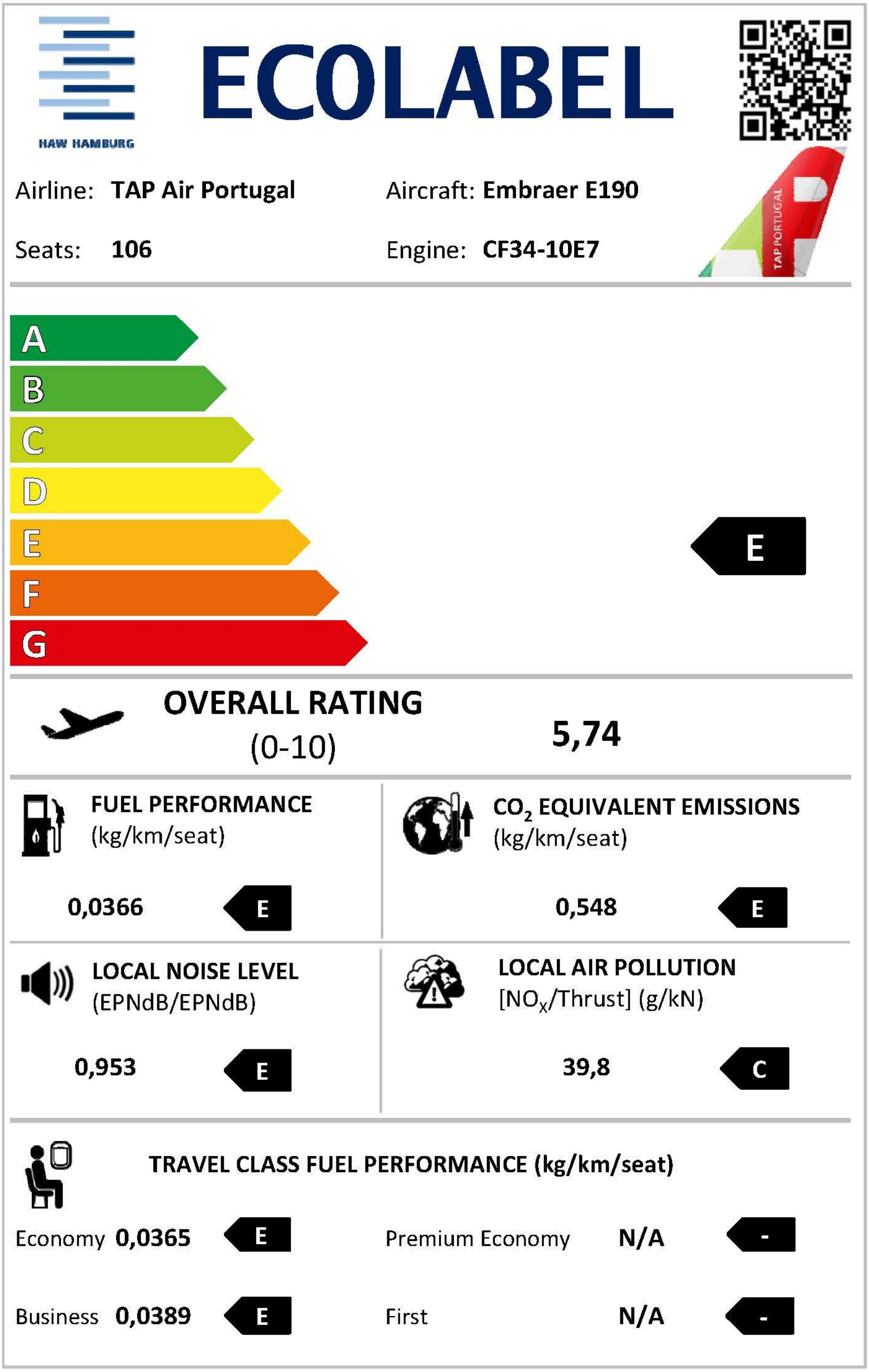

Figure C.83 Ecolabel for Embraer E190 of TAP Portugal

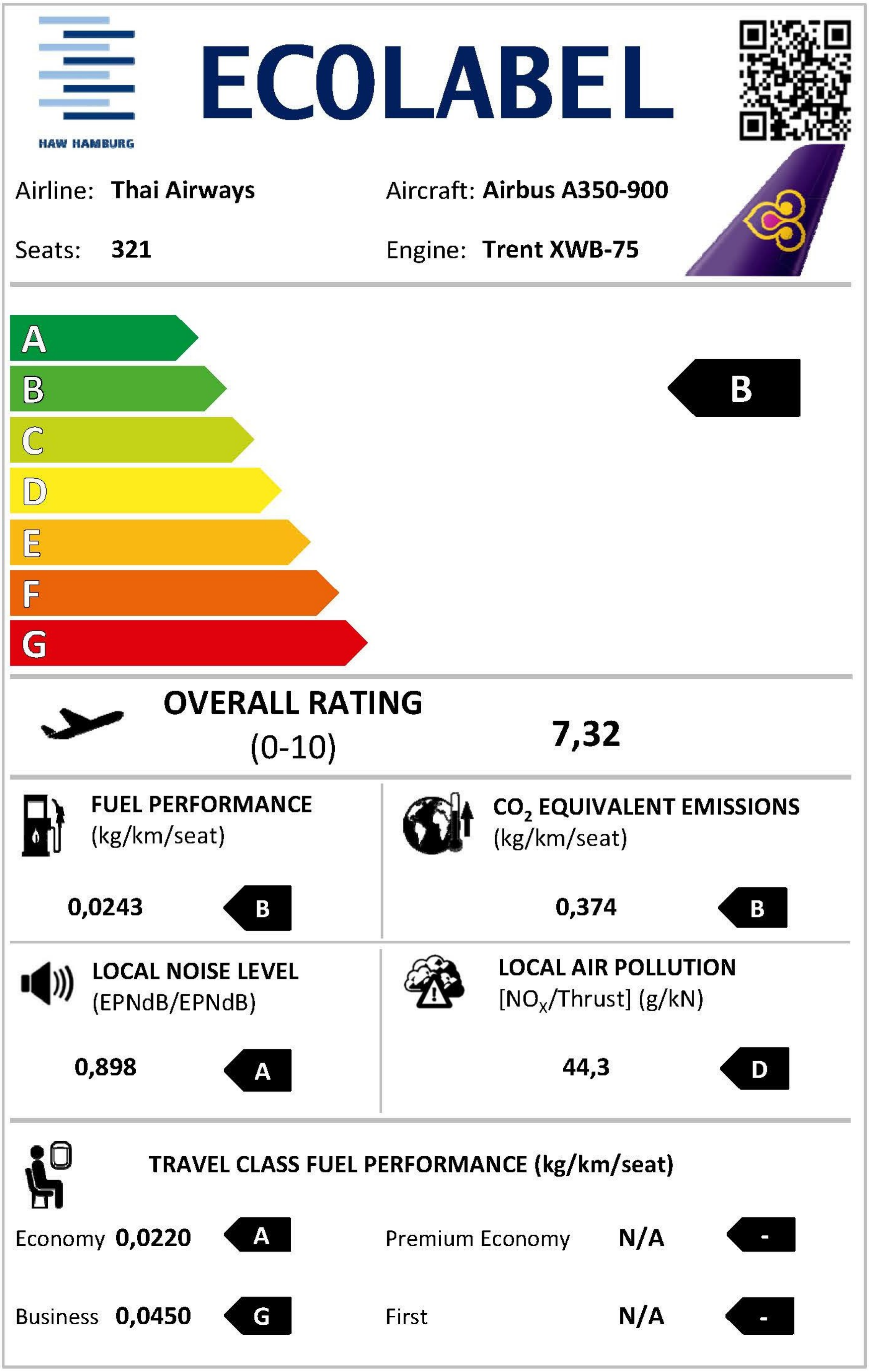

Figure C.84 Ecolabel for Airbus A350-900 of Thai Airways

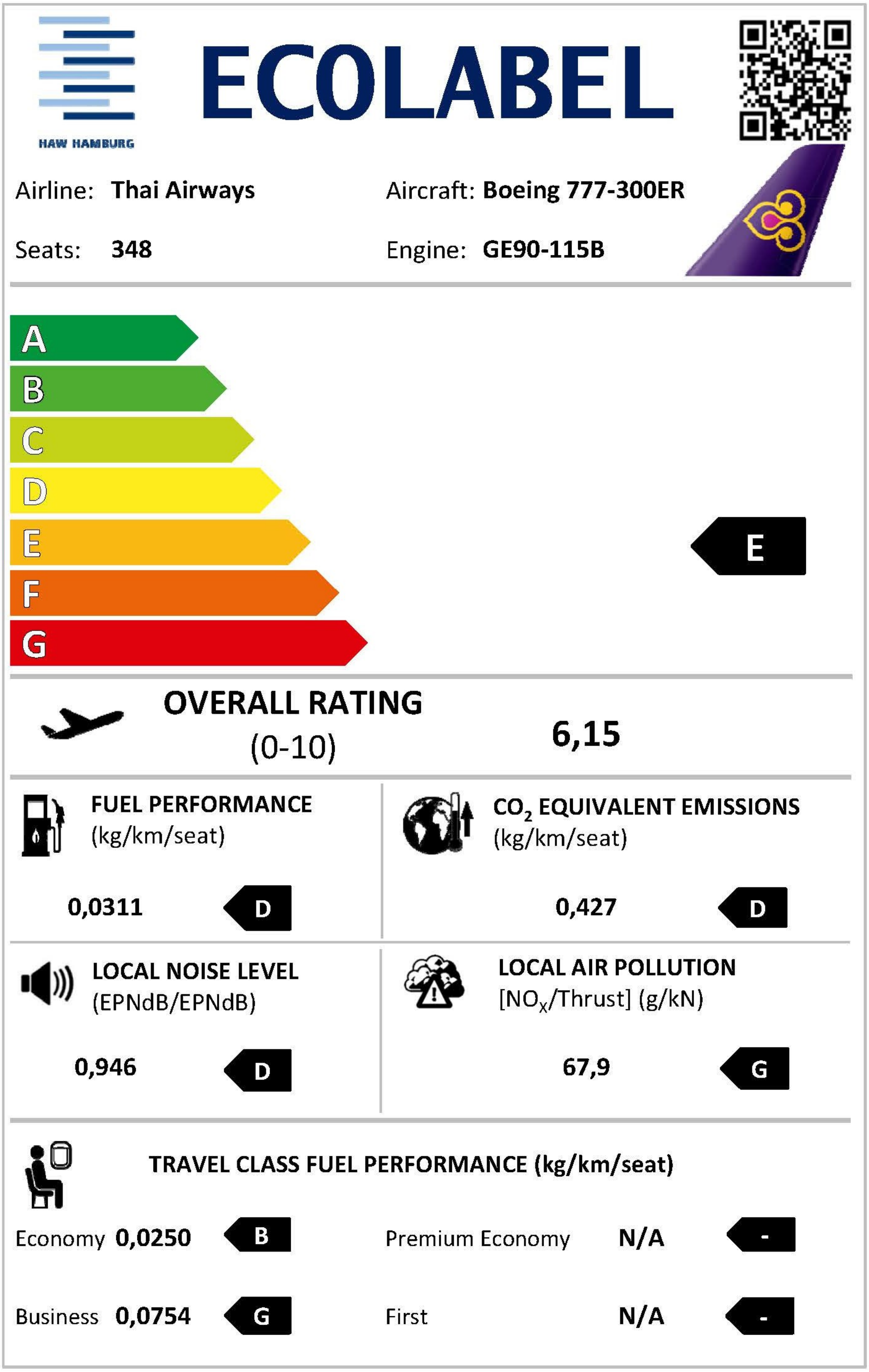

Figure C.85 Ecolabel for Boeing 777-300ER of Thai Airways

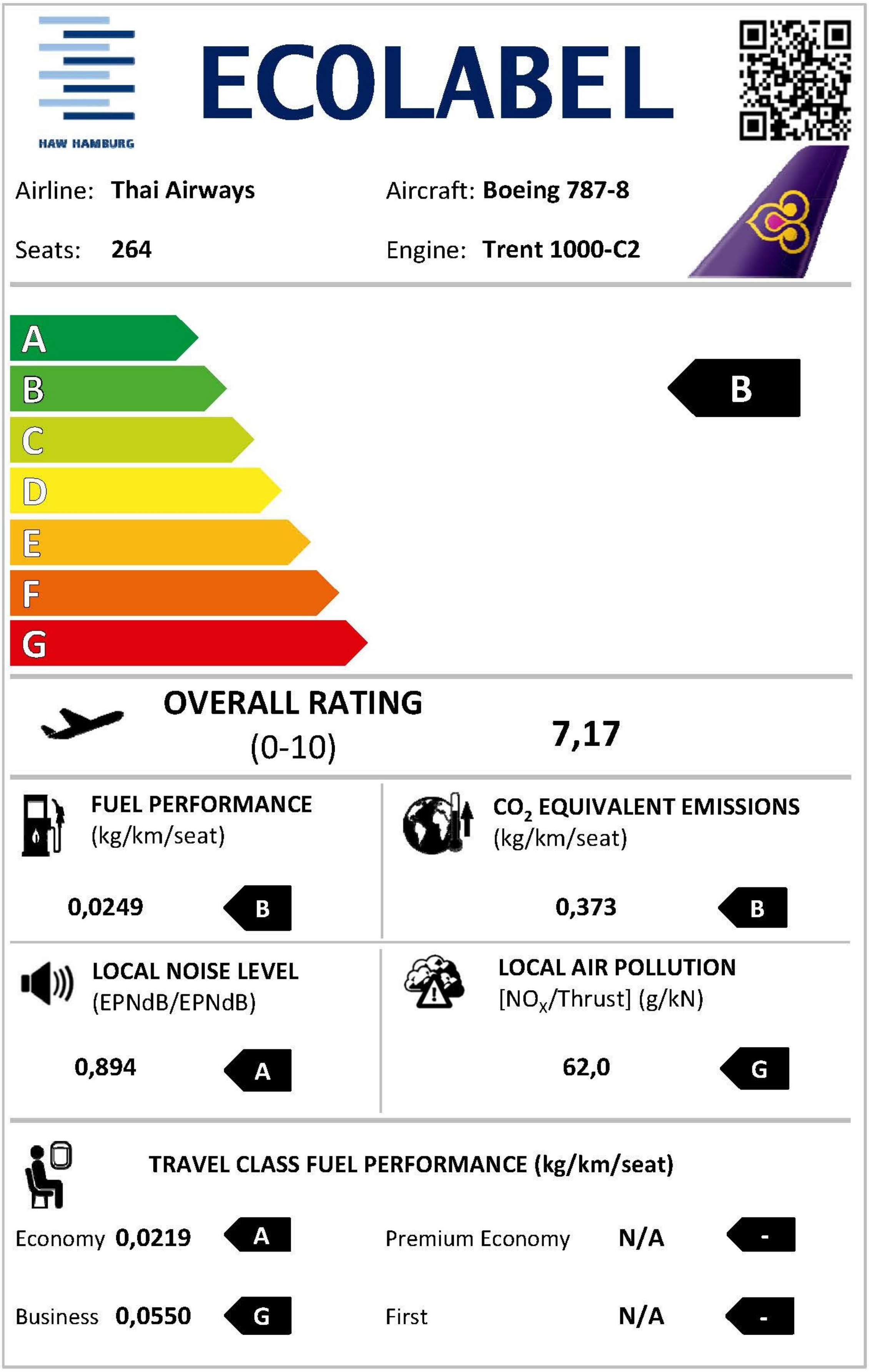

Figure C.86 Ecolabel for Boeing 787-8 of Thai Airways

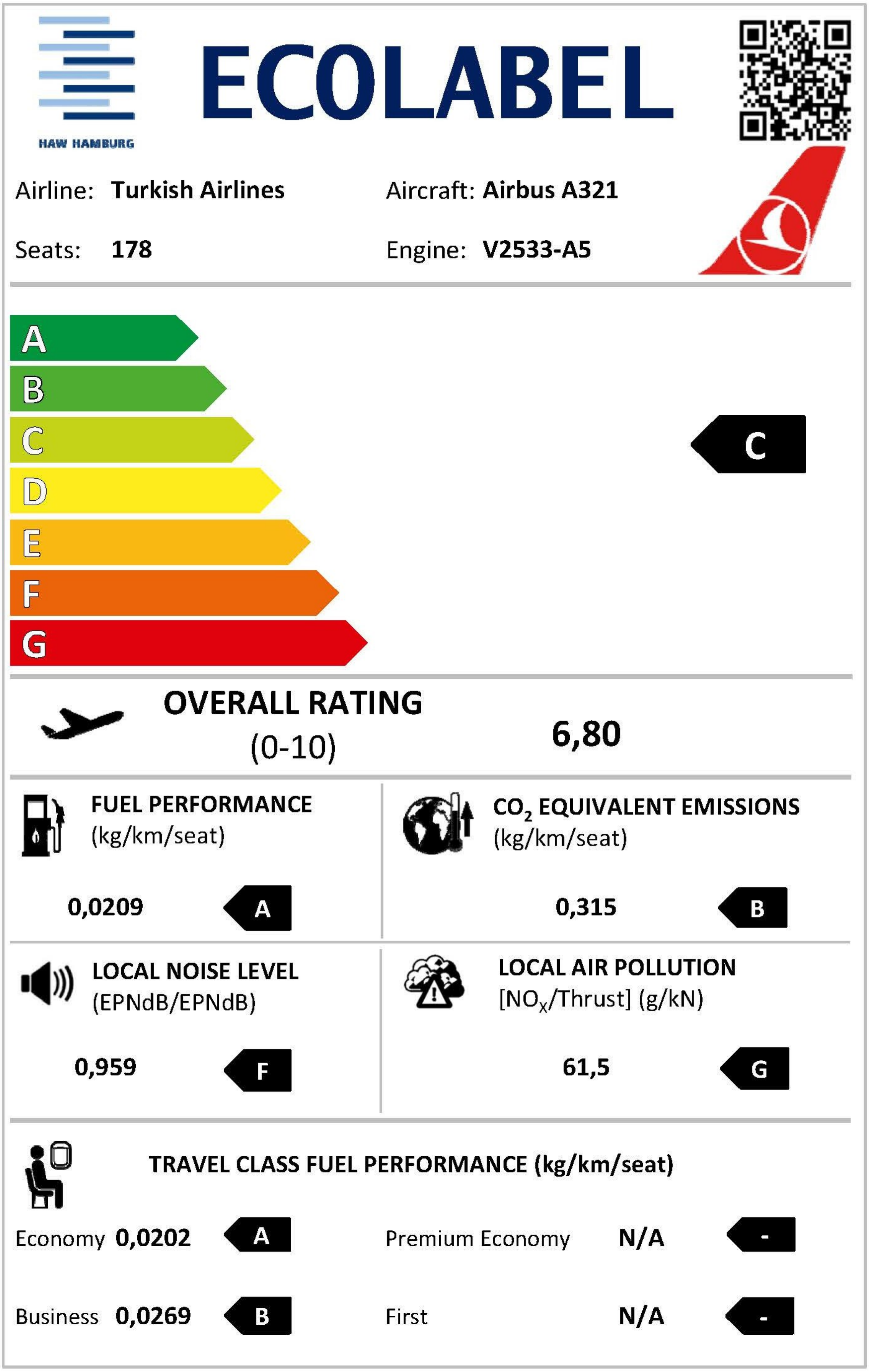

Figure C.87 Ecolabel for Airbus A321 of Turkish Airlines

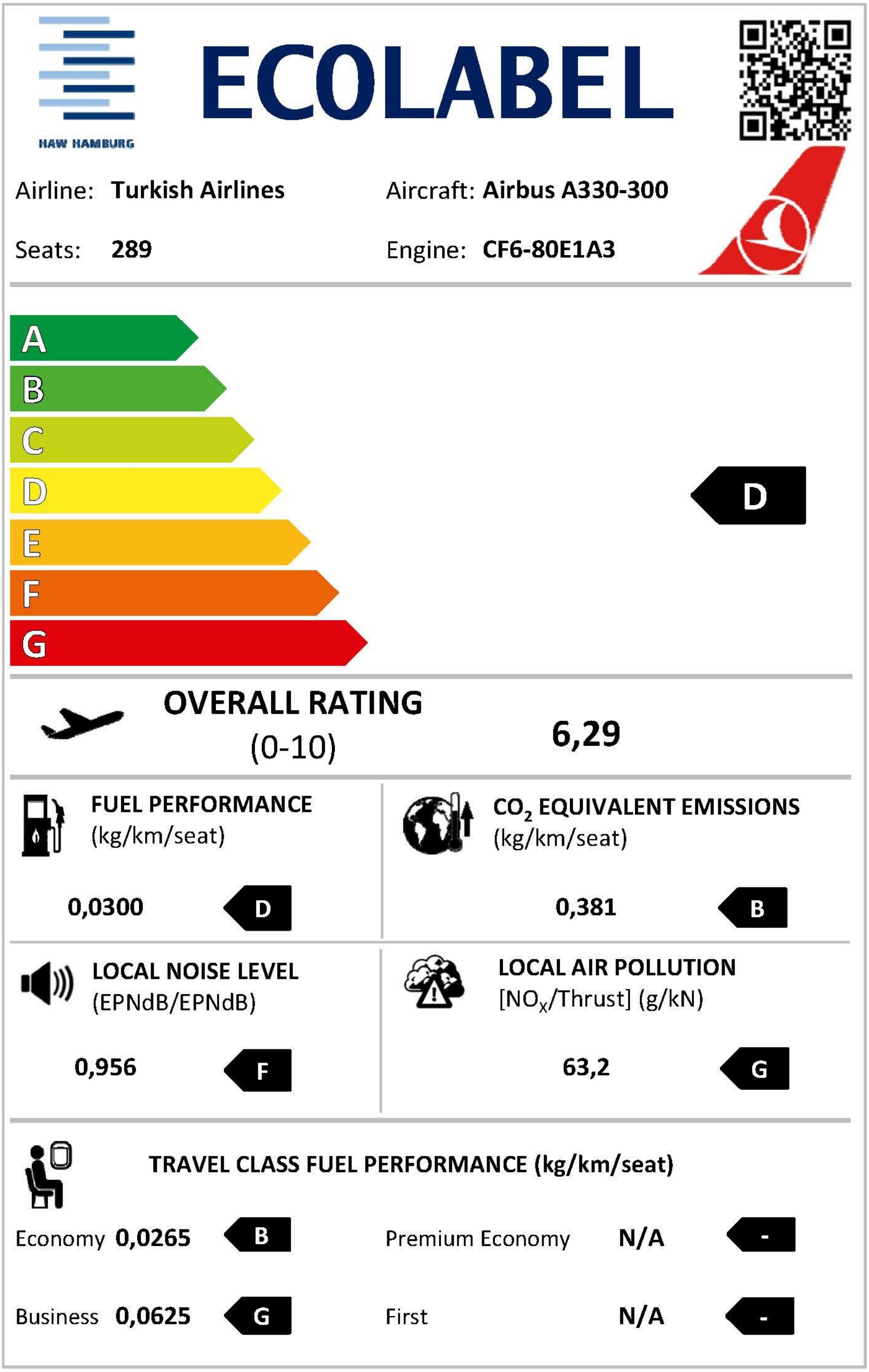

Figure C.88 Ecolabel for Airbus A330-300 of Turkish Airlines

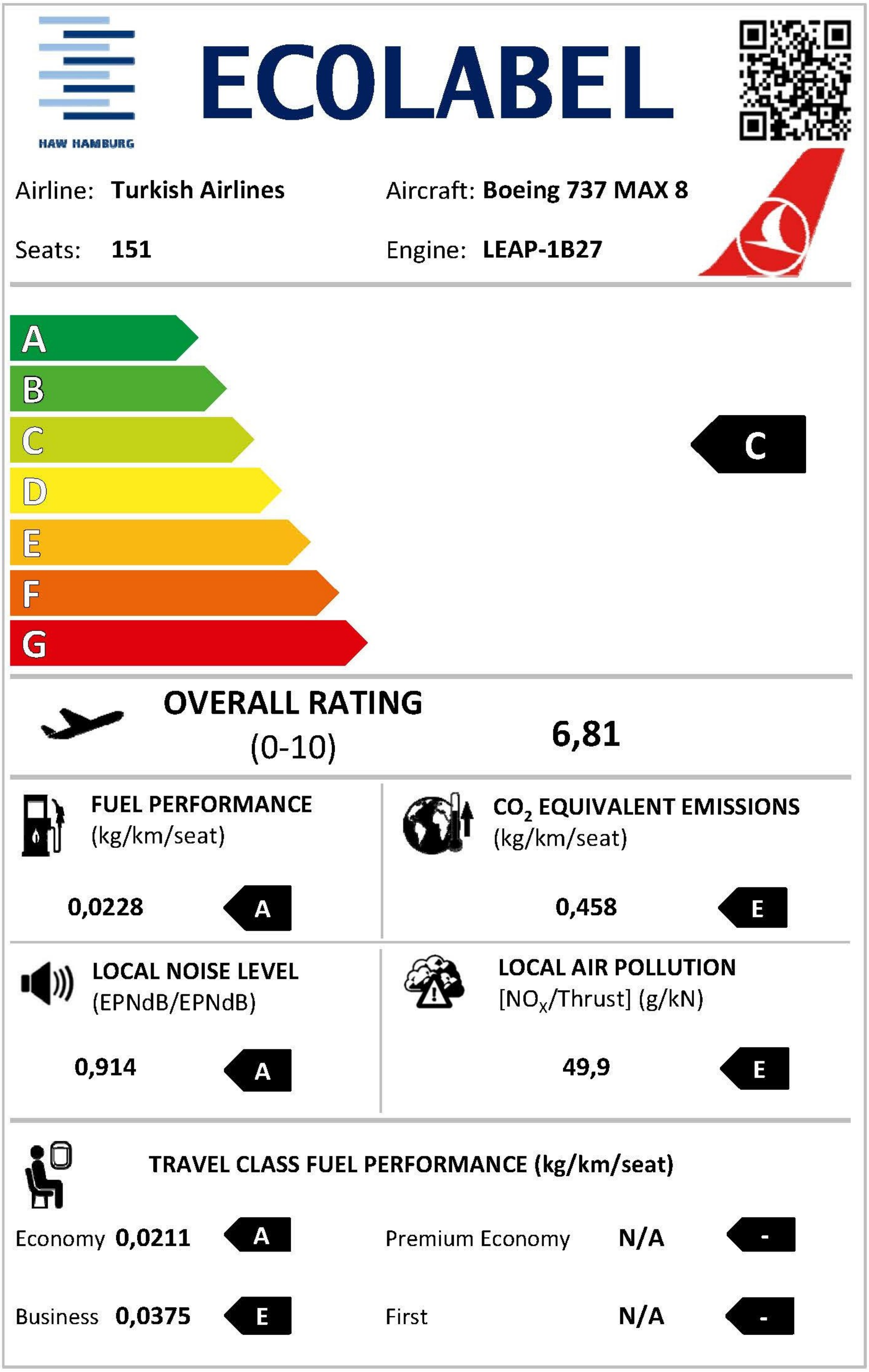

Figure C.89 Ecolabel for Boeing 737 MAX 8 of Turkish Airlines

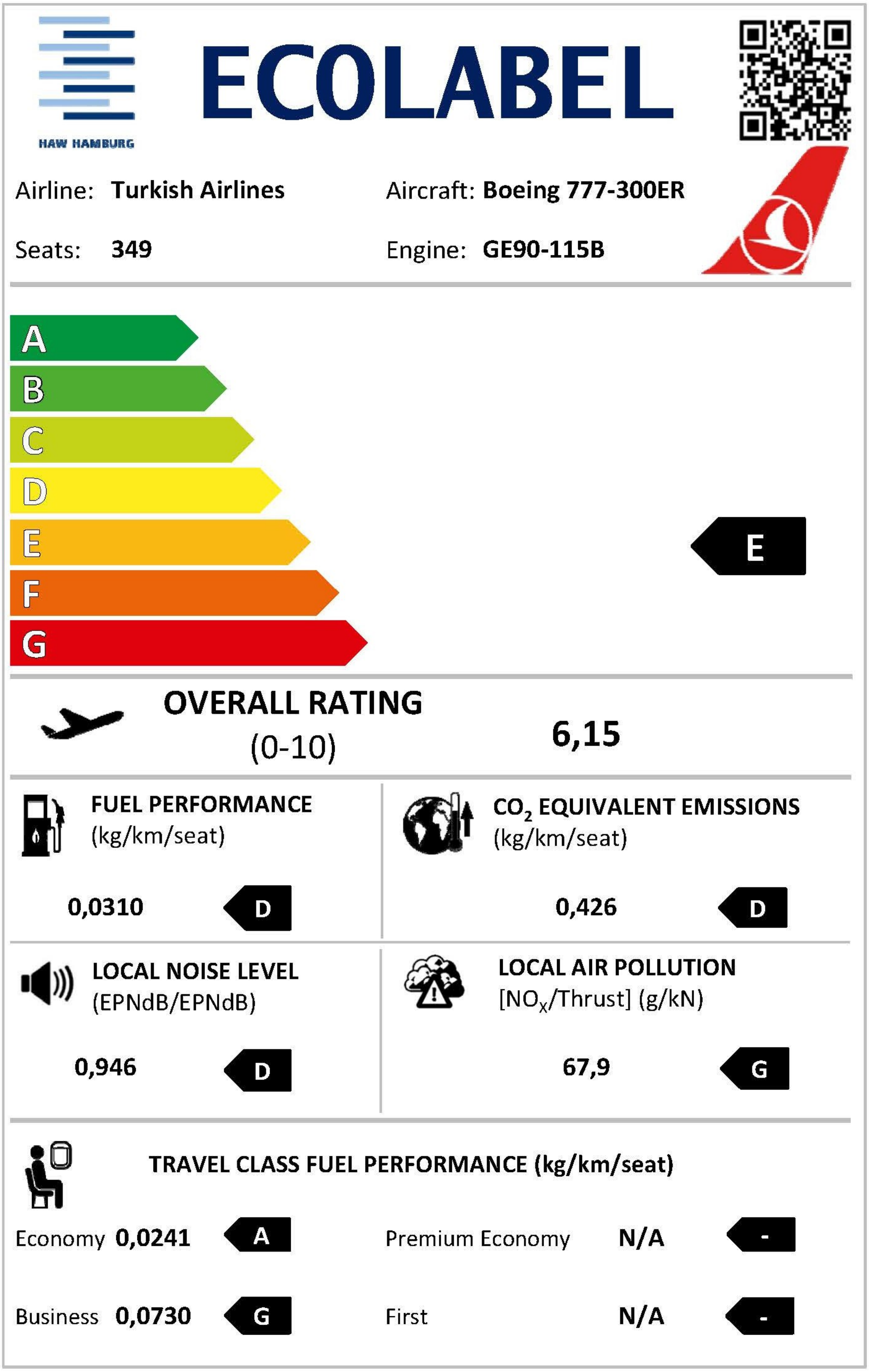

Figure C.90 Ecolabel for Boeing 777-300ER of Turkish Airlines

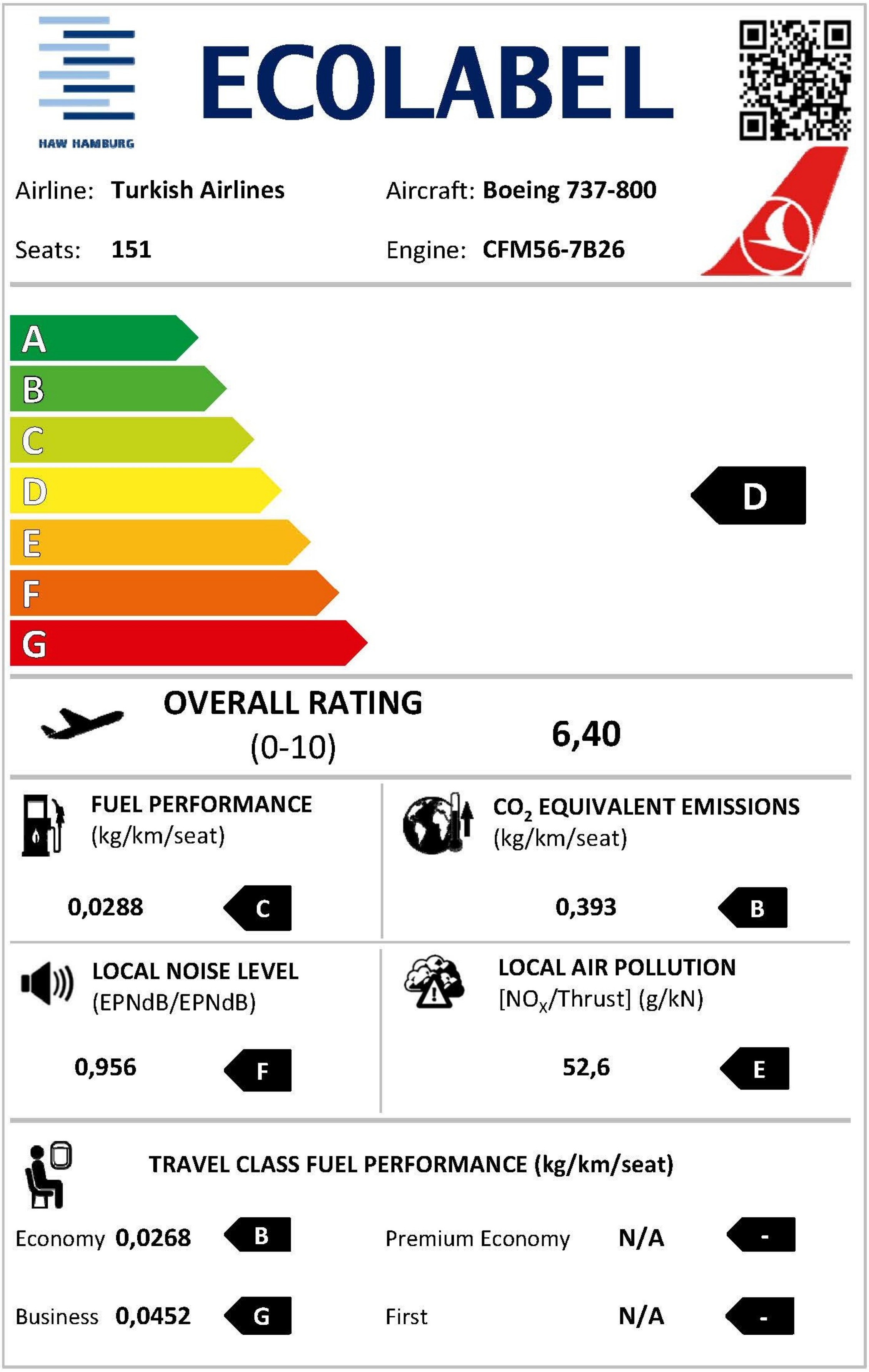

Figure C.91 Ecolabel for Boeing 737-800 of Turkish Airlines

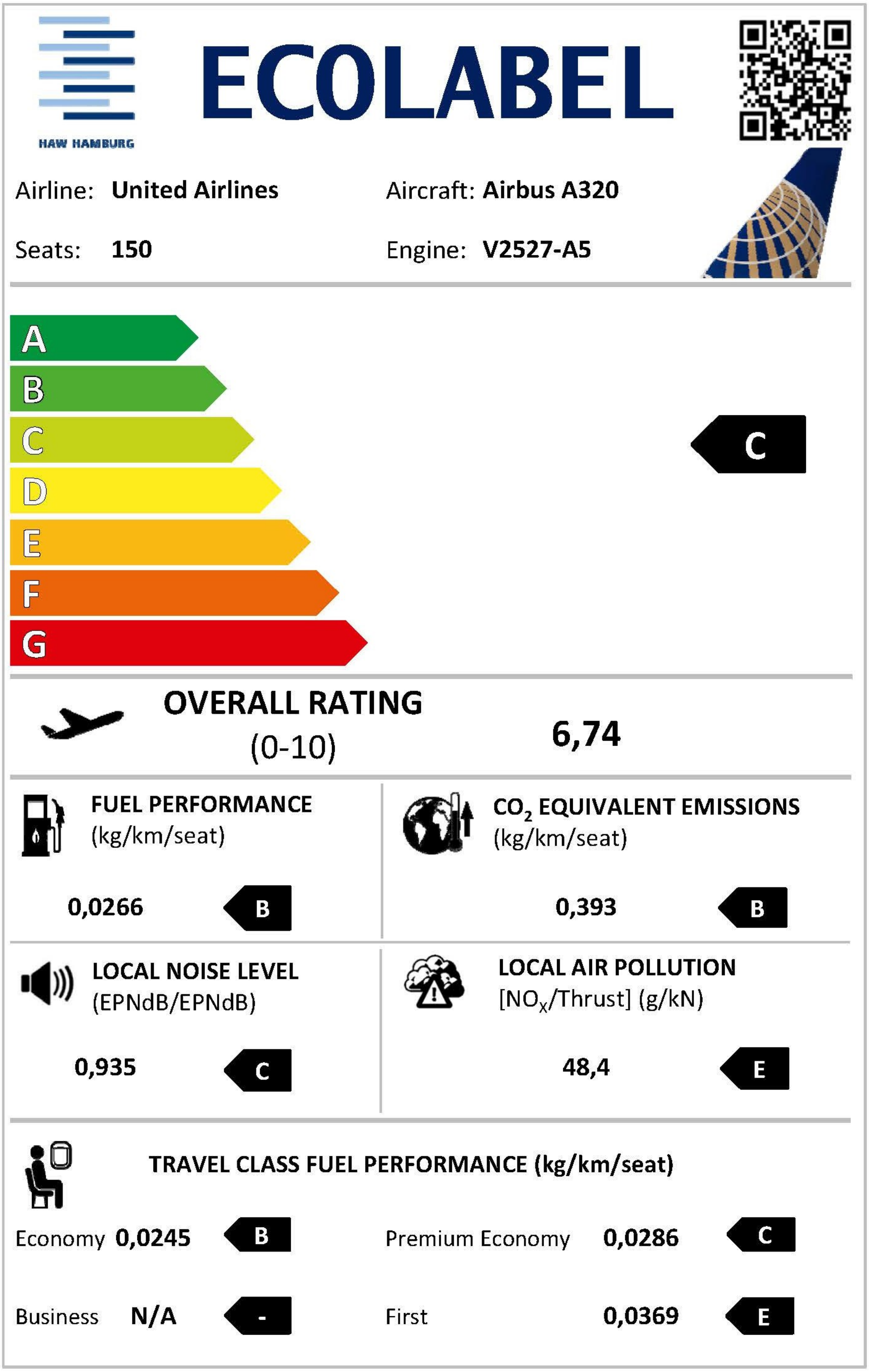

Figure C.92 Ecolabel for Airbus A320 of United Airlines

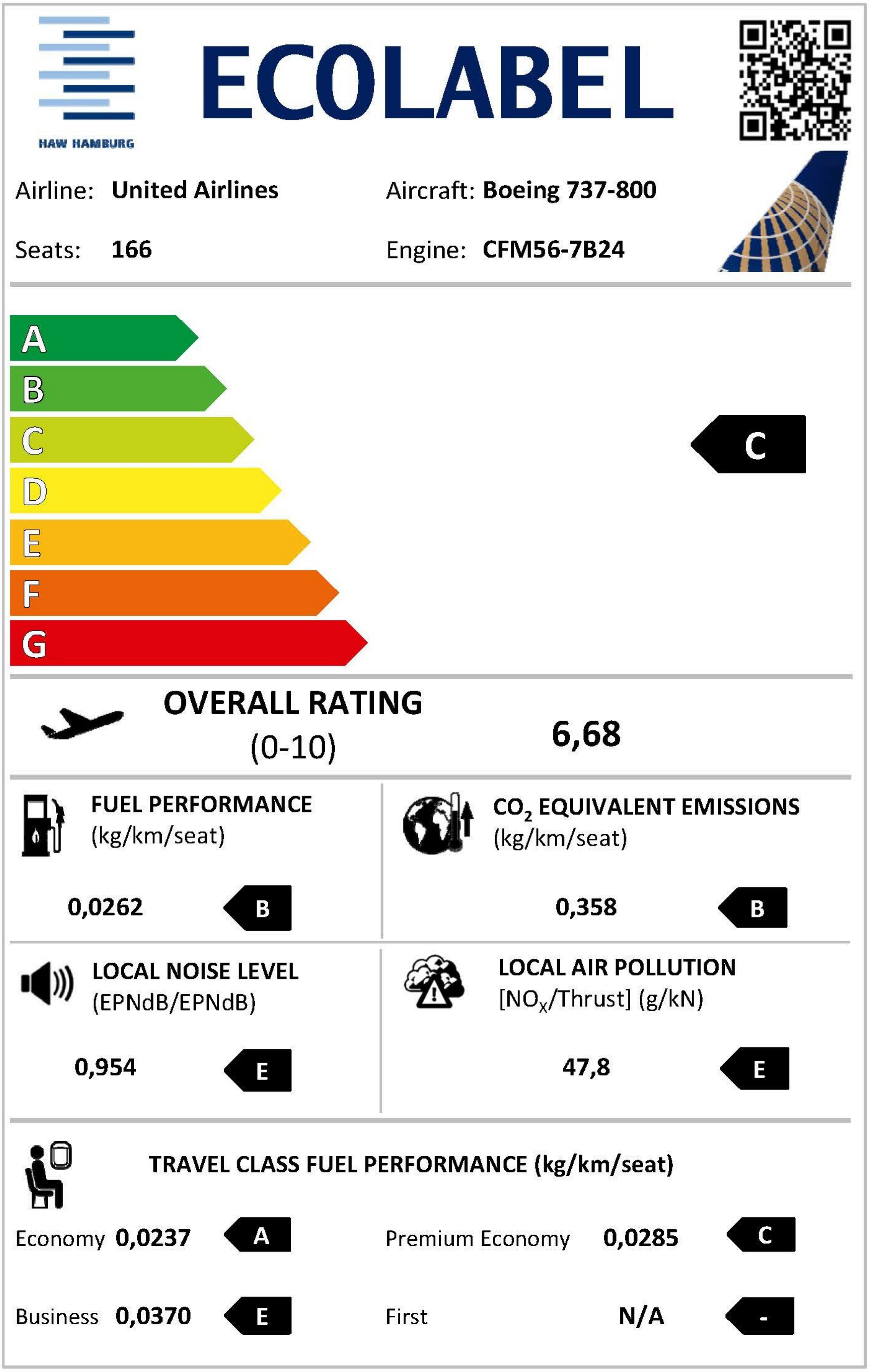

Figure C.93 Ecolabel for Boeing 737-800 of United Airlines

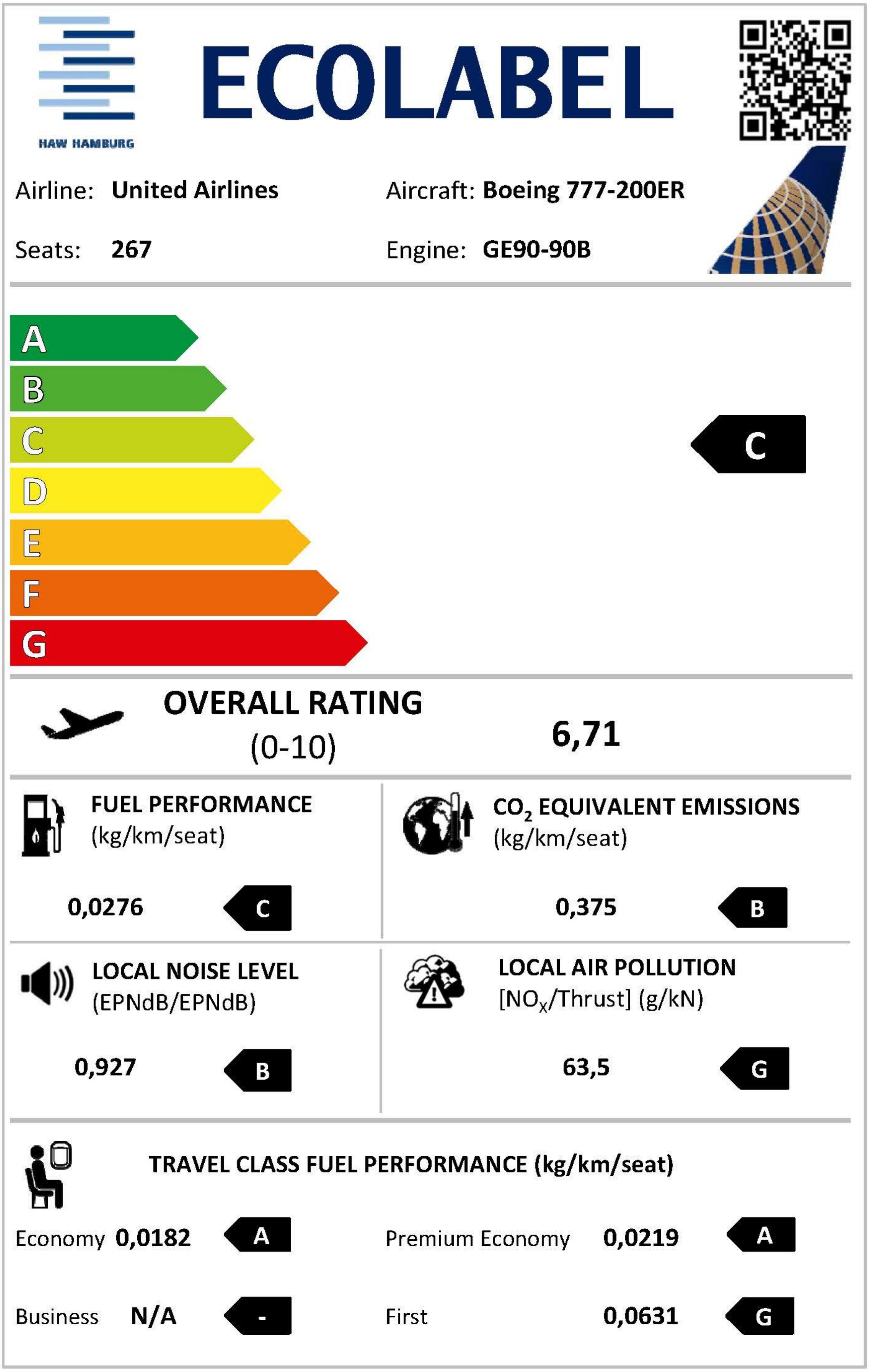

Figure C.94 Ecolabel for Boeing 777-200ER of United Airlines

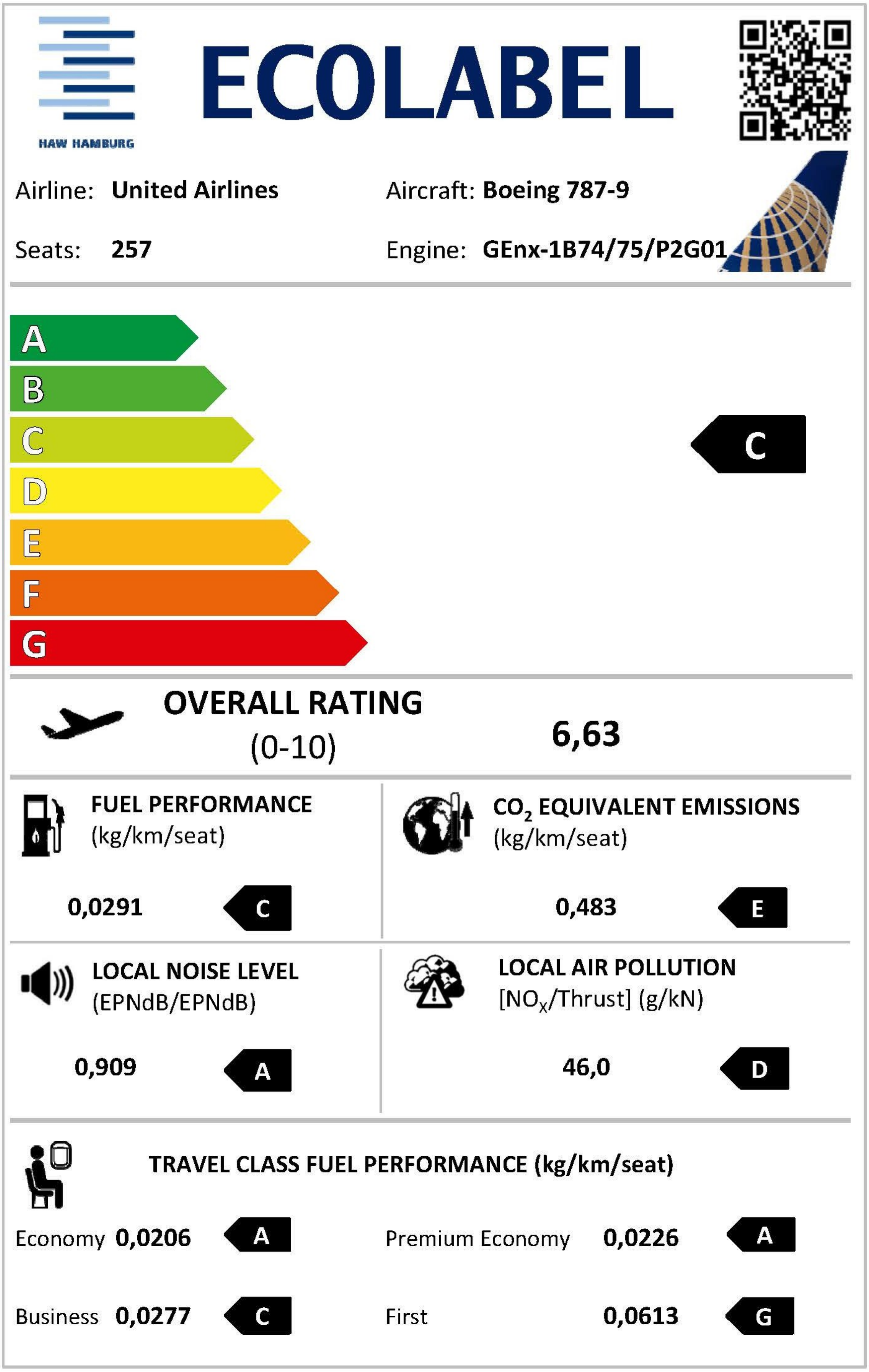

Figure C.95 Ecolabel for Boeing 787-9 of United Airlines

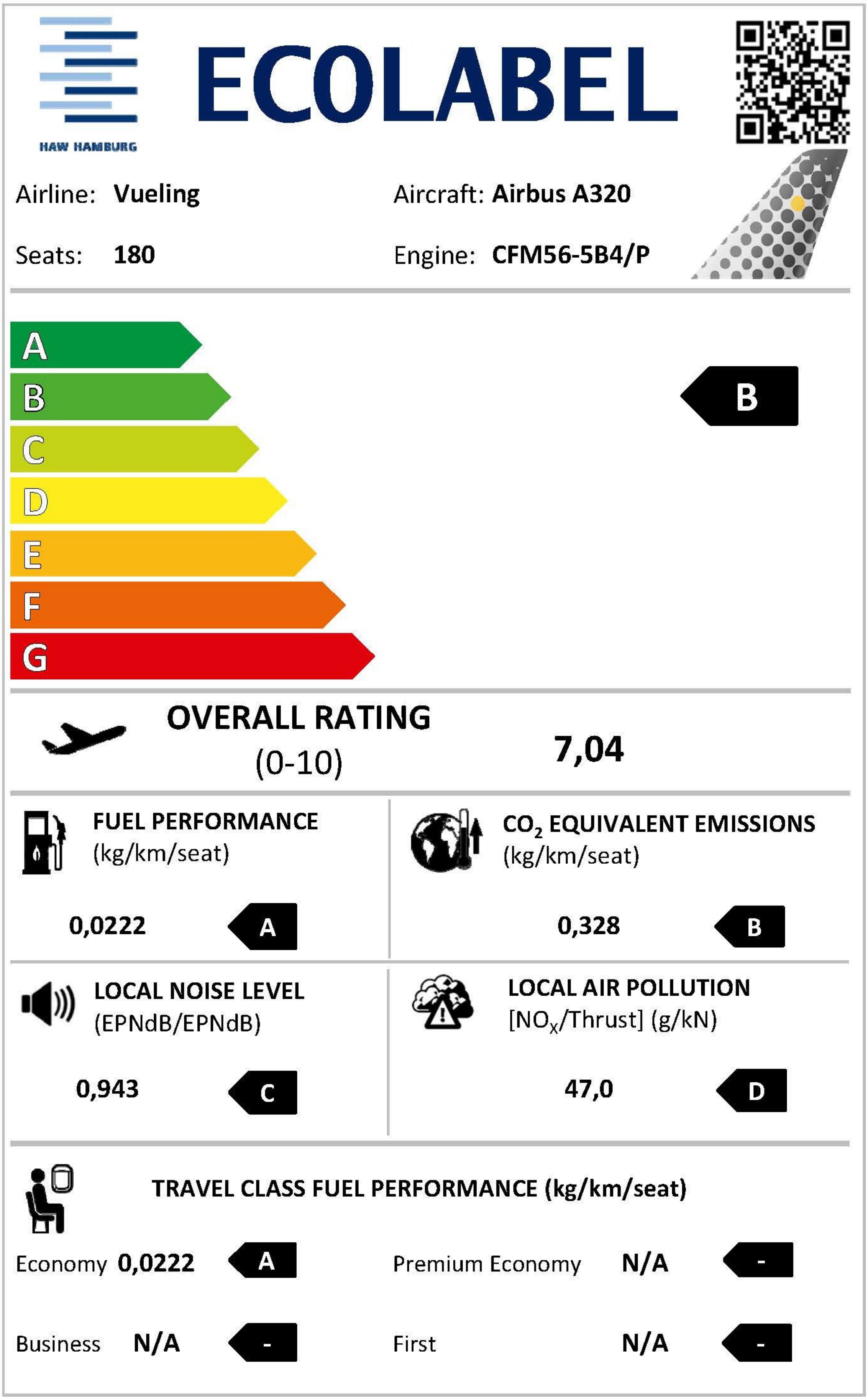

Figure C.96 Ecolabel for Airbus A320 of Vueling

Appendix D – Trip Emission Ecolabels

HAW HAMBURG

ECOLABEL

HAMBURG-ANTALYA
Distance: **2456 km**
Aircraft: **Boeing 737-800**
Seats: **189**
Engine: **CFM56-7B27**
Airline: **Corendon**

ENVIRONMENTAL RATING **1,01**

FUEL PERFORMANCE		
57,6	kg/seat	(0,87)*
CO_2 EQUIVALENT EMISSIONS		
788	kg/seat	(0,87)*
LOCAL NOISE LEVEL		
0,96	EPNdB/EPNdB	(1)*
LOCAL AIR POLLUTION		
71,1	g/seat	(1,42)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**57,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of one reference flight of 2400 km, performed by a Boeing 737-800

Figure D.1 Trip Emission Ecolabel Hamburg to Antalya by Corendon

ECOLABEL

HAMBURG-ANTALYA

Distance:	**2456 km**
Aircraft:	**Boeing 737-800**
Seats:	**189**
Engine:	**CFM56-7B26**
Airline:	**SunExpress**

ENVIRONMENTAL RATING

0,98

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
57,6	kg/seat	(0,87)*	**788**	kg/seat	(0,87)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
0,96	EPNdB/EPNdB	(1)*	**65,1**	g/seat	(1,3)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**57,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.2 Trip Emission Ecolabel Hamburg to Antalya by SunExpress

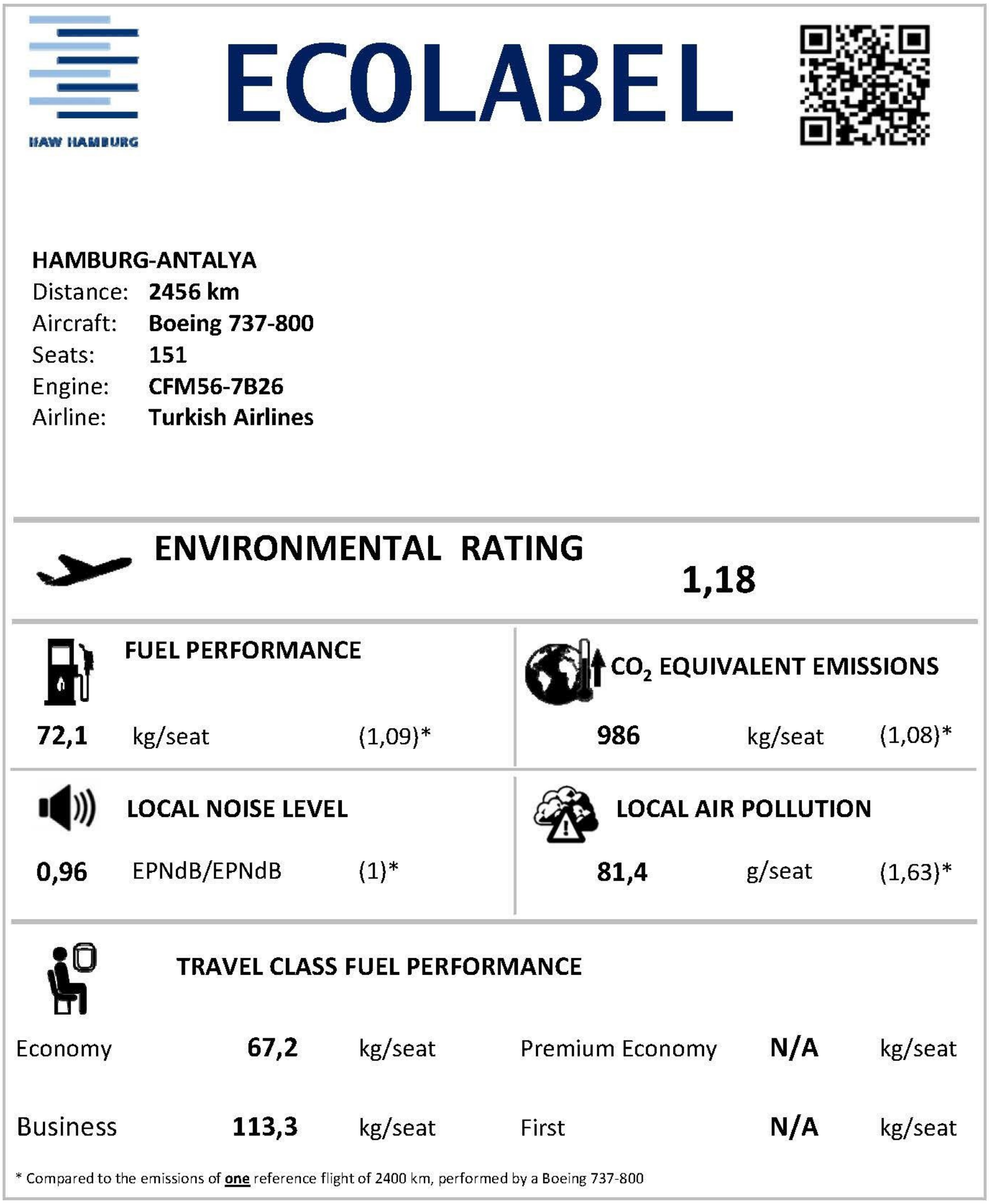

Figure D.3 Trip Emission Ecolabel Hamburg to Antalya by Turkish Airlines

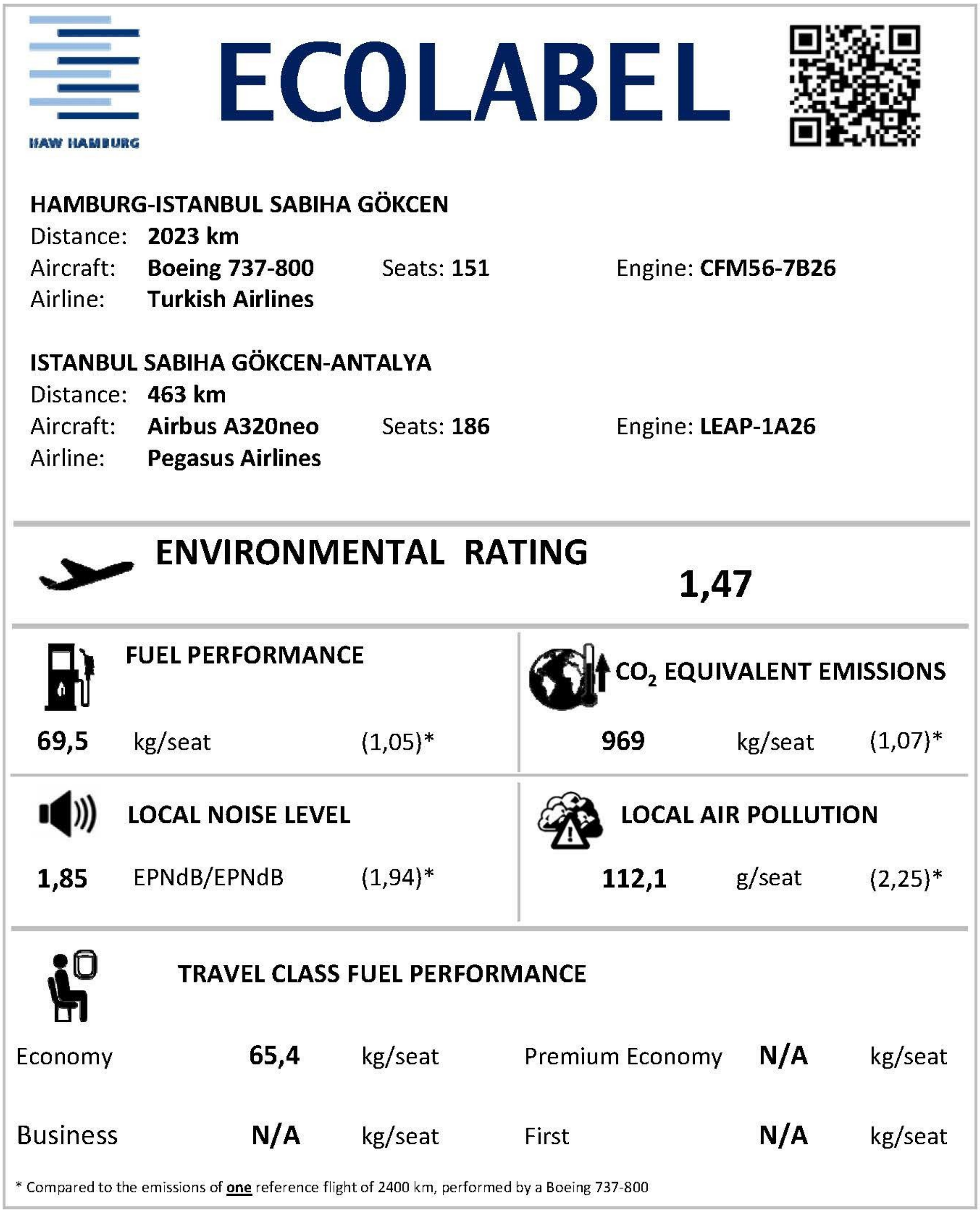

Figure D.4 Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish Airlines and Pegasus Airlines

HAW HAMBURG

ECOLABEL

HAMBURG-ISTANBUL SABIHA GÖKCEN

Distance: **2023 km**
Aircraft: **Boeing 737-800** Seats: **151** Engine: **CFM56-7B26**
Airline: **Turkish Airlines**

ISTANBUL SABIHA GÖKCEN-ANTALYA

Distance: **463 km**
Aircraft: **Boeing 737-800** Seats: **151** Engine: **CFM56-7B26**
Airline: **Turkish Airlines**

ENVIRONMENTAL RATING **1,73**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
74,4	kg/seat	(1,12)*	**1017**	kg/seat	(1,12)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,91	EPNdB/EPNdB	(2)*	**162,9**	g/seat	(3,26)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**69,3**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**116,9**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.5 Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish Airlines

HAW HAMBURG

ECOLABEL

HAMBURG-IZMIR
Distance: **2151 km**
Aircraft: **Boeing 737-800** Seats: **189** Engine: **CFM56-7B26**
Airline: **SunExpress**

IZMIR-ANTALYA
Distance: **357 km**
Aircraft: **Boeing 737-800** Seats: **189** Engine: **CFM56-7B26**
Airline: **SunExpress**

ENVIRONMENTAL RATING **1,46**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
59,9	kg/seat	(0,9)*	**820**	kg/seat	(0,9)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,91	EPNdB/EPNdB	(2)*	**130,1**	g/seat	(2,61)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**59,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.6 Trip Emission Ecolabel Hamburg to Antalya via Izmir by SunExpress

HAW HAMBURG

ECOLABEL

HAMBURG-ISTANBUL ATATÜRK

Distance:	**1990 km**		
Aircraft:	**Airbus A321**	Seats: **178**	Engine: **V2533-A5**
Airline:	**Turkish Airlines**		

ISTANBUL ATATÜRK-ANTALYA

Distance:	**484 km**		
Aircraft:	**Airbus A330-300**	Seats: **289**	Engine: **CF6-80E1A3**
Airline:	**Turkish Airlines**		

ENVIRONMENTAL RATING **1,87**

FUEL PERFORMANCE	**58,7**	kg/seat	(0,88)*
CO_2 EQUIVALENT EMISSIONS	**846**	kg/seat	(0,93)*
LOCAL NOISE LEVEL	**1,92**	EPNdB/EPNdB	(2,01)*
LOCAL AIR POLLUTION	**230,4**	g/seat	(4,62)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**55,3**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**88,2**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.7 Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish Airlines

HAW HAMBURG

ECOLABEL

HAMBURG-ISTANBUL ATATÜRK

Distance: **1990 km**

Aircraft: **Airbus A321** Seats: **178** Engine: **V2533-A5**

Airline: **Turkish Airlines**

ISTANBUL ATATÜRK-ANTALYA

Distance: **484 km**

Aircraft: **Airbus A321** Seats: **178** Engine: **V2533-A5**

Airline: **Turkish Airlines**

ENVIRONMENTAL RATING **1,70**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
53,9	kg/seat	(0,81)*	**810**	kg/seat	(0,89)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,92	EPNdB/EPNdB	(2,01)*	**194,3**	g/seat	(3,89)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**51,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**69,2**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.8 Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish Airlines

HAW HAMBURG

ECOLABEL

HAMBURG-ISTANBUL ATATÜRK

Distance:	**1990 km**		
Aircraft:	**Airbus A330-300**	Seats: **289**	Engine: **CF6-80E1A3**
Airline:	**Turkish Airlines**		

ISTANBUL ATATÜRK-ANTALYA

Distance:	**484 km**		
Aircraft:	**Airbus A321**	Seats: **178**	Engine: **V2533-A5**
Airline:	**Turkish Airlines**		

ENVIRONMENTAL RATING **1,96**

FUEL PERFORMANCE	**72,4**	kg/seat	(1,09)*
CO_2 EQUIVALENT EMISSIONS	**946**	kg/seat	(1,04)*
LOCAL NOISE LEVEL	**1,92**	EPNdB/EPNdB	(2,01)*
LOCAL AIR POLLUTION	**230,4**	g/seat	(4,62)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**64,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**141,8**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of one reference flight of 2400 km, performed by a Boeing 737-800

Figure D.9 Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish Airlines

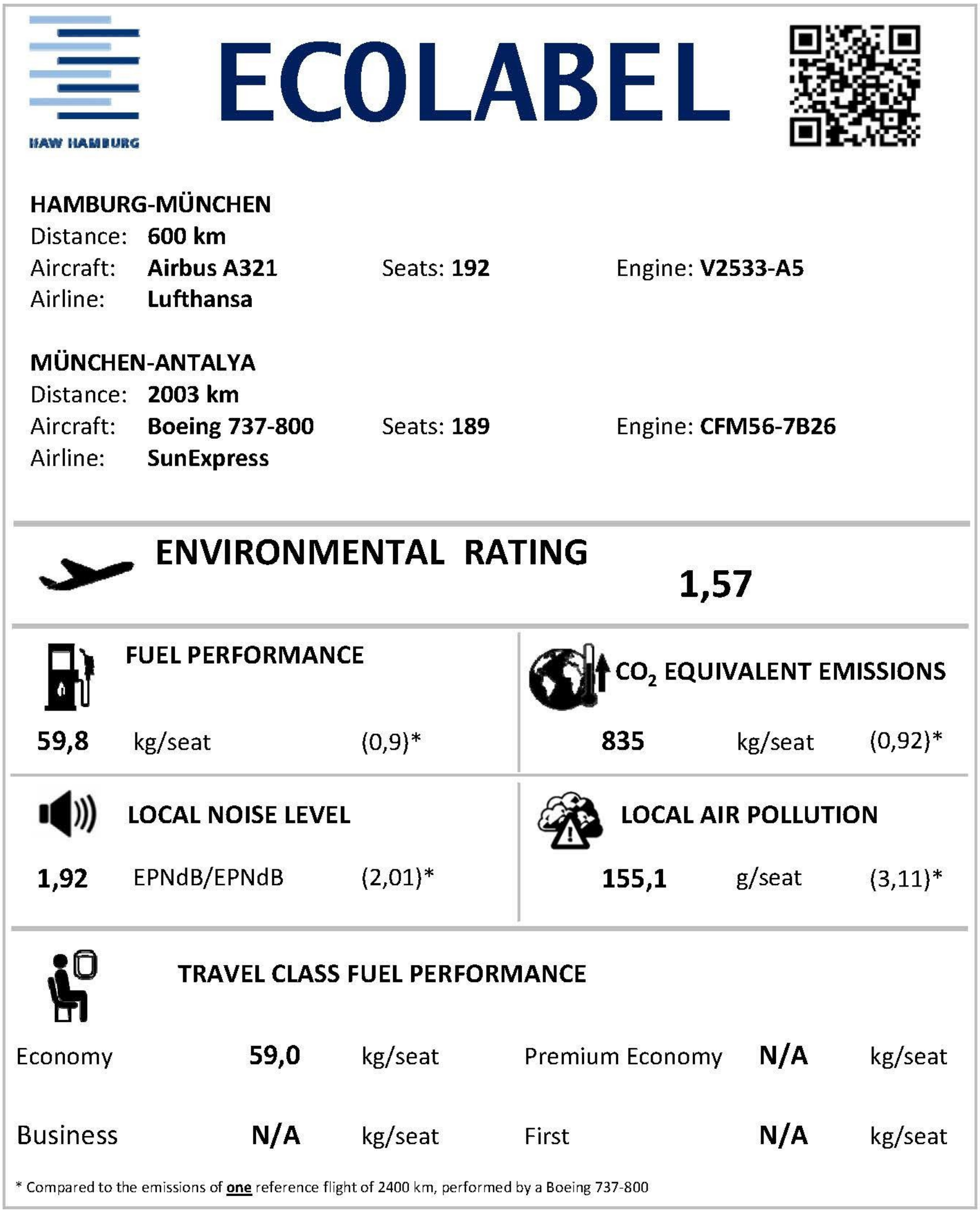

Figure D.10 Trip Emission Ecolabel Hamburg to Antalya via Munich by Lufthansa and SunExpress

HAW HAMBURG

ECOLABEL

HAMBURG-HELSINKI
Distance: **1172 km**
Aircraft: **Embraer E190** Seats: **100** Engine: **CF34-10E7**
Airline: **Finnair**

HELSINKI-BANGKOK
Distance: **7912 km**
Aircraft: **Airbus A350-900** Seats: **336** Engine: **Trent XWB-75**
Airline: **Finnair**

ENVIRONMENTAL RATING **3,27**

FUEL PERFORMANCE
232,4 kg/seat (3,5)*

CO_2 EQUIVALENT EMISSIONS
3554 kg/seat (3,91)*

LOCAL NOISE LEVEL
1,85 EPNdB/EPNdB (1,94)*

LOCAL AIR POLLUTION
154,7 g/seat (3,1)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**201,5**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**499,8**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.11 Trip Emission Ecolabel Hamburg to Bangkok by Finnair

HAW HAMBURG

ECOLABEL

HAMBURG-AMSTERDAM

Distance:	**380 km**		
Aircraft:	**Airbus A319**	Seats: **138**	Engine: **CFM56-5B6/P**
Airline:	**Eurowings**		

AMSTERDAM-BANGKOK

Distance:	**9217 km**		
Aircraft:	**Boeing 777-300ER**	Seats: **313**	Engine: **GE90-115B**
Airline:	**EVA Air**		

ENVIRONMENTAL RATING **4,54**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
331,5	kg/seat	(4,99)*	**4567**	kg/seat	(5,02)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,89	EPNdB/EPNdB	(1,98)*	**284,3**	g/seat	(5,7)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**248,8**	kg/seat	Premium Economy	**305,23**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.12 Trip Emission Ecolabel Hamburg to Bangkok via Amsterdam by Eurowings and EVA Air

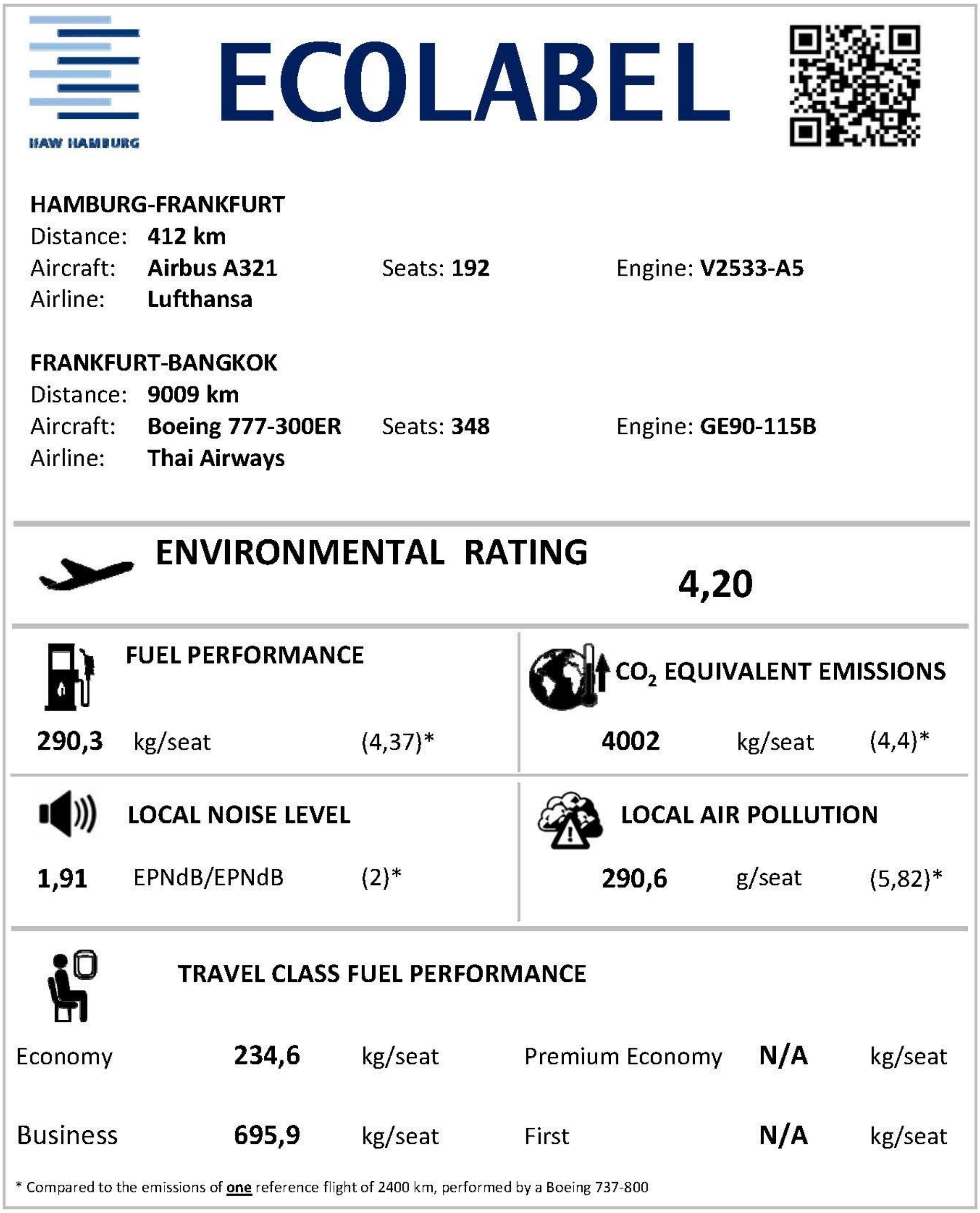

Figure D.13 Trip Emission Ecolabel Hamburg to Bangkok via Frankfurt by Lufthansa and Thai Airways

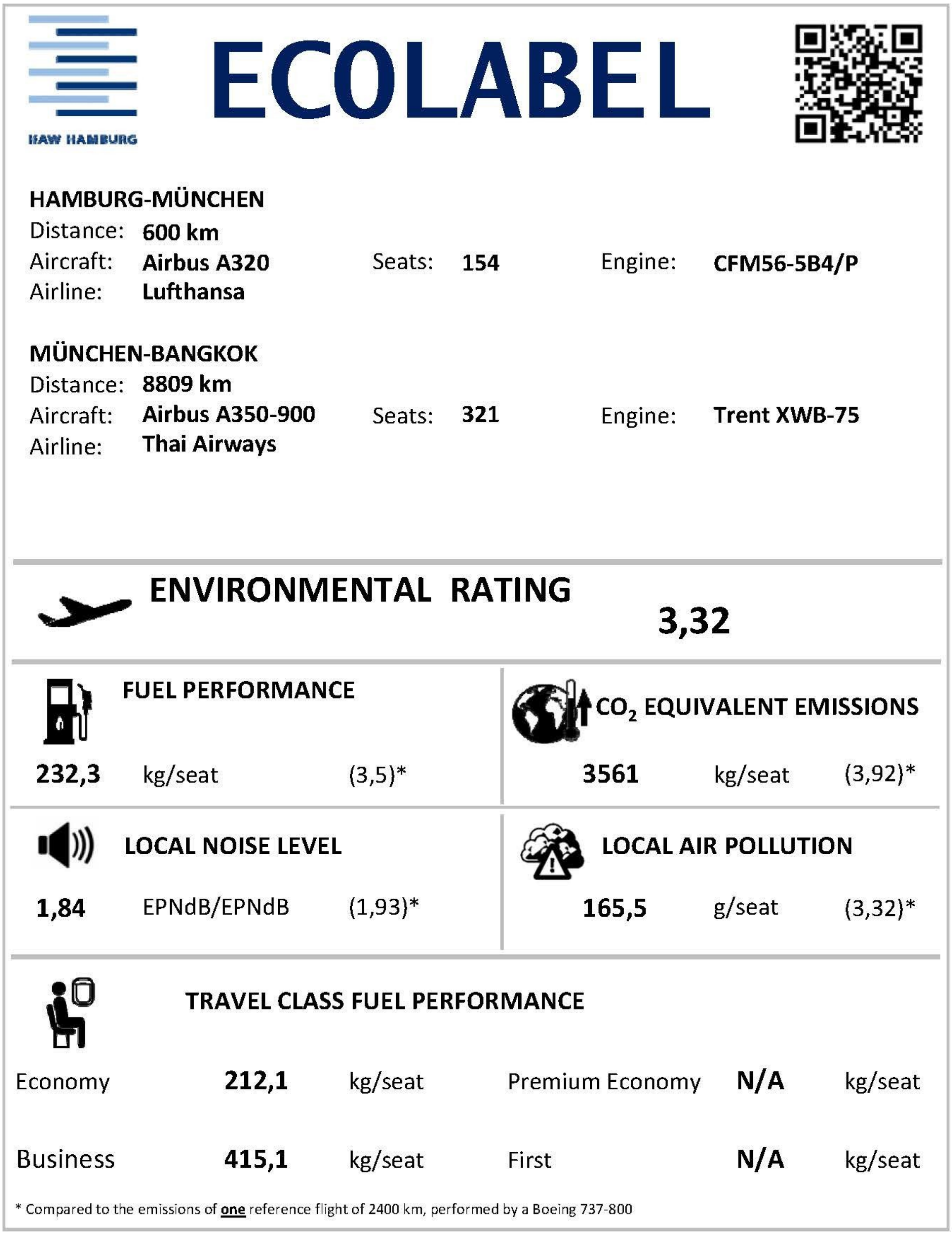

Figure D.14 Trip Emission Ecolabel Hamburg to Bangkok via Munich by Lufthansa and Thai Airways

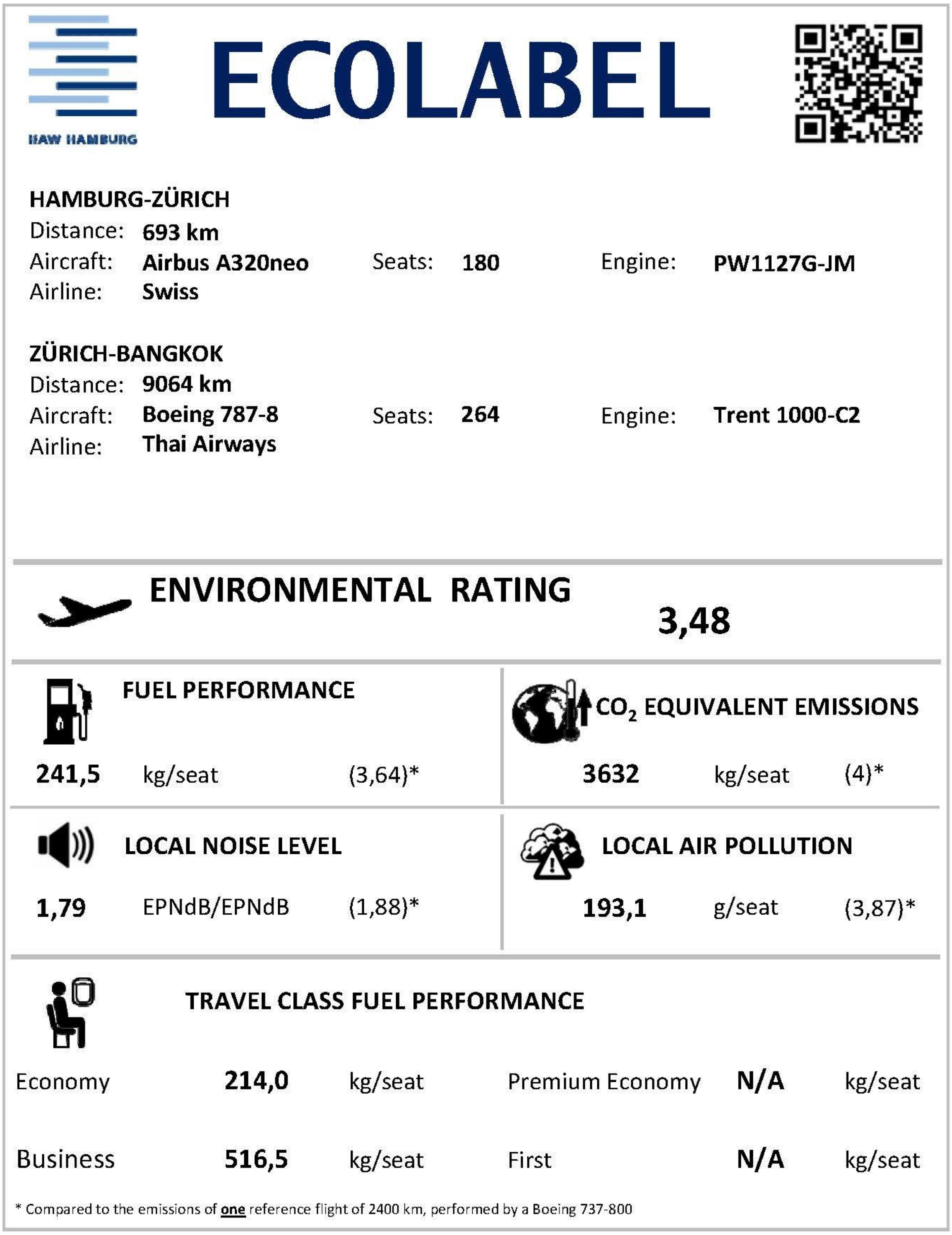

Figure D.15 Trip Emission Ecolabel Hamburg to Bangkok via Zürich by Swiss and Thai Airways

ECOLABEL

HAW HAMBURG

HAMBURG-DUBAI

Distance: **4888 km**
Aircraft: **Airbus A380-800** Seats: **489** Engine: **GP7270**
Airline: **Emirates**

DUBAI-BANGKOK

Distance: **4909 km**
Aircraft: **Boeing 777-300ER** Seats: **354** Engine: **GE90-115B**
Airline: **Emirates**

ENVIRONMENTAL RATING

5,41

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
322,9	kg/seat	(4,86)*	**6078**	kg/seat	(6,69)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,86	EPNdB/EPNdB	(1,95)*	**342,0**	g/seat	(6,85)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**277,5**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**519,7**	kg/seat	First	**798,6**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.16 Trip Emission Ecolabel Hamburg to Bangkok via Dubai by Emirates

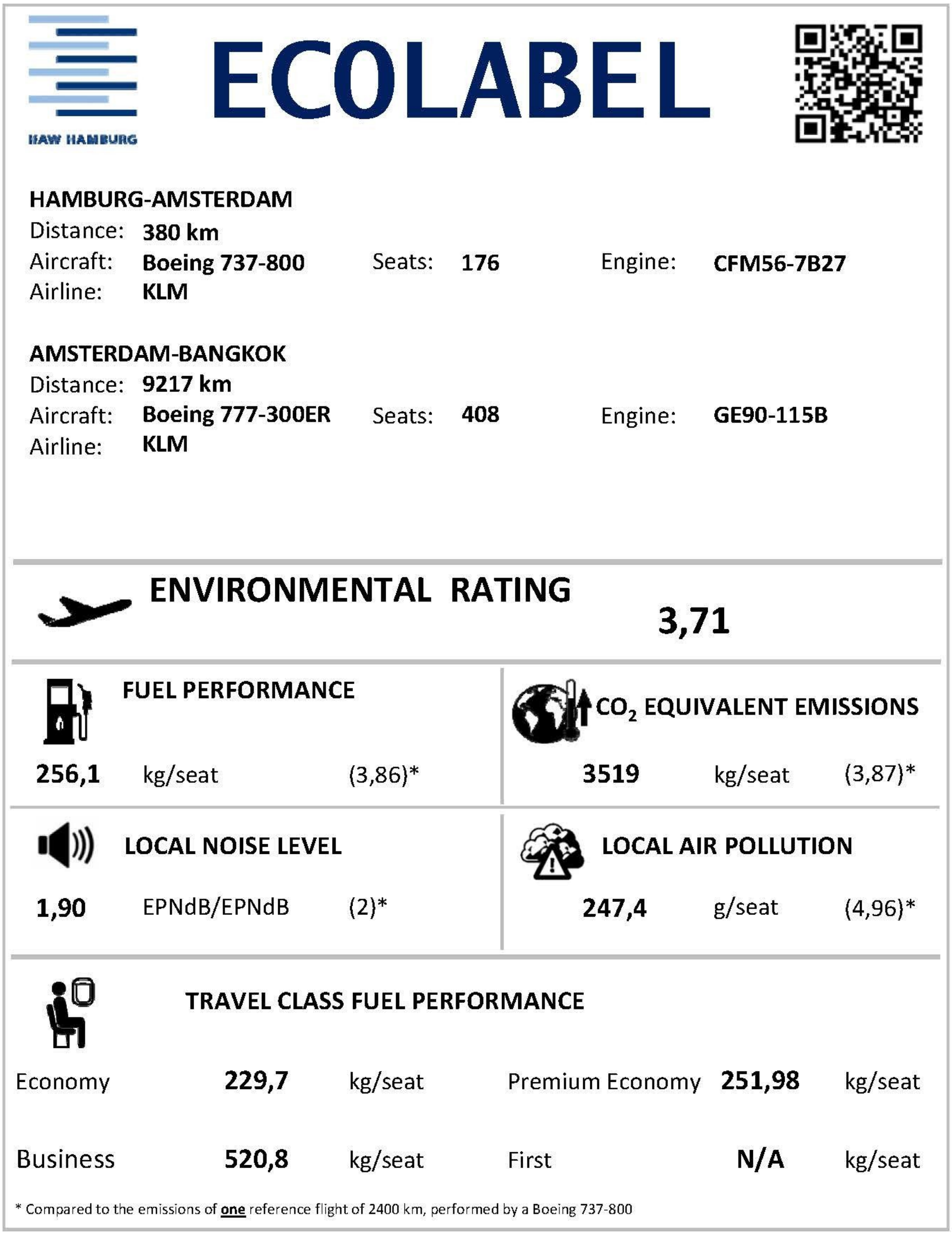

Figure D.17 Trip Emission Ecolabel Hamburg to Bangkok via Amsterdam by KLM

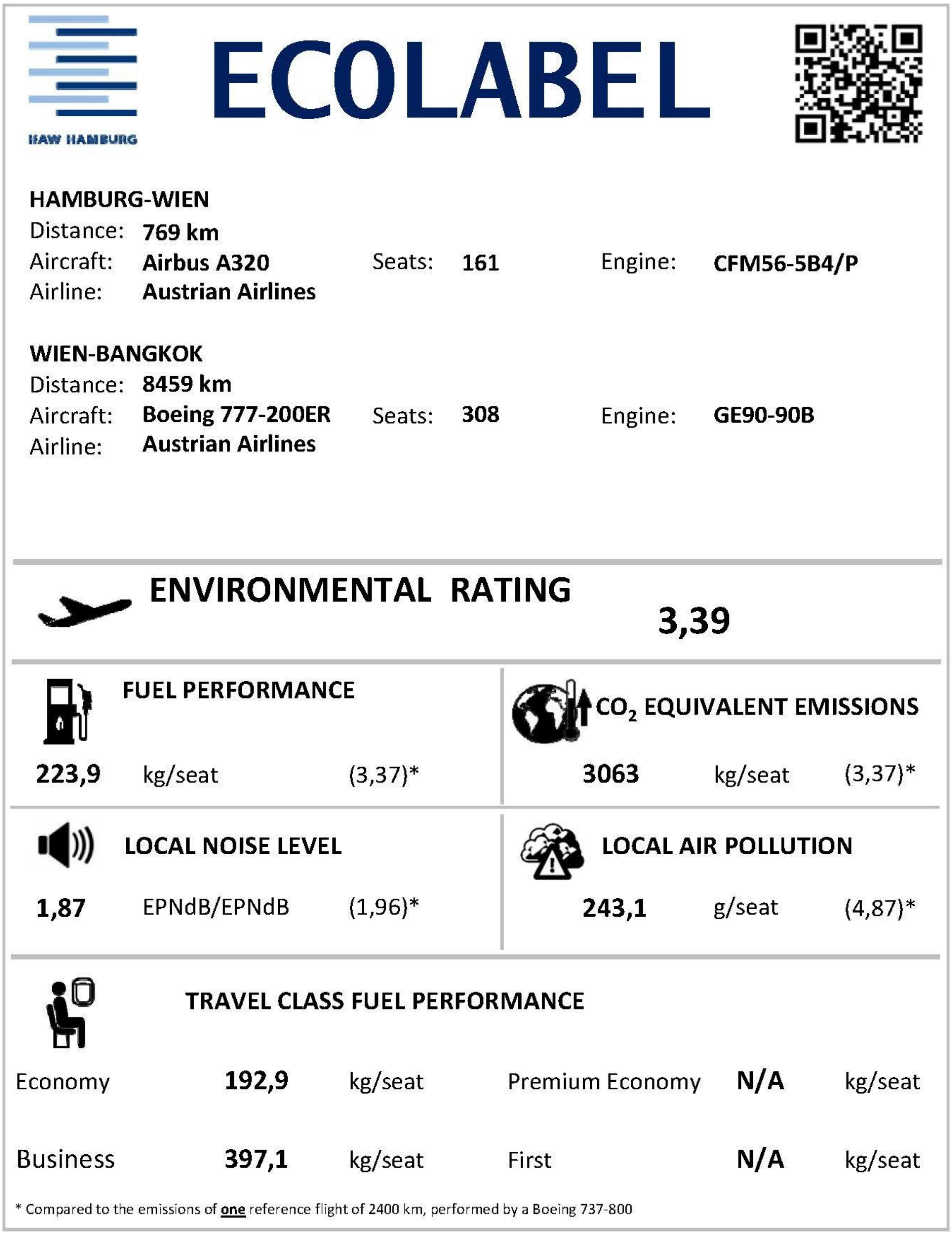

Figure D.18 Trip Emission Ecolabel Hamburg to Bangkok via Vienna by Austrian Airlines

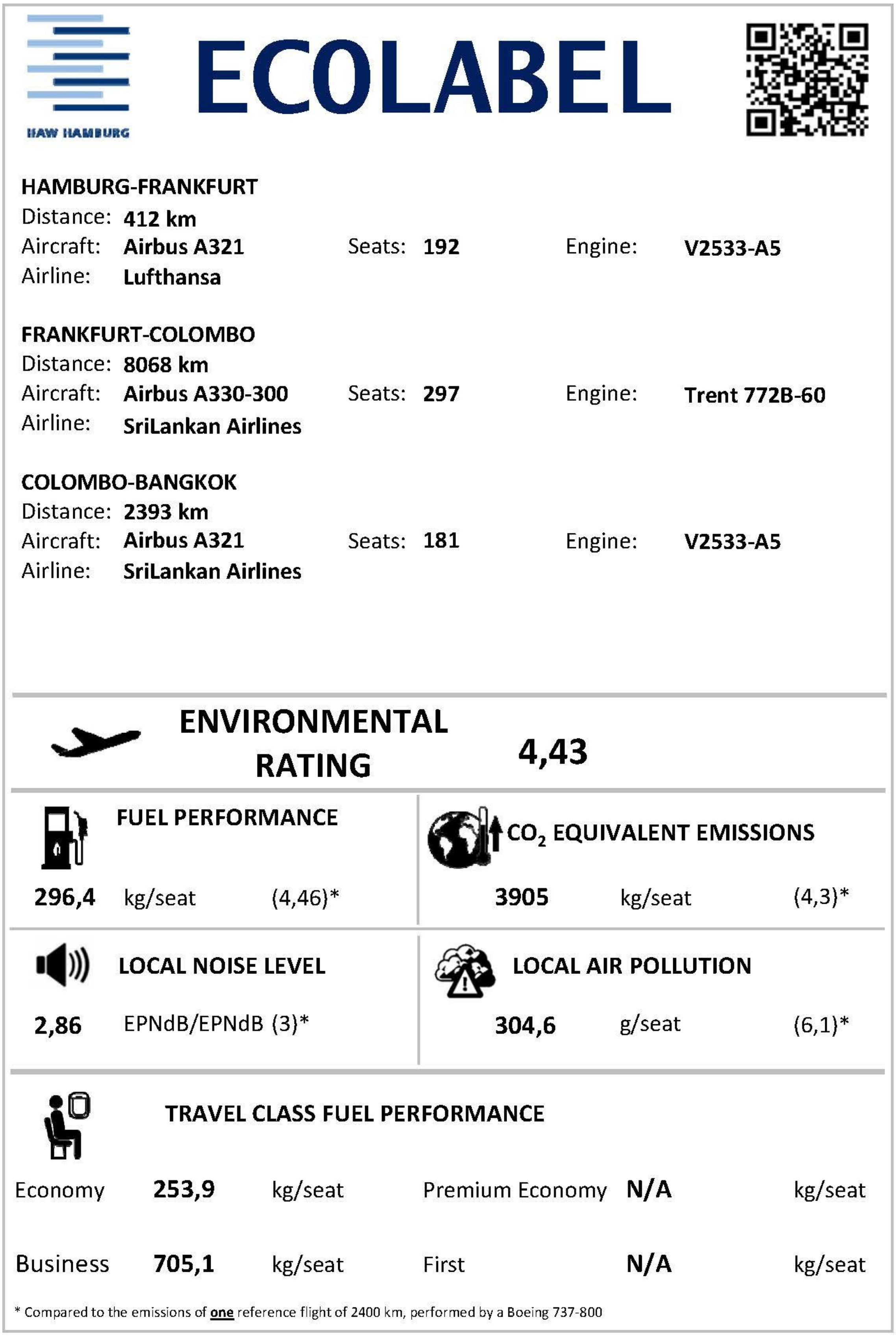

Figure D.19 Trip Emission Ecolabel Hamburg to Bangkok via Frankfurt and Colombo by Lufthansa and SriLankan Airlines

HAW HAMBURG

ECOLABEL

HAMBURG-FRANKFURT
Distance: **412 km**
Aircraft: **Airbus A321** Seats: **192** Engine: **V2533-A5**
Airline: **Lufthansa**

FRANKFURT-BAHRAIN
Distance: **4444 km**
Aircraft: **Airbus A321neo** Seats: **169** Engine: **LEAP-1A33**
Airline: **Gulf Air**

BAHRAIN-BANGKOK
Distance: **5392 km**
Aircraft: **Boeing 787-9** Seats: **282** Engine: **Trent 1000-K2**
Airline: **Gulf Air**

ENVIRONMENTAL RATING **4,81**

FUEL PERFORMANCE
264,7 kg/seat (3,99)*

CO_2 EQUIVALENT EMISSIONS
4611 kg/seat (5,07)*

LOCAL NOISE LEVEL
2,78 EPNdB/EPNdB (2,91)*

LOCAL AIR POLLUTION
349,2 g/seat (7)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**213,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**861,7**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.20 Trip Emission Ecolabel Hamburg to Bangkok via Frankfurt and Bahrain by Lufthansa and Gulf Air

ECOLABEL

HAW HAMBURG

HAMBURG-AMSTERDAM

Distance:	**380 km**		
Aircraft:	**Embraer E190**	Seats: **100**	Engine: **CF34-10E5**
Airline:	**KLM**		

AMSTERDAM-ORANJESTAD

Distance:	**7883 km**		
Aircraft:	**Boeing 777-300ER**	Seats: **408**	Engine: **GE90-115B**
Airline:	**KLM**		

ORANJESTAD-BONAIRE

Distance:	**194 km**		
Aircraft:	**Boeing 777-300ER**	Seats: **408**	Engine: **GE90-115B**
Airline:	**KLM**		

ENVIRONMENTAL RATING **4,32**

FUEL PERFORMANCE

233,3 kg/seat (3,51)*

CO_2 EQUIVALENT EMISSIONS

3227 kg/seat (3,55)*

LOCAL NOISE LEVEL

2,85 EPNdB/EPNdB (2,98)*

LOCAL AIR POLLUTION

398,8 g/seat (7,99)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**209,9**	kg/seat	Premium Economy	**229,7**	kg/seat
Business	**466,8**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.21 Trip Emission Ecolabel Hamburg to Bonaire via Amsterdam and Oranjestad by KLM

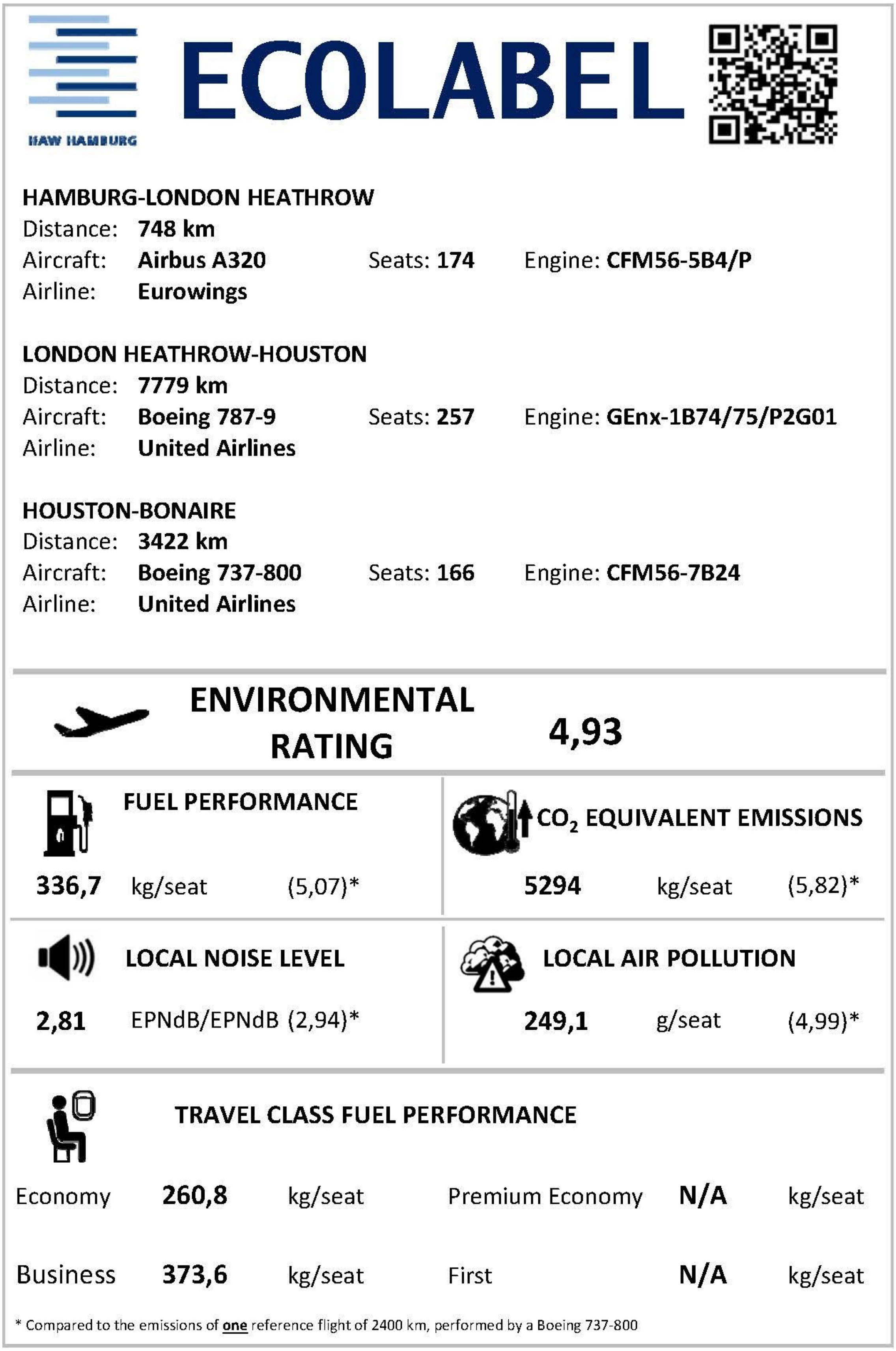

Figure D.22 Trip Emission Ecolabel Hamburg to Bonaire via London Heathrow and Houston by Eurowings and United Airlines

ECOLABEL

HAW HAMBURG

HAMBURG-FRANKFURT
Distance: **412 km**
Aircraft: **Airbus A320** Seats: **154** Engine: **CFM56-5B4/P**
Airline: **Lufthansa**

FRANKFURT-HOUSTON
Distance: **8421 km**
Aircraft: **Boeing 777-200ER** Seats: **267** Engine: **GE90-90B**
Airline: **United Airlines**

HOUSTON-BONAIRE
Distance: **3422 km**
Aircraft: **Boeing 737-800** Seats: **166** Engine: **CFM56-7B24**
Airline: **United Airlines**

ENVIRONMENTAL RATING **4,97**

FUEL PERFORMANCE
336,6 kg/seat (5,07)*

CO_2 EQUIVALENT EMISSIONS
4592 kg/seat (5,05)*

LOCAL NOISE LEVEL
2,82 EPNdB/EPNdB (2,96)*

LOCAL AIR POLLUTION
334,8 g/seat (6,71)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**248,5**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.23 Trip Emission Ecolabel Hamburg to Bonaire via Frankfurt and Houston by Lufthansa and United Airlines

HAW HAMBURG

ECOLABEL

HAMBURG-LONDON HEATHROW

Distance:	**748 km**		
Aircraft:	**Airbus A320**	Seats: **171**	Engine: **V2527E-A5**
Airline:	**British Airways**		

LONDON HEATHROW-MIAMI

Distance:	**7121 km**		
Aircraft:	**Boeing 777-300ER**	Seats: **304**	Engine: **GE90-115B**
Airline:	**American Airlines**		

MIAMI-BONAIRE

Distance:	**1970 km**		
Aircraft:	**Airbus A319**	Seats: **128**	Engine: **CFM56-5B6/P**
Airline:	**American Airlines**		

ENVIRONMENTAL RATING **5,07**

FUEL PERFORMANCE

331,6 kg/seat (4,99)*

CO_2 EQUIVALENT EMISSIONS

4636 kg/seat (5,1)*

LOCAL NOISE LEVEL

2,82 EPNdB/EPNdB (2,96)*

LOCAL AIR POLLUTION

358,6 g/seat (7,19)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**271,3**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.24 Trip Emission Ecolabel Hamburg to Bonaire via London Heathrow and Miami by British Airways and American Airlines

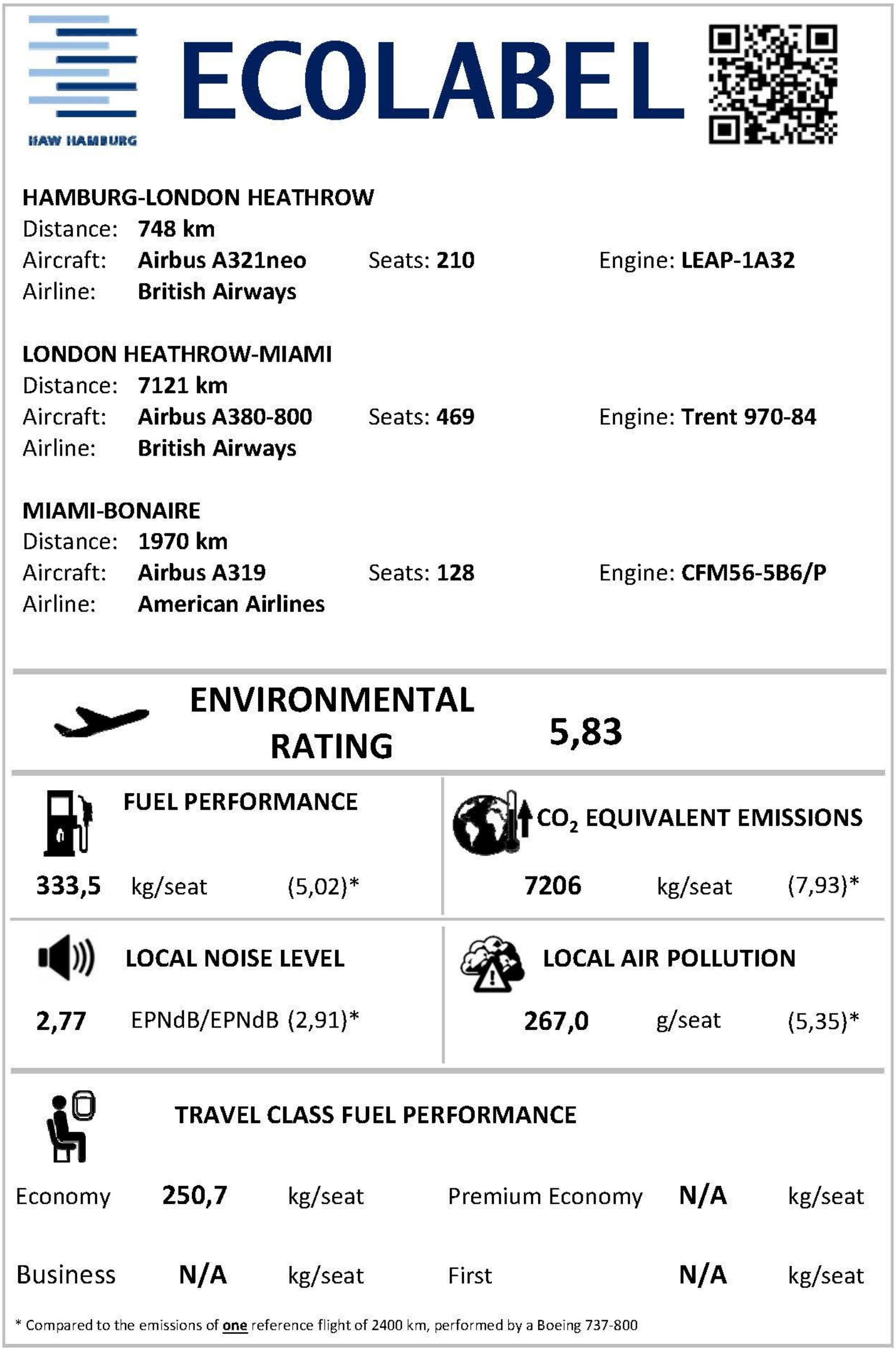

Figure D.25 Trip Emission Ecolabel Hamburg to Bonaire via London Heathrow and Miami by British Airways and American Airlines

ECOLABEL

HAW HAMBURG

HAMBURG-AMSTERDAM

Distance:	**380 km**		
Aircraft:	**Embraer E175**	Seats: **88**	Engine: **CF34-8E5**
Airline:	**KLM**		

AMSTERDAM-ATLANTA

Distance:	**7082 km**		
Aircraft:	**Airbus A330-300**	Seats: **293**	Engine: **PW4168A**
Airline:	**Delta Air Lines**		

ATLANTA-BONAIRE

Distance:	**2893 km**		
Aircraft:	**Boeing 737-800**	Seats: **160**	Engine: **CFM56-7B26**
Airline:	**Delta Air Lines**		

ENVIRONMENTAL RATING **4,18**

FUEL PERFORMANCE	**306,7**	kg/seat	(4,62)*
CO_2 EQUIVALENT EMISSIONS	**4008**	kg/seat	(4,41)*
LOCAL NOISE LEVEL	**2,88**	EPNdB/EPNdB	(3,02)*
LOCAL AIR POLLUTION	**222,5**	g/seat	(4,46)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**260,0**	kg/seat	Premium Economy	**286,4**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.26 Trip Emission Ecolabel Hamburg to Bonaire via Amsterdam and Atlanta by KLM and Delta Air Lines

HAW HAMBURG

ECOLABEL

HAMBURG-AMSTERDAM
Distance: **380 km**
Aircraft: **Embraer E175** Seats: **88** Engine: **CF34-8E5**
Airline: **KLM**

AMSTERDAM-ATLANTA
Distance: **7082 km**
Aircraft: **Airbus A350-900** Seats: **306** Engine: **Trent XWB-75**
Airline: **Delta Air Lines**

ATLANTA-BONAIRE
Distance: **2893 km**
Aircraft: **Boeing 737-800** Seats: **160** Engine: **CFM56-7B26**
Airline: **Delta Air Lines**

ENVIRONMENTAL RATING **4,14**

FUEL PERFORMANCE
277,5 kg/seat (4,18)*

CO_2 EQUIVALENT EMISSIONS
4122 kg/seat (4,54)*

LOCAL NOISE LEVEL
2,82 EPNdB/EPNdB (2,95)*

LOCAL AIR POLLUTION
224,1 g/seat (4,49)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**233,8**	kg/seat	Premium Economy	**275,8**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.27 Trip Emission Ecolabel Hamburg to Bonaire via Amsterdam and Atlanta by KLM and Delta Air Lines

HAW HAMBURG

ECOLABEL

HAMBURG-FRANKFURT
Distance: **412 km**
Aircraft: **Airbus A320** Seats: **154** Engine: **CFM56-5B4/P**
Airline: **Lufthansa**

FRANKFURT-HOUSTON
Distance: **8421 km**
Aircraft: **Boeing 747-8** Seats: **364** Engine: **GeNx-2B67**
Airline: **Lufthansa**

HOUSTON-BONAIRE
Distance: **3422 km**
Aircraft: **Boeing 737-800** Seats: **160** Engine: **CFM56-7B26**
Airline: **Delta**

ENVIRONMENTAL RATING **4,29**

FUEL PERFORMANCE
431,8 kg/seat (6,5)*

CO_2 EQUIVALENT EMISSIONS
2993 kg/seat (3,29)*

LOCAL NOISE LEVEL
2,82 EPNdB/EPNdB (2,96)*

LOCAL AIR POLLUTION
270,8 g/seat (5,43)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**328,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.28 Trip Emission Ecolabel Hamburg to Bonaire via Frankfurt and Houston by Lufthansa and Delta Air Lines

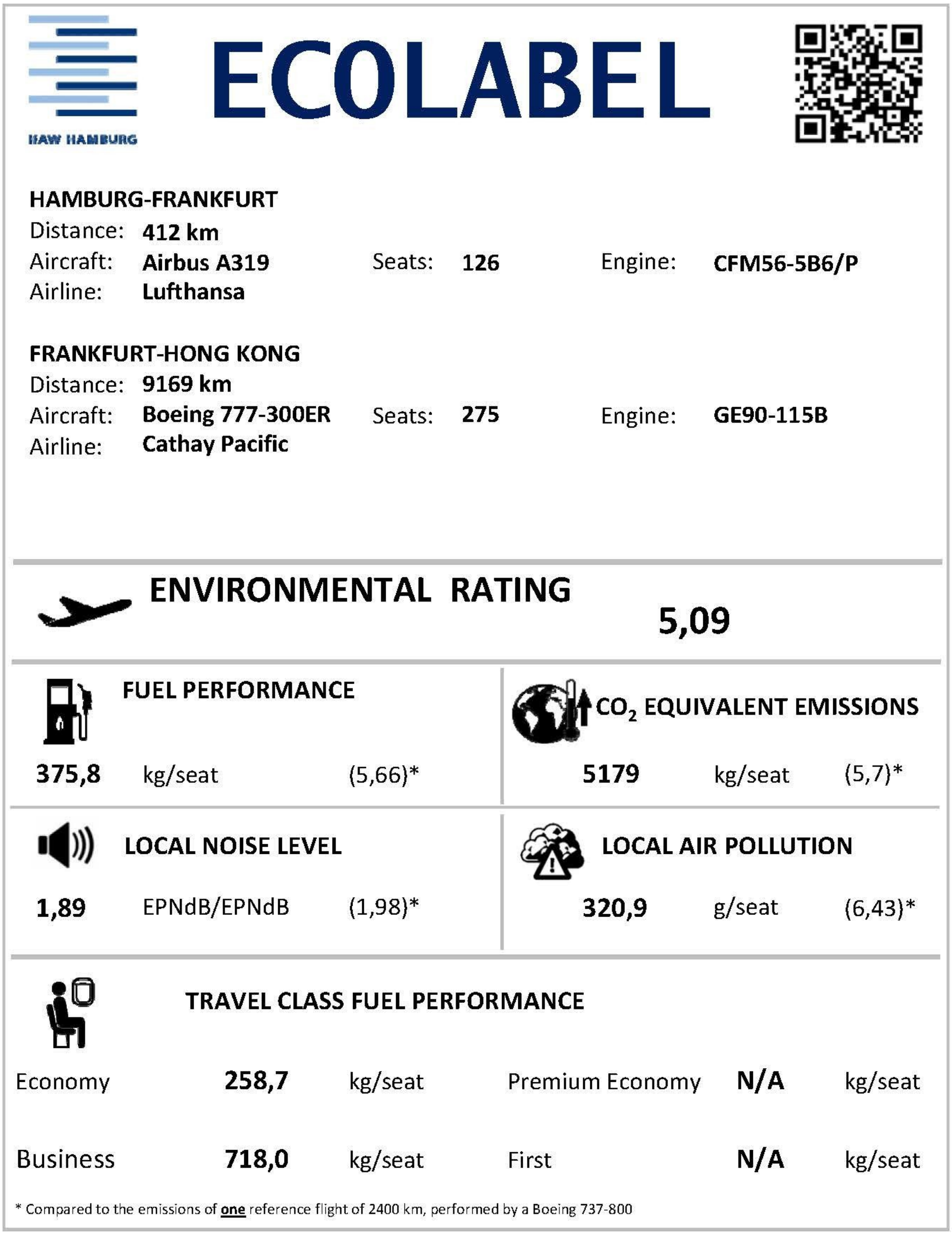

Figure D.29 Trip Emission Ecolabel Hamburg to Hong Kong via Frankfurt by Lufthansa and Cathay Pacific

HAW HAMBURG

ECOLABEL

HAMBURG-ISTANBUL ATATÜRK

Distance:	**1990 km**				
Aircraft:	**Airbus A321**	Seats:	**178**	Engine:	**V2533-A5**
Airline:	**Turkish Airlines**				

ISTANBUL ATATÜRK-HONG KONG

Distance:	**8022 km**				
Aircraft:	**Boeing 777-300ER**	Seats:	**349**	Engine:	**GE90-115B**
Airline:	**Turkish Airlines**				

ENVIRONMENTAL RATING **4,27**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
292,7	kg/seat	(4,41)*	**4078**	kg/seat	(4,49)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,91	EPNdB/EPNdB	(2)*	**297,1**	g/seat	(5,95)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**235,8**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**643,9**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.30 Trip Emission Ecolabel Hamburg to Hong Kong via Istanbul by Turkish Airlines

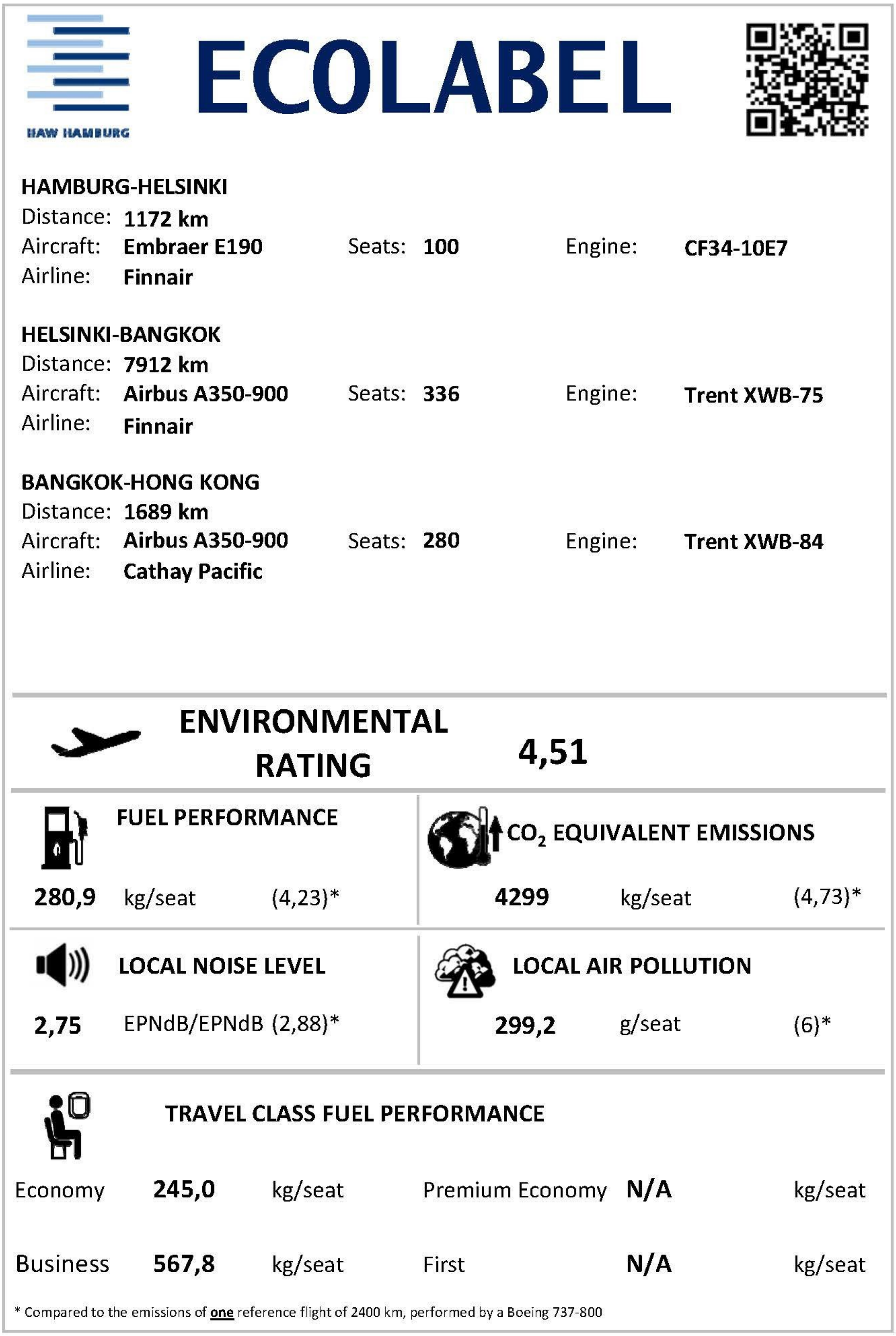

Figure D.31 Trip Emission Ecolabel Hamburg to Hong Kong via Helsinki and Bangkok by Finnair and Cathay Pacific

HAW HAMBURG

ECOLABEL

HAMBURG-DUBAI
Distance: **4888 km**
Aircraft: **Airbus A380-800** Seats: **489** Engine: **GP7270**
Airline: **Emirates**

DUBAI-BANGKOK
Distance: **4909 km**
Aircraft: **Boeing 777-300ER** Seats: **354** Engine: **GE90-115B**
Airline: **Emirates**

BANGKOK-HONG KONG
Distance: **1689 km**
Aircraft: **Boeing 777-300ER** Seats: **354** Engine: **GE90-115B**
Airline: **Emirates**

ENVIRONMENTAL RATING **6,88**

FUEL PERFORMANCE
376,0 kg/seat (5,66)*

CO_2 EQUIVALENT EMISSIONS
6808 kg/seat (7,49)*

LOCAL NOISE LEVEL
2,81 EPNdB/EPNdB (2,94)*

LOCAL AIR POLLUTION
539,1 g/seat (10,8)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**322,3**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**620,9**	kg/seat	First	**915,0**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.32 Trip Emission Ecolabel Hamburg to Hong Kong via Dubai and Bangkok by Emirates

ECOLABEL

HAW HAMBURG

HAMBURG-MÜNCHEN

Distance:	**600 km**				
Aircraft:	**Airbus A320**	Seats:	**154**	Engine:	**CFM56-5B4/P**
Airline:	**Lufthansa**				

MÜNCHEN-BANGKOK

Distance:	**8809 km**				
Aircraft:	**Airbus A350-900**	Seats:	**321**	Engine:	**Trent XWB-75**
Airline:	**Thai Airways**				

BANGKOK-HONG KONG

Distance:	**1689 km**				
Aircraft:	**Boeing 777-300ER**	Seats:	**348**	Engine:	**GE90-115B**
Airline:	**Thai Airways**				

ENVIRONMENTAL RATING **4,81**

FUEL PERFORMANCE

286,3 kg/seat (4,31)*

CO_2 EQUIVALENT EMISSIONS

4304 kg/seat (4,73)*

LOCAL NOISE LEVEL

2,79 EPNdB/EPNdB (2,92)*

LOCAL AIR POLLUTION

366,0 g/seat (7,33)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**255,5**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**546,3**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.33 Trip Emission Ecolabel Hamburg to Hong Kong via Munich and Bangkok by Lufthansa and Thai Airways

HAW HAMBURG

ECOLABEL

HAMBURG-FRANKFURT
Distance: **412 km**
Aircraft: **Airbus A319** Seats: **126** Engine: **CFM56-5B6/P**
Airline: **Lufthansa**

FRANKFURT-BANGKOK
Distance: **9009 km**
Aircraft: **Boeing 777-300ER** Seats: **348** Engine: **GE90-115B**
Airline: **Thai Airways**

BANGKOK-HONG KONG
Distance: **1689 km**
Aircraft: **Boeing 777-300ER** Seats: **348** Engine: **GE90-115B**
Airline: **Thai Airways**

ENVIRONMENTAL RATING **5,64**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
348,9	kg/seat	(5,25)*	**4809**	kg/seat	(5,29)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
2,83	EPNdB/EPNdB	(2,97)*	**468,2**	g/seat	(9,38)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**283,1**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**828,0**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of one reference flight of 2400 km, performed by a Boeing 737-800

Figure D.34 Trip Emission Ecolabel Hamburg to Hong Kong via Frankfurt and Bangkok by Lufthansa and Thai Airways

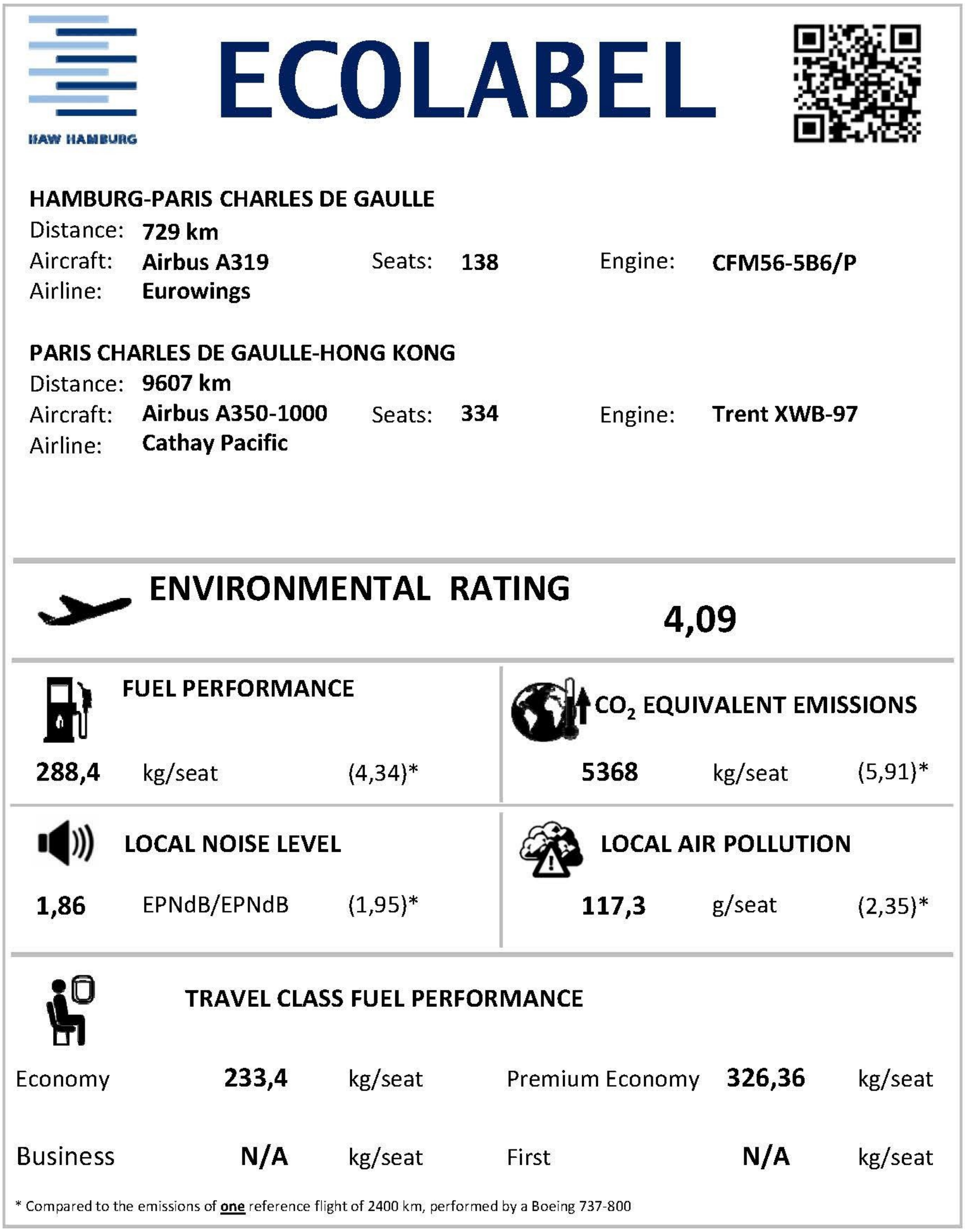

Figure D.35 Trip Emission Ecolabel Hamburg to Hong Kong via Paris by Eurowings and Cathay Pacific

HAW HAMBURG

ECOLABEL

HAMBURG-LONDON HEATHROW

Distance:	**748 km**				
Aircraft:	**Airbus A320**	Seats:	**171**	Engine:	**V2527E-A5**
Airline:	**British Airways**				

LONDON HEATHROW-HONG KONG

Distance:	**9648 km**				
Aircraft:	**Airbus A350-1000**	Seats:	**334**	Engine:	**Trent XWB-97**
Airline:	**Cathay Pacific**				

ENVIRONMENTAL RATING **4,67**

FUEL PERFORMANCE

287,4 kg/seat (4,33)*

CO_2 EQUIVALENT EMISSIONS

5358 kg/seat (5,9)*

LOCAL NOISE LEVEL

1,85 EPNdB/EPNdB (1,94)*

LOCAL AIR POLLUTION

263,8 g/seat (5,29)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**233,1**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.36 Trip Emission Ecolabel Hamburg to Hong Kong via London Heathrow by British Airways and Cathay Pacific

HAW HAMBURG

ECOLABEL

HAMBURG-LONDON HEATHROW
Distance: **748 km**
Aircraft: **Airbus A320** Seats: **171** Engine: **V2527E-A5**
Airline: **British Airways**

LONDON HEATHROW-DOHA
Distance: **5247 km**
Aircraft: **Airbus A380-800** Seats: **517** Engine: **GP7270**
Airline: **Qatar Airways**

DOHA-HONG KONG
Distance: **6301 km**
Aircraft: **Airbus A350-900** Seats: **283** Engine: **Trent XWB-75**
Airline: **Qatar Airways**

ENVIRONMENTAL RATING **6,00**

FUEL PERFORMANCE
367,8 kg/seat (5,54)*

CO_2 EQUIVALENT EMISSIONS
7024 kg/seat (7,73)*

LOCAL NOISE LEVEL
2,75 EPNdB/EPNdB (2,88)*

LOCAL AIR POLLUTION
304,6 g/seat (6,1)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**299,7**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.37 Trip Emission Ecolabel Hamburg to Hong Kong via London Heathrow and Doha by British Airways and Qatar Airways

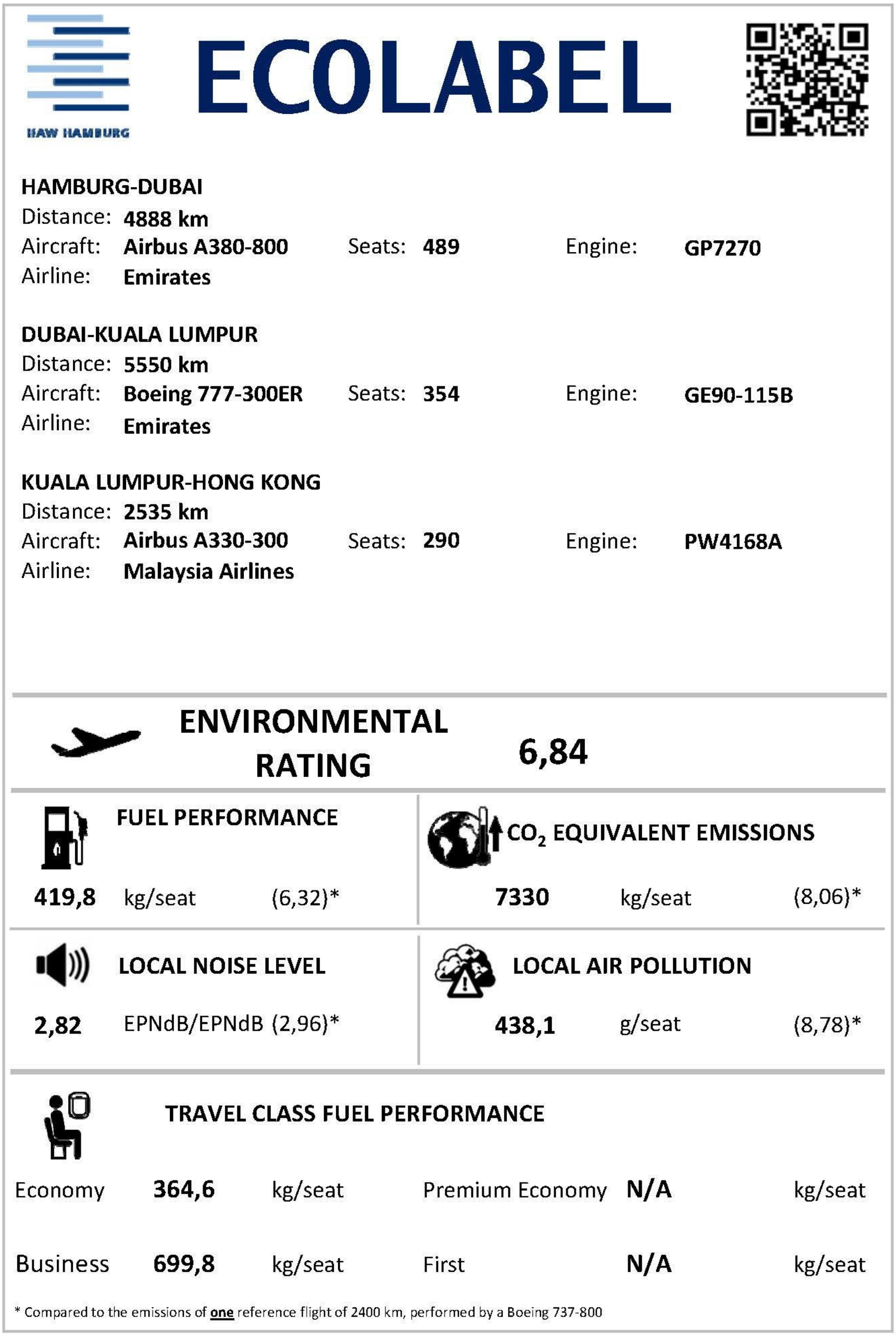

Figure D.38 Trip Emission Ecolabel Hamburg to Hong Kong via Dubai and Kuala Lumpur by Emirates and Malaysia Airlines

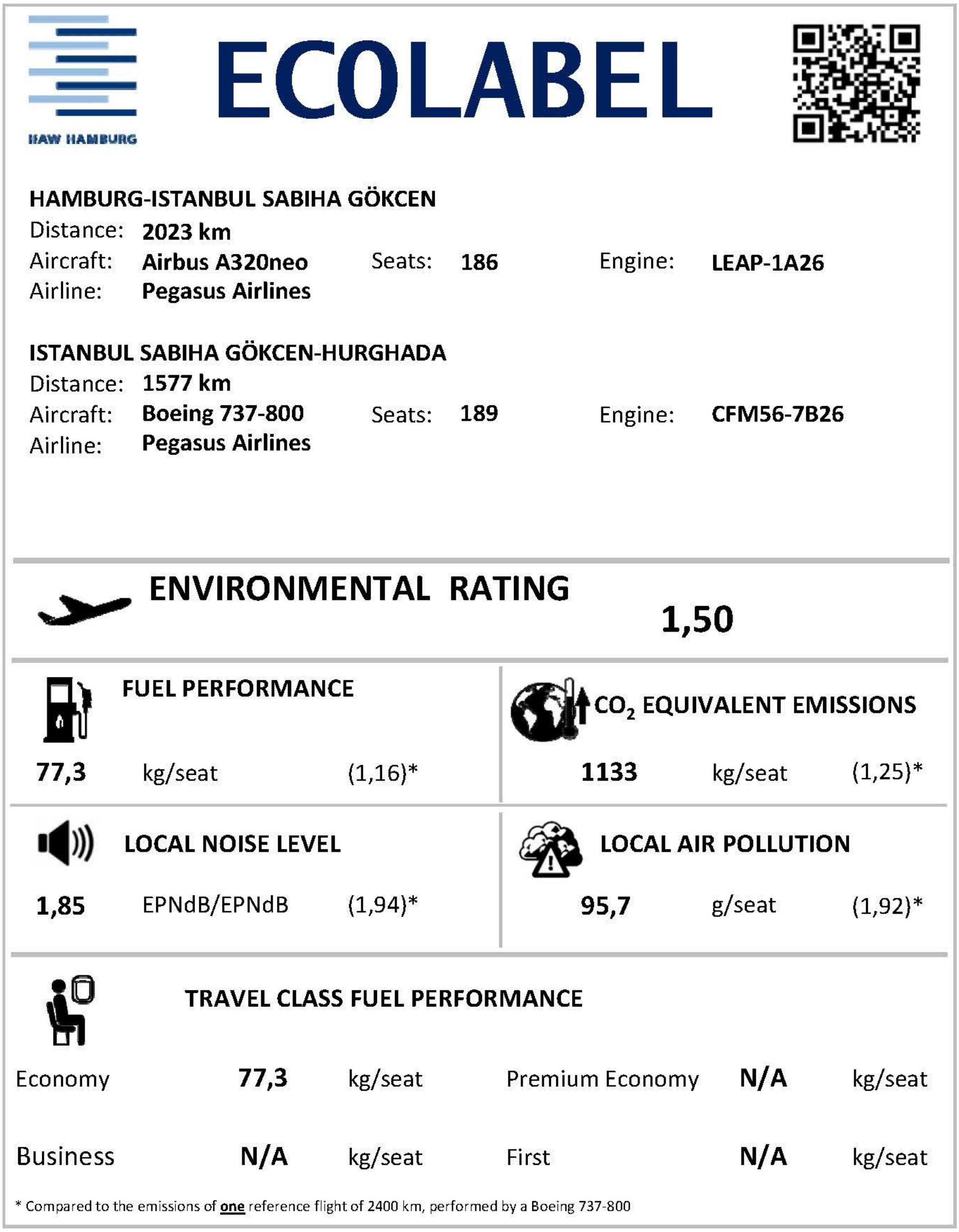

Figure D.39 Trip Emission Ecolabel Hamburg to Hurghada via Istanbul by Pegasus Airlines

HAW HAMBURG

ECOLABEL

HAMBURG-DÜSSELDORF

Distance: **340 km**

Aircraft: **Airbus A319** Seats: **138** Engine: **CFM56-5B6/P**

Airline: **Eurowings**

DÜSSELDORF-HURGHADA

Distance: **3511 km**

Aircraft: **Airbus A320** Seats: **174** Engine: **CFM56-5B4/P**

Airline: **Eurowings**

ENVIRONMENTAL RATING **1,78**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
92,1	kg/seat	(1,39)*	**1360**	kg/seat	(1,5)*

LOCAL NOISE LEVEL			LOCAL AIR POLLUTION		
1,88	EPNdB/EPNdB	(1,98)*	**126,2**	g/seat	(2,53)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**88,4**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.40 Trip Emission Ecolabel Hamburg to Hurghada via Düsseldorf by Eurowings

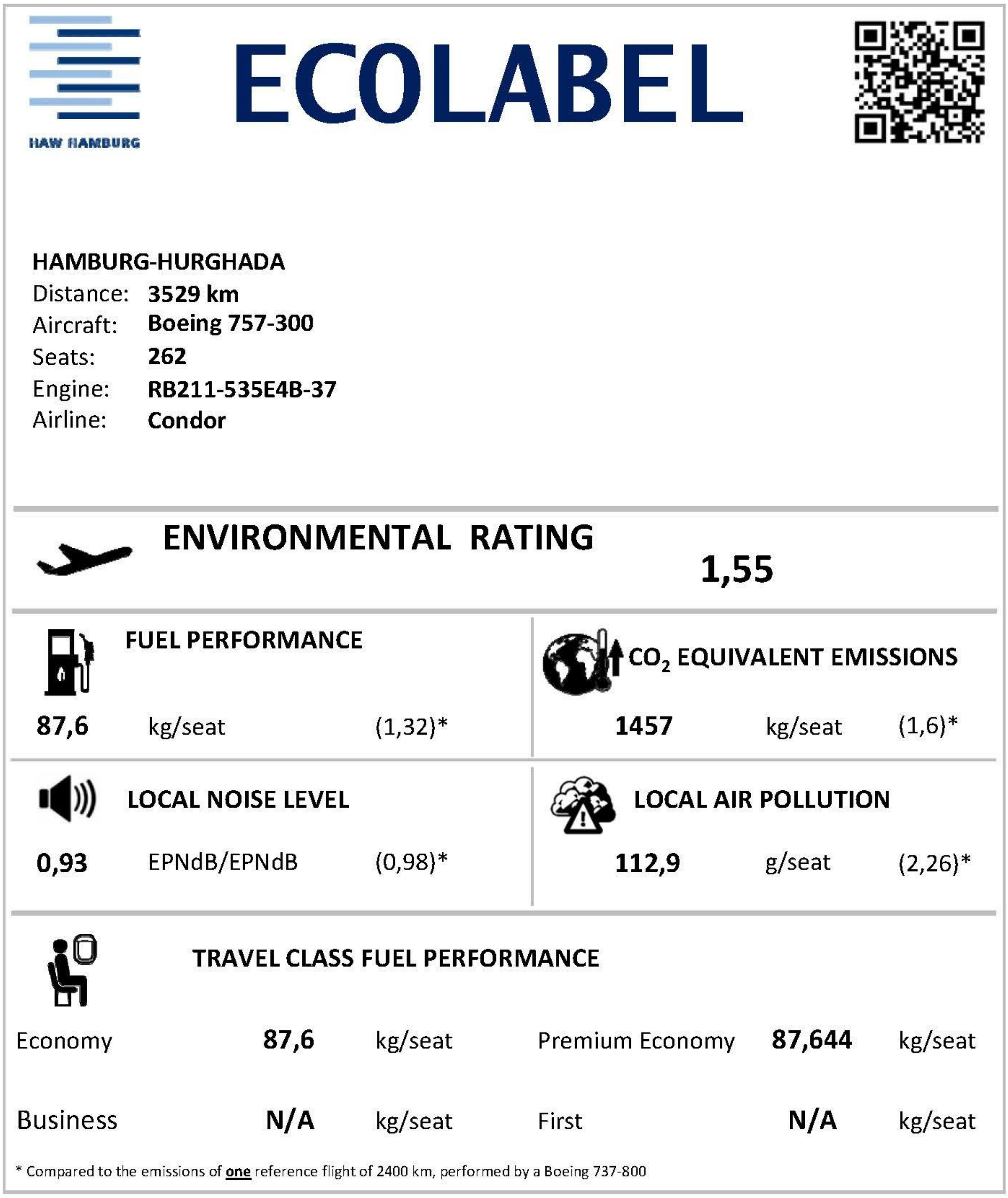

Figure D.41 Trip Emission Ecolabel Hamburg to Hurghada by Condor

HAW HAMBURG

ECOLABEL

HAMBURG-ISTANBUL ATATÜRK

Distance:	**1990 km**				
Aircraft:	**Airbus A321**	Seats:	**178**	Engine:	**V2533-A5**
Airline:	**Turkish Airlines**				

ISTANBUL ATATÜRK-HURGHADA

Distance:	**1598 km**				
Aircraft:	**Boeing 737 MAX 8**	Seats:	**151**	Engine:	**LEAP-1B27**
Airline:	**Turkish Airlines**				

ENVIRONMENTAL RATING **1,97**

FUEL PERFORMANCE

80,3 kg/seat (1,21)*

CO_2 EQUIVALENT EMISSIONS

1398 kg/seat (1,54)*

LOCAL NOISE LEVEL

1,87 EPNdB/EPNdB (1,96)*

LOCAL AIR POLLUTION

179,5 g/seat (3,6)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**75,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**116,7**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.42 Trip Emission Ecolabel Hamburg to Hurghada via Istanbul by Turkish Airlines

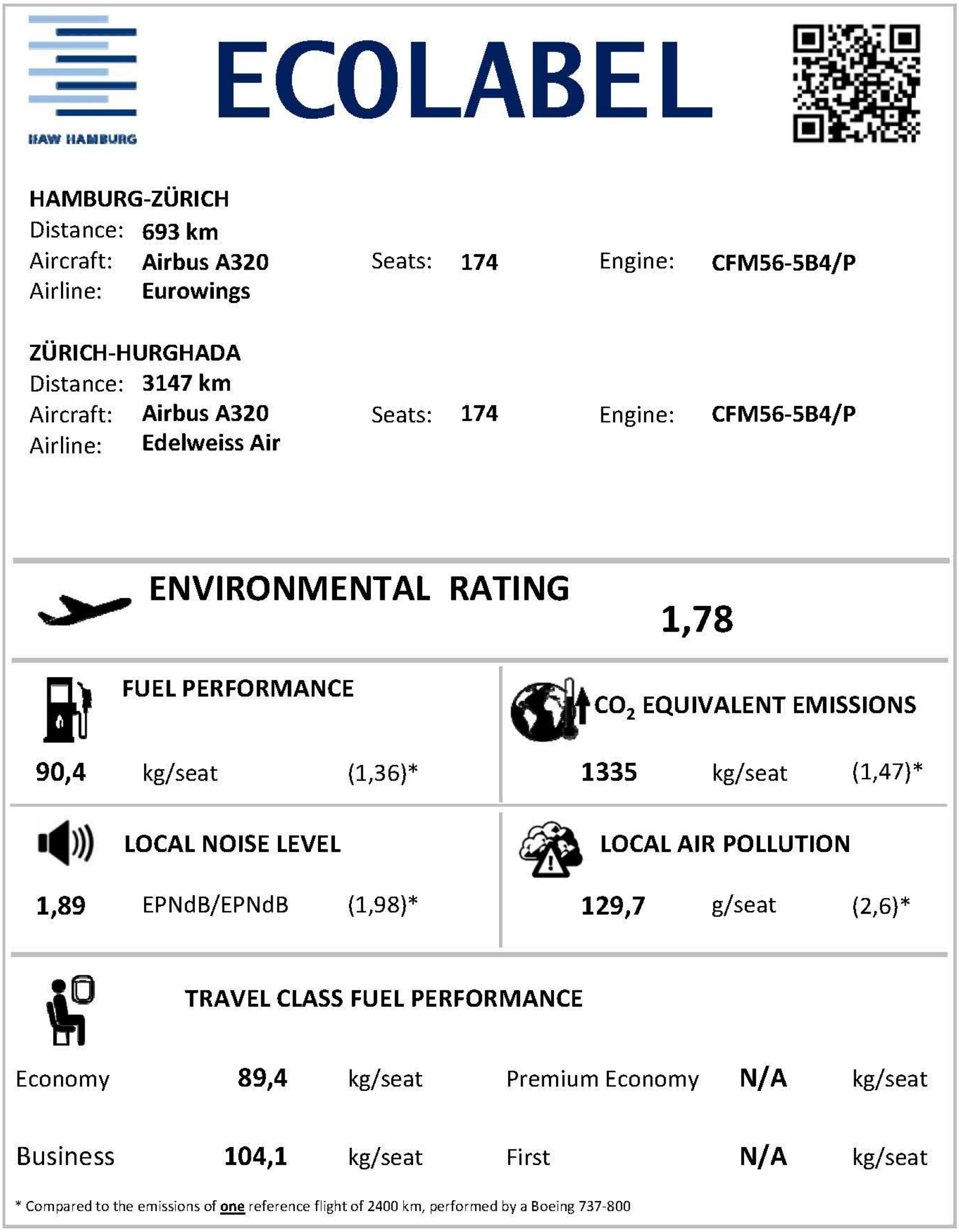

Figure D.43 Trip Emission Ecolabel Hamburg to Hurghada via Zürich by Eurowings and Edelweiss Air

HAW HAMBURG

ECOLABEL

HAMBURG-ZÜRICH

Distance:	**693 km**				
Aircraft:	**Airbus A321**	Seats:	**219**	Engine:	**CFM56-5B1/3**
Airline:	**Swiss**				

ZÜRICH-HURGHADA

Distance:	**3147 km**				
Aircraft:	**Airbus A320**	Seats:	**174**	Engine:	**CFM56-5B4/P**
Airline:	**Edelweiss Air**				

ENVIRONMENTAL RATING **1,69**

FUEL PERFORMANCE

86,0 kg/seat (1,3)*

CO_2 EQUIVALENT EMISSIONS

1273 kg/seat (1,4)*

LOCAL NOISE LEVEL

1,91 EPNdB/EPNdB (2,01)*

LOCAL AIR POLLUTION

117,3 g/seat (2,35)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**85,4**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**91,4**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.44 Trip Emission Ecolabel Hamburg to Hurghada via Zürich by Swiss and Edelweiss Air

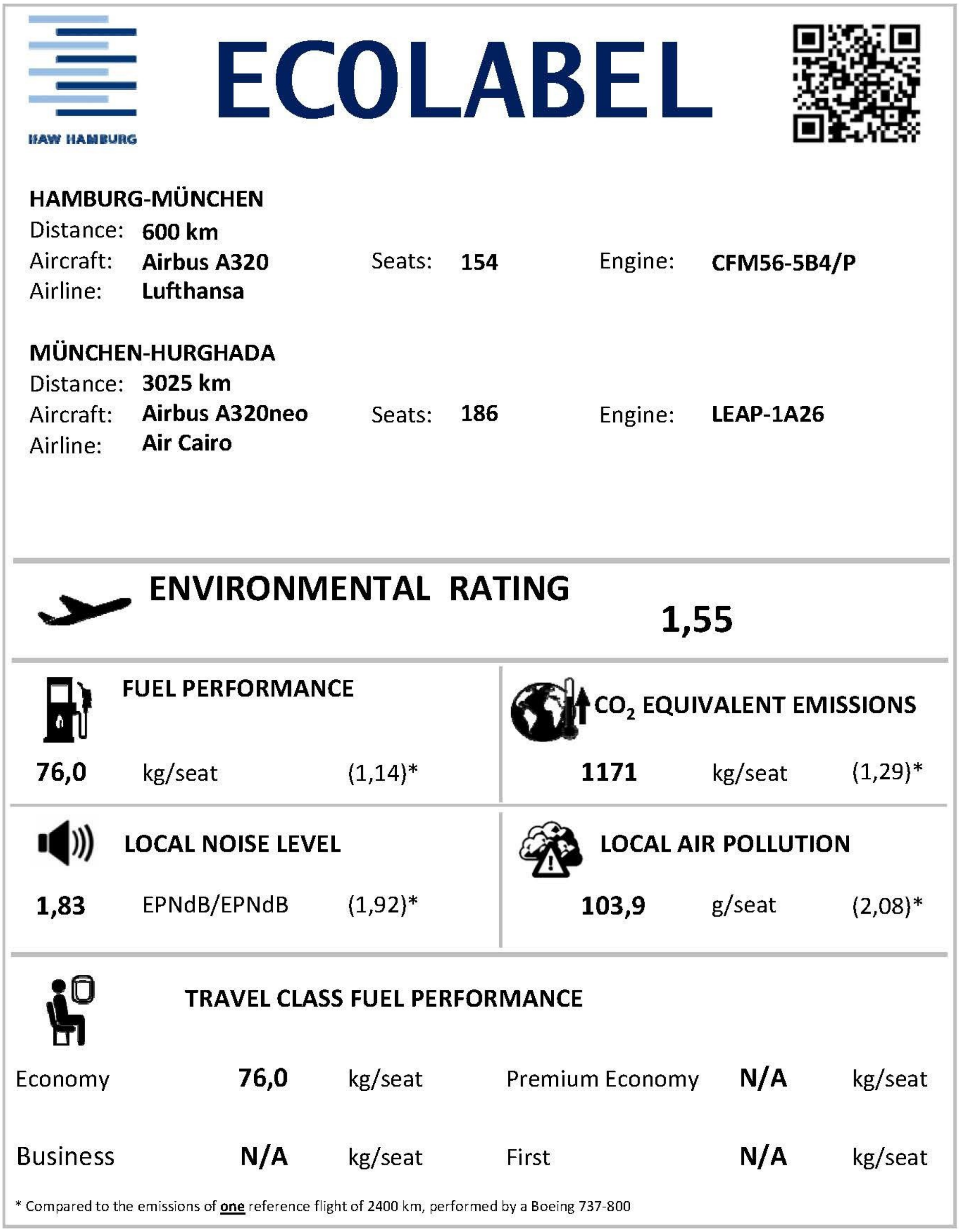

Figure D.45 Trip Emission Ecolabel Hamburg to Hurghada via Munich by Lufthansa and Air Cairo

HAW HAMBURG

ECOLABEL

HAMBURG-FRANKFURT

Distance:	**412 km**				
Aircraft:	**Airbus A321**	Seats:	**192**	Engine:	**V2533-A5**
Airline:	**Lufthansa**				

FRANKFURT-KAIRO

Distance:	**2922 km**				
Aircraft:	**Airbus A321neo**	Seats:	**199**	Engine:	**PW1133G-JM**
Airline:	**Lufthansa**				

KAIRO-HURGHADA

Distance:	**401 km**				
Aircraft:	**Boeing 737-800**	Seats:	**154**	Engine:	**CFM56-7B26**
Airline:	**EgyptAir**				

ENVIRONMENTAL RATING **2,38**

FUEL PERFORMANCE
84,3 kg/seat (1,27)*

CO_2 EQUIVALENT EMISSIONS
1478 kg/seat (1,63)*

LOCAL NOISE LEVEL
2,83 EPNdB/EPNdB (2,97)*

LOCAL AIR POLLUTION
218,8 g/seat (4,38)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**78,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**116,5**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.46 Trip Emission Ecolabel Hamburg to Hurghada via Frankfurt and Cairo by Lufthansa and EgyptAir

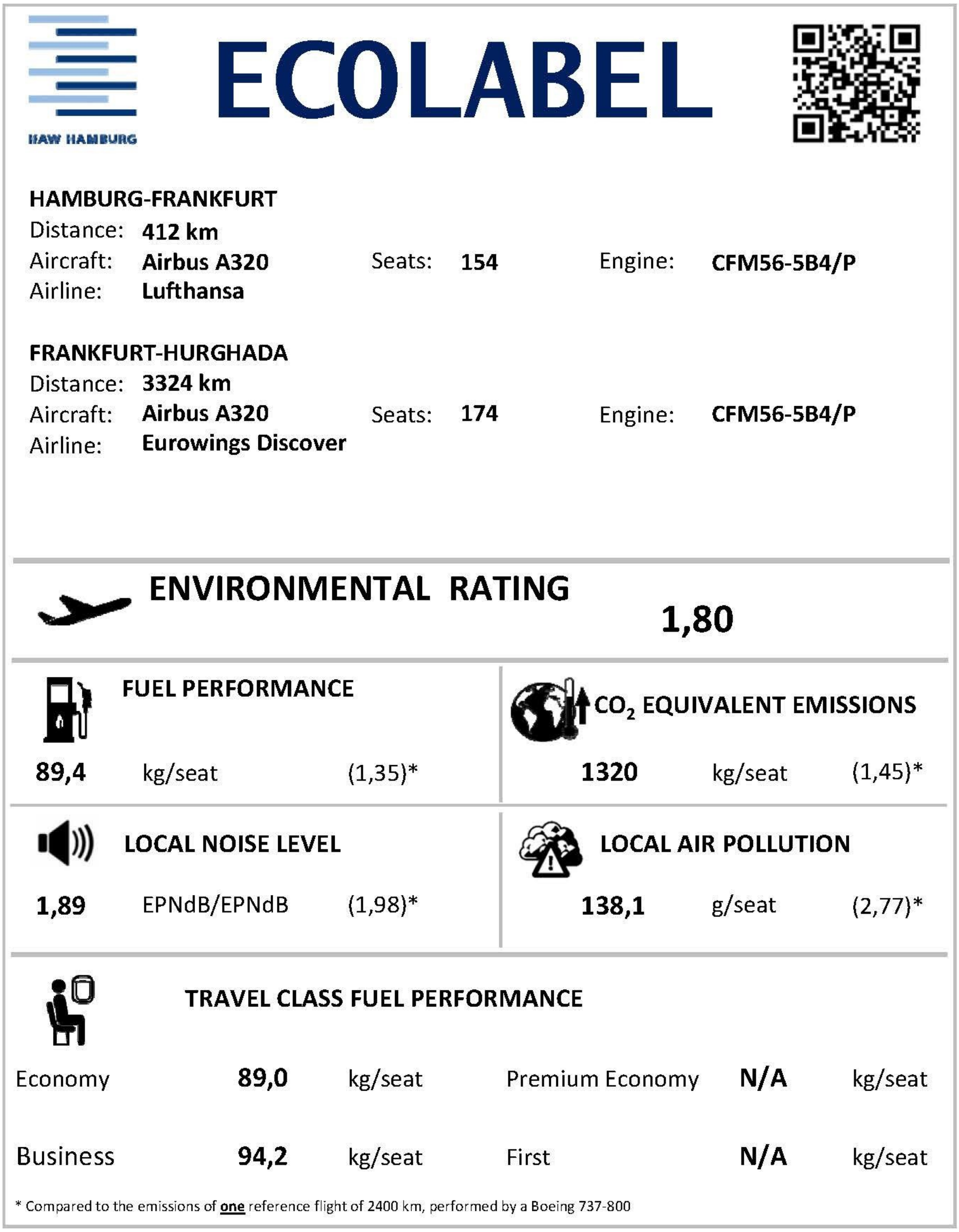

Figure D.47 Trip Emission Ecolabel Hamburg to Hurghada via Frankfurt by Lufthansa and Eurowings Discover

HAW HAMBURG

ECOLABEL

HAMBURG-FRANKFURT
Distance: **412 km**
Aircraft: **Airbus A320neo** Seats: **166** Engine: **PW1127G-JM**
Airline: **Lufthansa**

FRANKFURT-NEW YORK JFK
Distance: **6206 km**
Aircraft: **Boeing 767-300ER** Seats: **257** Engine: **PW4060**
Airline: **Condor**

ENVIRONMENTAL RATING **2,51**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
172,0	kg/seat	(2,59)*	**2278**	kg/seat	(2,51)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,86	EPNdB/EPNdB	(1,95)*	**148,8**	g/seat	(2,98)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**155,0**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**334,4**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.48 Trip Emission Ecolabel Hamburg to New York via Frankfurt by Lufthansa and Condor

HAW HAMBURG

ECOLABEL

HAMBURG-KEFLAVIK
Distance: **2173 km**
Aircraft: **Boeing 737 MAX 9** Seats: **178** Engine: **LEAP-1B28**
Airline: **Icelandair**

KEFLAVIK-NEW YORK JFK
Distance: **4172 km**
Aircraft: **Boeing 767-300ER** Seats: **259** Engine: **CF6-80C2B6**
Airline: **Icelandair**

ENVIRONMENTAL RATING **2,64**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
155,3	kg/seat	(2,34)*	**2404**	kg/seat	(2,64)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,87	EPNdB/EPNdB	(1,96)*	**180,1**	g/seat	(3,61)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**148,1**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**224,1**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.49 Trip Emission Ecolabel Hamburg to New York via Keflavik by Icelandair

ECOLABEL

HAW HAMBURG

HAMBURG-PARIS CDG

Distance:	**729 km**		
Aircraft:	**Airbus A220-300**	Seats: **135**	Engine: **PW1521G-3**
Airline:	**Air France**		

PARIS CDG-NEW YORK JFK

Distance:	**5849 km**		
Aircraft:	**Boeing 777-200ER**	Seats: **280**	Engine: **GE90-90B**
Airline:	**Air France**		

ENVIRONMENTAL RATING **2,92**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
173,6	kg/seat	(2,62)*	**2417**	kg/seat	(2,66)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,84	EPNdB/EPNdB	(1,93)*	**236,8**	g/seat	(4,75)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**150,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**315,9**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.50 Trip Emission Ecolabel Hamburg to New York via Paris by Air France

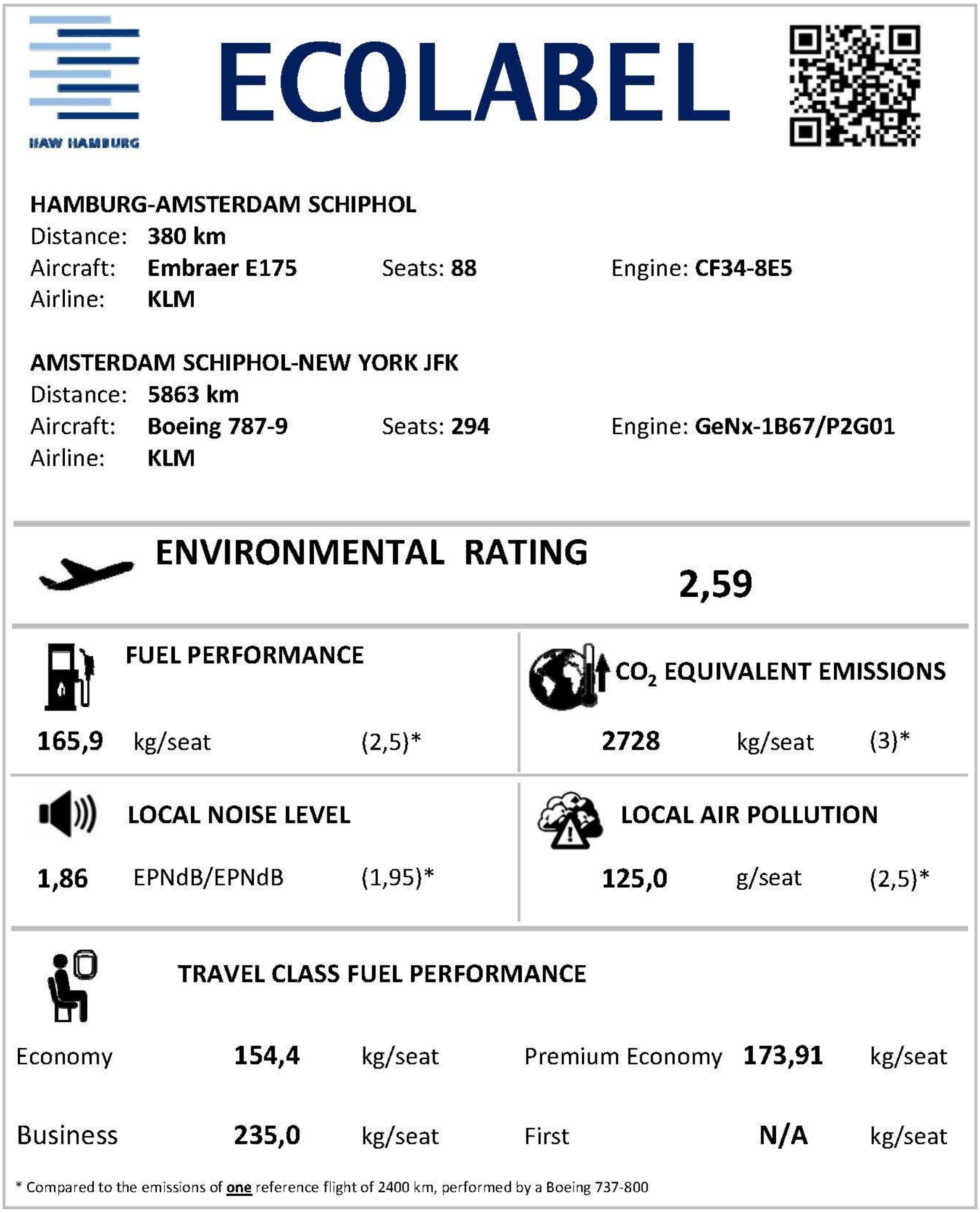

Figure D.51 Trip Emission Ecolabel Hamburg to New York via Amsterdam by KLM

ECOLABEL

HAW HAMBURG

HAMBURG-DUBLIN

Distance: **1076 km**

Aircraft: **Airbus A320** Seats: **174** Engine: **CFM56-5B4/P**

Airline: **Aer Lingus**

DUBLIN-NEW YORK NEWARK

Distance: **5138 km**

Aircraft: **Airbus A321neo** Seats: **184** Engine: **LEAP-1A33**

Airline: **Aer Lingus**

ENVIRONMENTAL RATING **2,56**

FUEL PERFORMANCE				**CO_2 EQUIVALENT EMISSIONS**			
144,1	kg/seat	(2,17)*		**2588**	kg/seat	(2,85)*	
LOCAL NOISE LEVEL				**LOCAL AIR POLLUTION**			
1,86	EPNdB/EPNdB	(1,95)*		**149,6**	g/seat	(3)*	

TRAVEL CLASS FUEL PERFORMANCE

Economy	**138,0**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.52 Trip Emission Ecolabel Hamburg to New York via Dublin by Aer Lingus

ECOLABEL

HAW HAMBURG

HAMBURG-KEFLAVIK
Distance: **2173 km**
Aircraft: **Boeing 737 MAX 9** Seats: **178** Engine: **LEAP-1B28**
Airline: **Icelandair**

KEFLAVIK-NEW YORK NEWARK
Distance: **4186 km**
Aircraft: **Boeing 737 MAX 8** Seats: **160** Engine: **LEAP-1B25**
Airline: **Icelandair**

ENVIRONMENTAL RATING **2,64**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
138,0	kg/seat	(2,08)*	**2815**	kg/seat	(3,1)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,83	EPNdB/EPNdB	(1,92)*	**149,3**	g/seat	(2,99)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**131,7**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**196,7**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.53 Trip Emission Ecolabel Hamburg to New York via Keflavik by Icelandair

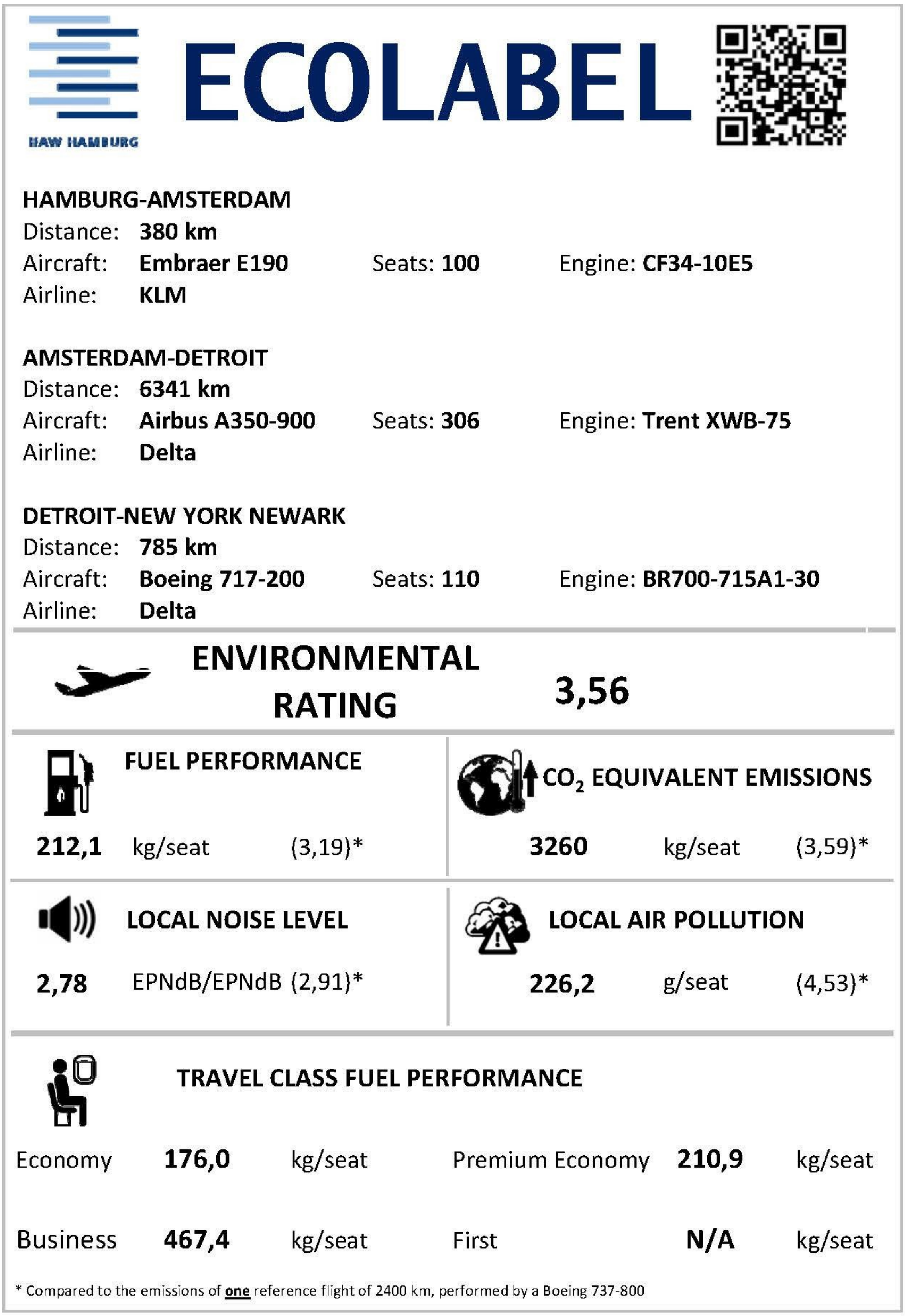

Figure D.54 Trip Emission Ecolabel Hamburg to New York via Amsterdam and Detroit by KLM and Delta Air Lines

ECOLABEL

HAW HAMBURG

HAMBURG-AMSTERDAM
Distance: **380 km**
Aircraft: **Embraer E190** Seats: **100** Engine: **CF34-10E5**
Airline: **KLM**

AMSTERDAM-NEW YORK JFK
Distance: **5884 km**
Aircraft: **Boeing 787-10** Seats: **344** Engine: **GEnx-1B76A/P2G01**
Airline: **KLM**

ENVIRONMENTAL RATING **2,58**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
153,8	kg/seat	(2,32)*	**2498**	kg/seat	(2,75)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,86	EPNdB/EPNdB	(1,95)*	**157,0**	g/seat	(3,15)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**135,6**	kg/seat	Premium Economy	**152,04**	kg/seat
Business	**284,4**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.55 Trip Emission Ecolabel Hamburg to New York via Amsterdam by KLM

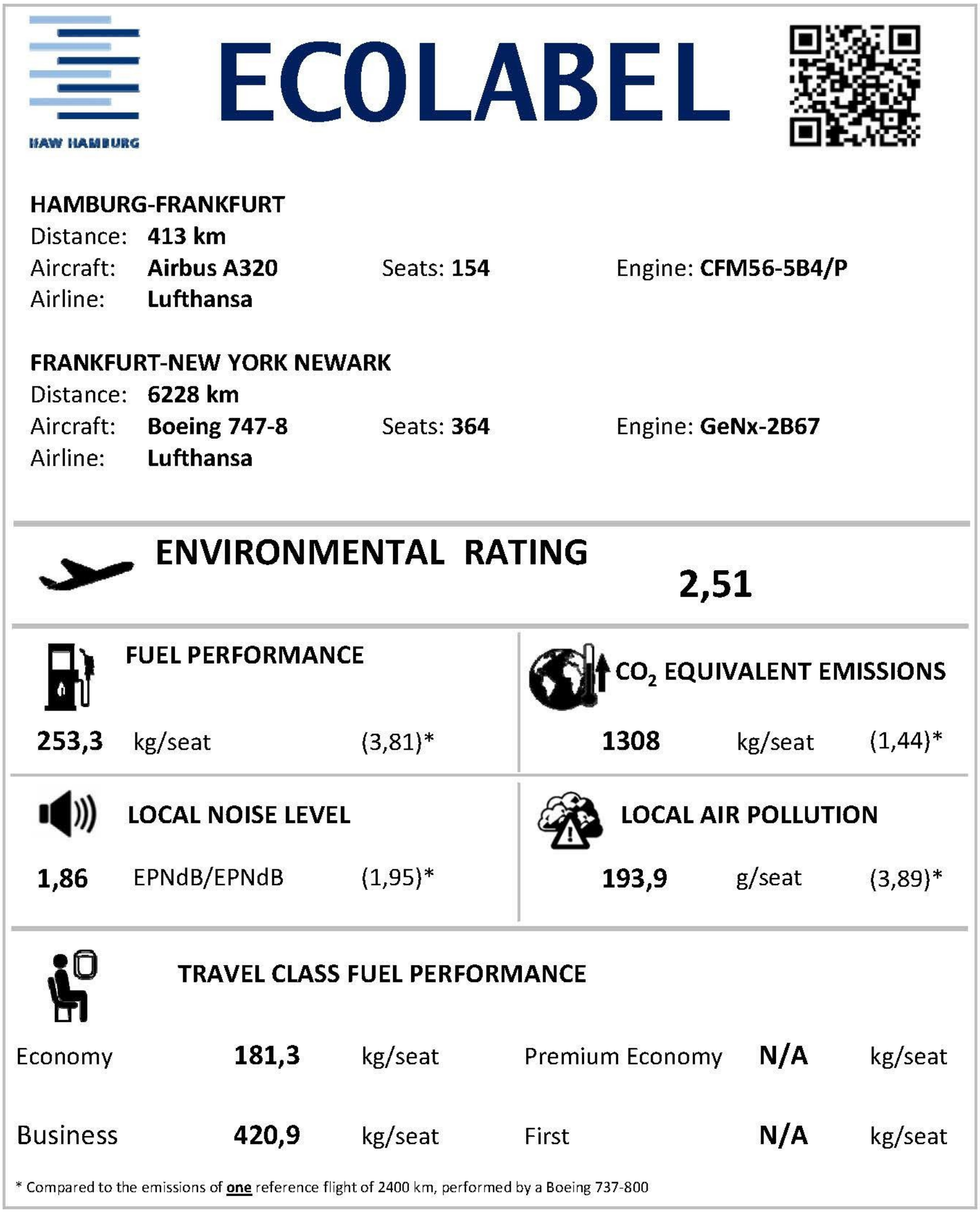

Figure D.56 Trip Emission Ecolabel Hamburg to New York via Frankfurt by Lufthansa

HAW HAMBURG

ECOLABEL

HAMBURG-LISBON
Distance: **2200 km**
Aircraft: **Airbus A320** Seats: **156** Engine: **CFM56-5B4/P**
Airline: **TAP Portugal**

LISBON-NEW YORK JFK
Distance: **5418 km**
Aircraft: **Airbus A330-900** Seats: **298** Engine: **Trent 7000-72**
Airline: **TAP Portugal**

ENVIRONMENTAL RATING **3,43**

FUEL PERFORMANCE	**202,5**	kg/seat	(3,05)*
CO_2 EQUIVALENT EMISSIONS	**3531**	kg/seat	(3,88)*
LOCAL NOISE LEVEL	**1,86**	EPNdB/EPNdB	(1,95)*
LOCAL AIR POLLUTION	**218,2**	g/seat	(4,37)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**183,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**291,7**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.57 Trip Emission Ecolabel Hamburg to New York via Lisbon by TAP Portugal

HAW HAMBURG

ECOLABEL

HAMBURG-MÜNCHEN
Distance: **600 km**
Aircraft: **Airbus A320** Seats: **154** Engine: **CFM56-5B4/P**
Airline: **Lufthansa**

MÜNCHEN-NEW YORK NEWARK
Distance: **6498 km**
Aircraft: **Airbus A350-900** Seats: **293** Engine: **Trent XWB-84**
Airline: **Lufthansa**

ENVIRONMENTAL RATING **3,10**

FUEL PERFORMANCE				**CO_2 EQUIVALENT EMISSIONS**			
191,3	kg/seat	(2,88)*		**2931**	kg/seat	(3,22)*	
LOCAL NOISE LEVEL				**LOCAL AIR POLLUTION**			
1,84	EPNdB/EPNdB	(1,93)*		**211,4**	g/seat	(4,24)*	

TRAVEL CLASS FUEL PERFORMANCE

Economy	**155,8**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**354,4**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.58 Trip Emission Ecolabel Hamburg to New York via Munich by Lufthansa

ECOLABEL

HAW HAMBURG

HAMBURG-FRANKFURT

Distance: **412 km**

Aircraft: **Airbus A320** Seats: **154** Engine: **CFM56-5B4/P**

Airline: **Lufthansa**

FRANKFURT-LAS PALMAS DE GRAN CANARIA

Distance: **3185 km**

Aircraft: **Airbus A320** Seats: **174** Engine: **CFM56-5B4/P**

Airline: **Eurowings Discover**

ENVIRONMENTAL RATING **1,77**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
86,2	kg/seat	(1,3)*	**1273**	kg/seat	(1,4)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,89	EPNdB/EPNdB	(1,98)*	**138,1**	g/seat	(2,77)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**85,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**90,8**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.59 Trip Emission Ecolabel Hamburg to Gran Canaria via Frankfurt by Lufthansa and Eurowings Discover

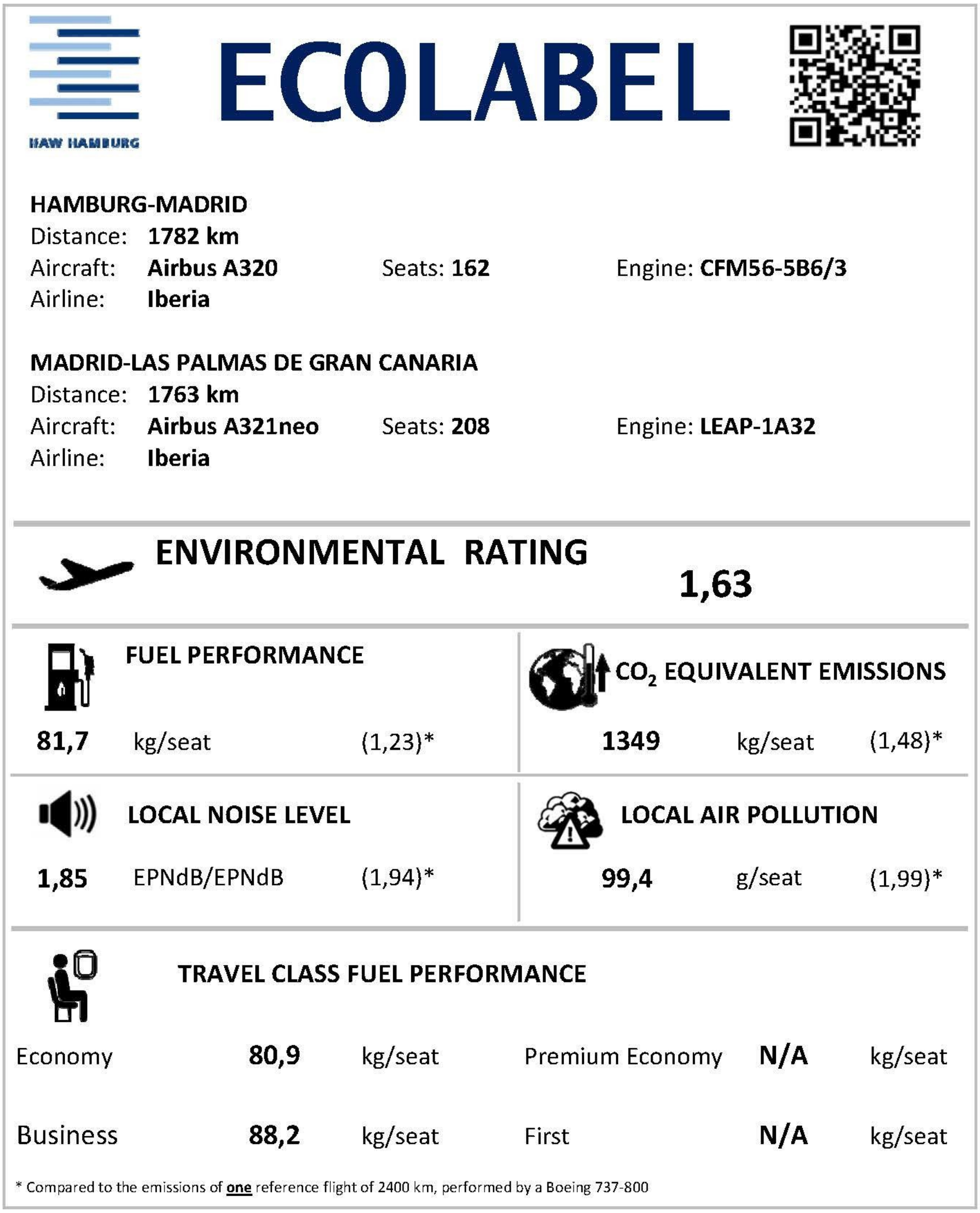

Figure D.60 Trip Emission Ecolabel Hamburg to Gran Canaria via Madrid by Iberia

HAW HAMBURG

ECOLABEL

HAMBURG-BARCELONA
Distance: **1493 km**
Aircraft: **Airbus A320** Seats: **180** Engine: **CFM56-5B4/P**
Airline: **Vueling**

BARCELONA-LAS PALMAS DE GRAN CANARIA
Distance: **2175 km**
Aircraft: **Airbus A320** Seats: **180** Engine: **CFM56-5B4/P**
Airline: **Vueling**

ENVIRONMENTAL RATING **1,69**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
83,6	kg/seat	(1,26)*	**1234**	kg/seat	(1,36)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,89	EPNdB/EPNdB	(1,98)*	**125,4**	g/seat	(2,51)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**83,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.61 Trip Emission Ecolabel Hamburg to Gran Canaria via Barcelona by Vueling

ECOLABEL

HAW HAMBURG

HAMBURG-FUERTEVENTURA

Distance:	**3406 km**		
Aircraft:	**Boeing 757-300**	Seats: **262**	Engine: **RB211-535E4B-37**
Airline:	**Condor**		

FUERTEVENTURA-LAS PALMAS DE GRAN CANARIA

Distance:	**160 km**		
Aircraft:	**ATR 72**	Seats: **72**	Engine: **PW127M**
Airline:	**Binter Canarias**		

ENVIRONMENTAL RATING **1,75**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
90,9	kg/seat	(1,37)*	**1431**	kg/seat	(1,57)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,83	EPNdB/EPNdB	(1,92)*	**116,3**	g/seat	(2,33)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**90,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.62 Trip Emission Ecolabel Hamburg to Gran Canaria via Fuerteventura by Condor and Binter Canarias

ECOLABEL

HAMBURG-ZÜRICH
Distance: **693 km**
Aircraft: **Airbus A321** Seats: **219** Engine: **CFM56-5B1/3**
Airline: **Swiss**

ZÜRICH-LAS PALMAS DE GRAN CANARIA
Distance: **3002 km**
Aircraft: **Airbus A320** Seats: **174** Engine: **CFM56-5B4/P**
Airline: **Edelweiss Air**

ENVIRONMENTAL RATING **1,66**

FUEL PERFORMANCE	**82,7**	kg/seat	(1,25)*
CO_2 EQUIVALENT EMISSIONS	**1224**	kg/seat	(1,35)*
LOCAL NOISE LEVEL	**1,91**	EPNdB/EPNdB	(2,01)*
LOCAL AIR POLLUTION	**117,3**	g/seat	(2,35)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**82,1**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**87,9**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.63 Trip Emission Ecolabel Hamburg to Gran Canaria via Zürich by Swiss and Edelweiss Air

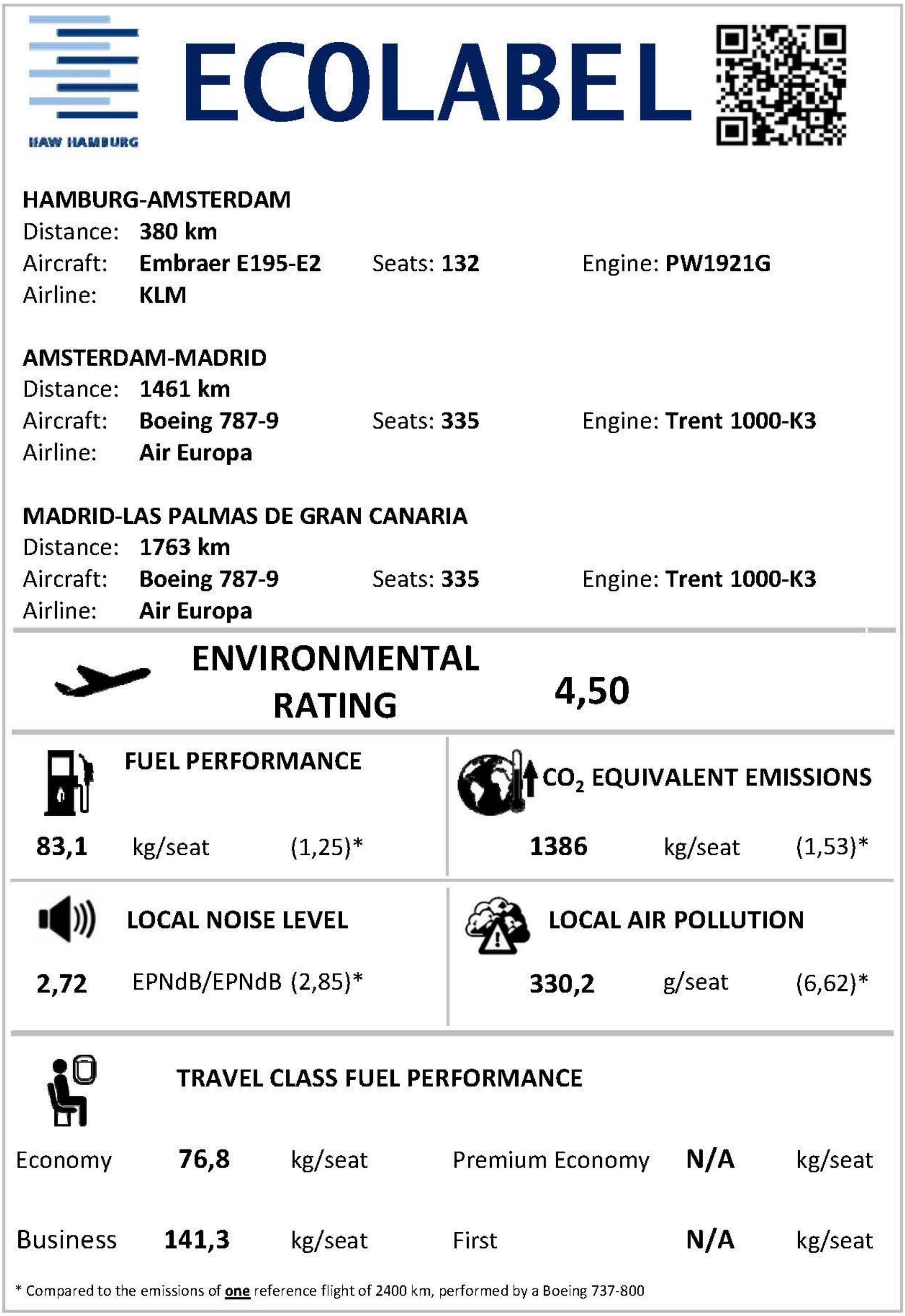

Figure D.64 Trip Emission Ecolabel Hamburg to Gran Canaria via Amsterdam and Madrid by KLM and Air Europa

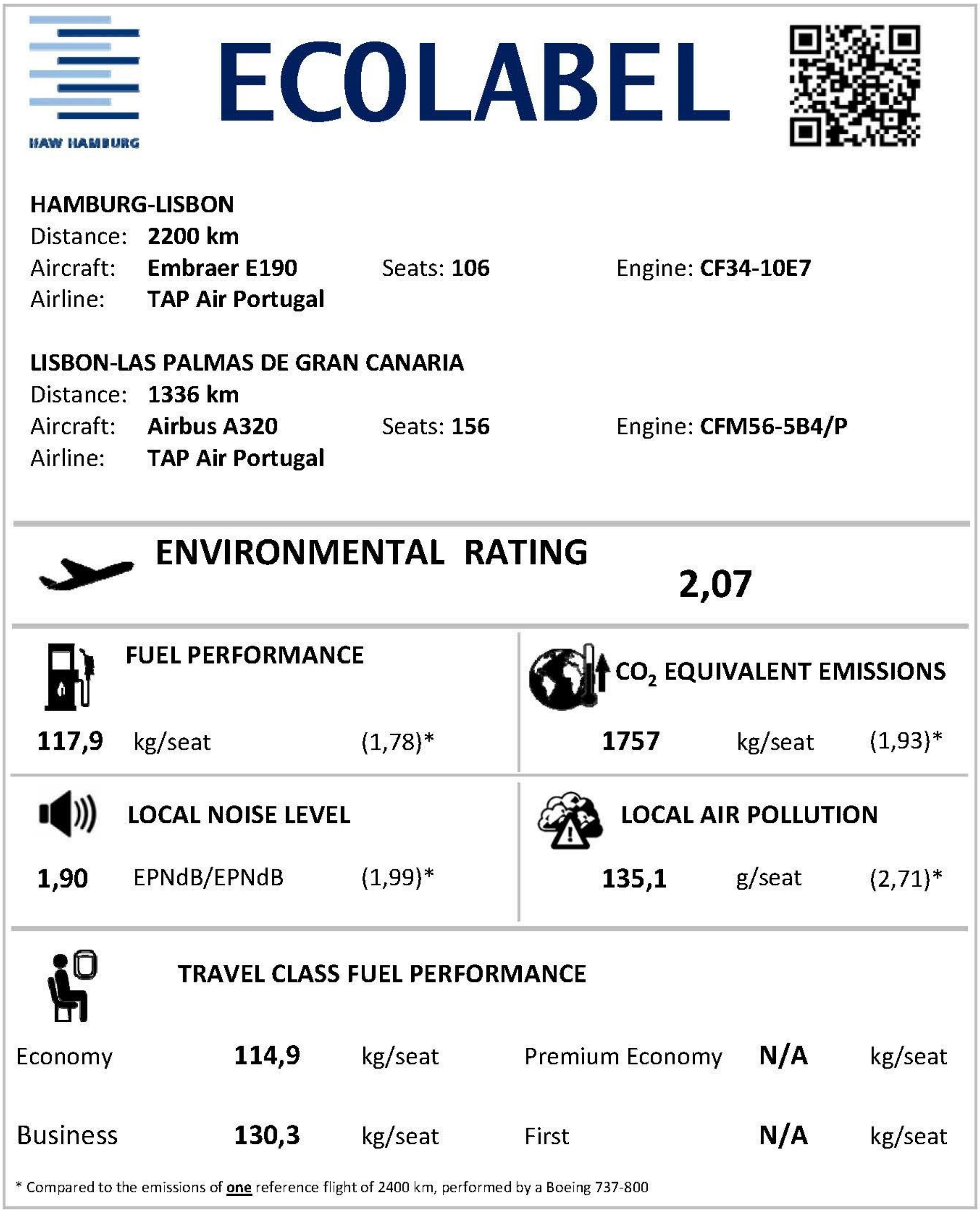

Figure D.65 Trip Emission Ecolabel Hamburg to Gran Canaria via Lisbon by TAP Air Portugal

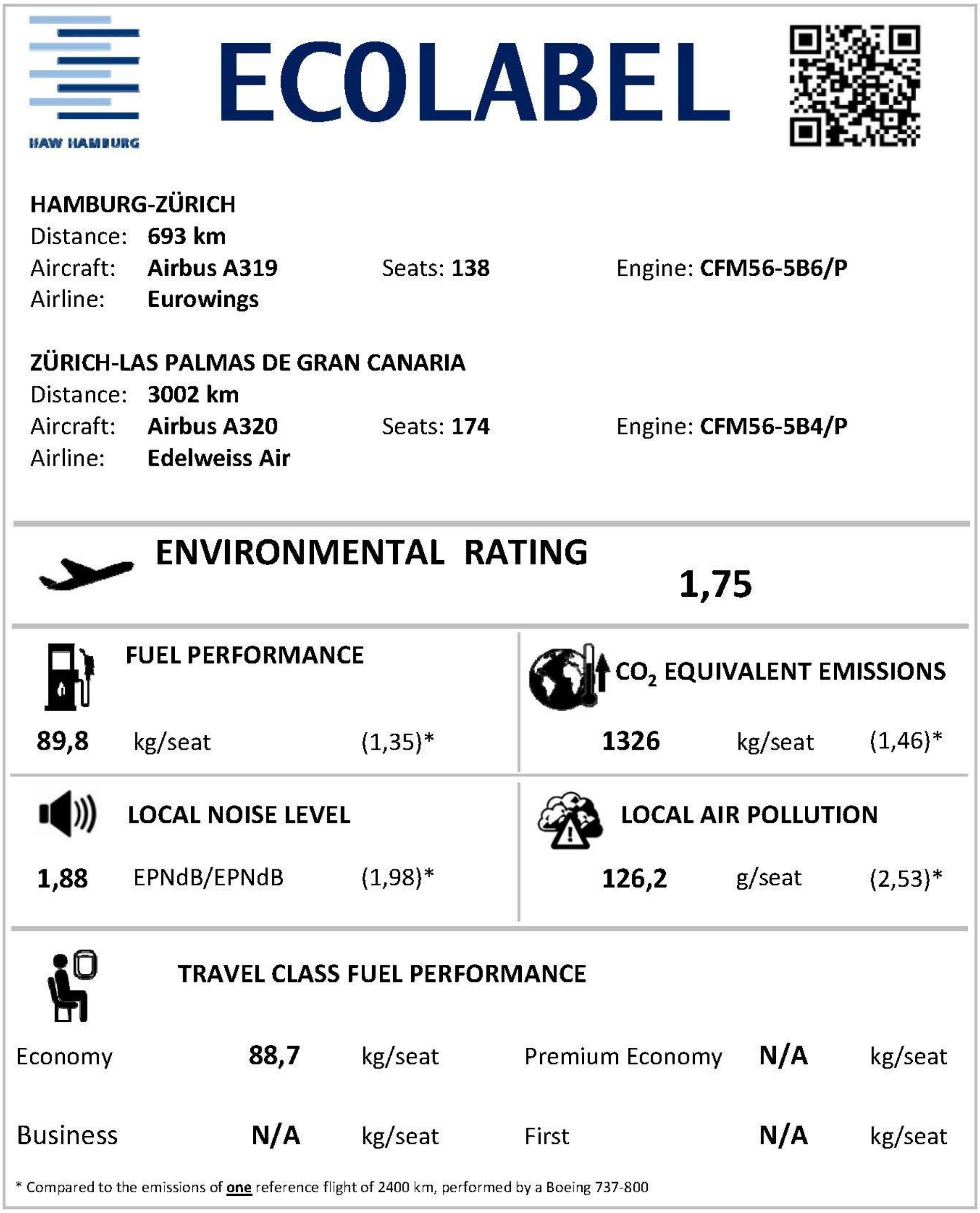

Figure D.66 Trip Emission Ecolabel Hamburg to Gran Canaria via Zürich by Eurowings and Edelweiss Air

HAW HAMBURG

ECOLABEL

HAMBURG-WIEN

Distance:	**769 km**		
Aircraft:	**Airbus A320**	Seats: **161**	Engine: **CFM56-5B4/P**
Airline:	**Austrian Airlines**		

WIEN-LAS PALMAS DE GRAN CANARIA

Distance:	**3547 km**		
Aircraft:	**Airbus A320**	Seats: **161**	Engine: **CFM56-5B4/P**
Airline:	**Austrian Airlines**		

ENVIRONMENTAL RATING **2,00**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
109,5	kg/seat	(1,65)*	**1617**	kg/seat	(1,78)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,89	EPNdB/EPNdB	(1,98)*	**140,1**	g/seat	(2,81)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**107,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**118,7**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.67 Trip Emission Ecolabel Hamburg to Gran Canaria via Vienna by Austrian Airlines

HAW HAMBURG

ECOLABEL

HAMBURG-MADRID
Distance: **1782 km**
Aircraft: **Airbus A320** Seats: **162** Engine: **CFM56-5B6/3**
Airline: **Iberia**

MADRID-VIGO
Distance: **467 km**
Aircraft: **Airbus A319** Seats: **208** Engine: **CFM56-5B5/3**
Airline: **Iberia**

VIGO-LAS PALMAS DE GRAN CANARIA
Distance: **1701 km**
Aircraft: **Bombardier CRJ1000** Seats: **100** Engine: **CF34-8C5A2**
Airline: **Iberia**

ENVIRONMENTAL RATING **4,50**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
105,4	kg/seat	(1,59)*	**1584**	kg/seat	(1,74)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
2,83	EPNdB/EPNdB	(2,96)*	**119,2**	g/seat	(2,39)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**104,8**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.68 Trip Emission Ecolabel Hamburg to Gran Canaria via Madrid and Vigo by Iberia

HAW HAMBURG

ECOLABEL

HAMBURG-ISTANBUL ATATÜRK

Distance:	**1990 km**				
Aircraft:	**Airbus A321**	Seats:	**178**	Engine:	**V2533-A5**
Airline:	**Turkish Airlines**				

ISTANBUL ATATÜRK-MEXICO CITY

Distance:	**11432 km**				
Aircraft:	**Boeing 777-300ER**	Seats:	**349**	Engine:	**GE90-115B**
Airline:	**Turkish Airlines**				

ENVIRONMENTAL RATING **5,22**

FUEL PERFORMANCE	**398,3**	kg/seat	(6)*
CO_2 EQUIVALENT EMISSIONS	**5530**	kg/seat	(6,08)*
LOCAL NOISE LEVEL	**1,91**	EPNdB/EPNdB	(2)*
LOCAL AIR POLLUTION	**297,1**	g/seat	(5,95)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**318,0**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**892,7**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.69 Trip Emission Ecolabel Hamburg to Mexico City via Istanbul by Turkish Airlines

ECOLABEL

HAMBURG-AMSTERDAM

Distance:	**380 km**				
Aircraft:	**Embraer E190**	Seats:	**100**	Engine:	**CF34-10E5**
Airline:	**KLM**				

AMSTERDAM-MEXICO CITY

Distance:	**9220 km**				
Aircraft:	**Boeing 787-9**	Seats:	**294**	Engine:	**GeNx-1B67/P2G01**
Airline:	**KLM**				

ENVIRONMENTAL RATING

3,51

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
252,3	kg/seat	(3,8)*	**4163**	kg/seat	(4,58)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,85	EPNdB/EPNdB	(1,94)*	**131,2**	g/seat	(2,63)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**234,7**	kg/seat	Premium Economy	**263,97**	kg/seat
Business	**359,7**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of one reference flight of 2400 km, performed by a Boeing 737-800

Figure D.70 Trip Emission Ecolabel Hamburg to Mexico City via Amsterdam by KLM

HAW HAMBURG

ECOLABEL

HAMBURG-PARIS CHALES DE GAULLE

Distance:	**729 km**				
Aircraft:	**Airbus A320**	Seats:	**178**	Engine:	**CFM56-5B4/P**
Airline:	**Air France**				

PARIS CHALES DE GAULLE-MEXICO CITY

Distance:	**9213 km**				
Aircraft:	**Boeing 777-300ER**	Seats:	**381**	Engine:	**GE90-115B**
Airline:	**Air France**				

ENVIRONMENTAL RATING **3,93**

FUEL PERFORMANCE		
280,3	kg/seat	(4,22)*
CO_2 EQUIVALENT EMISSIONS		
3870	kg/seat	(4,26)*
LOCAL NOISE LEVEL		
1,89	EPNdB/EPNdB	(1,98)*
LOCAL AIR POLLUTION		
246,5	g/seat	(4,94)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**240,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.71 Trip Emission Ecolabel Hamburg to Mexico City via Paris by Air France

HAW HAMBURG

ECOLABEL

HAMBURG-PARIS CHALES DE GAULLE
Distance: **729 km**
Aircraft: **Airbus A319** Seats: **142** Engine: **CFM56-5B5/3**
Airline: **Air France**

PARIS CHALES DE GAULLE-ATLANTA
Distance: **7072 km**
Aircraft: **Boeing 777-200ER** Seats: **280** Engine: **GE90-90B**
Airline: **Air France**

ATLANTA-MEXICO CITY
Distance: **2141 km**
Aircraft: **Boeing 737-800** Seats: **160** Engine: **CFM56-7B26**
Airline: **Delta Air Lines**

ENVIRONMENTAL RATING **4,25**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
267,1	kg/seat	(4,02)*	**3655**	kg/seat	(4,02)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
2,82	EPNdB/EPNdB	(2,95)*	**310,1**	g/seat	(6,21)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**236,4**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of one reference flight of 2400 km, performed by a Boeing 737-800

Figure D.72 Trip Emission Ecolabel Hamburg to Mexico City via Paris and Atlanta by Air France and Delta Air Lines

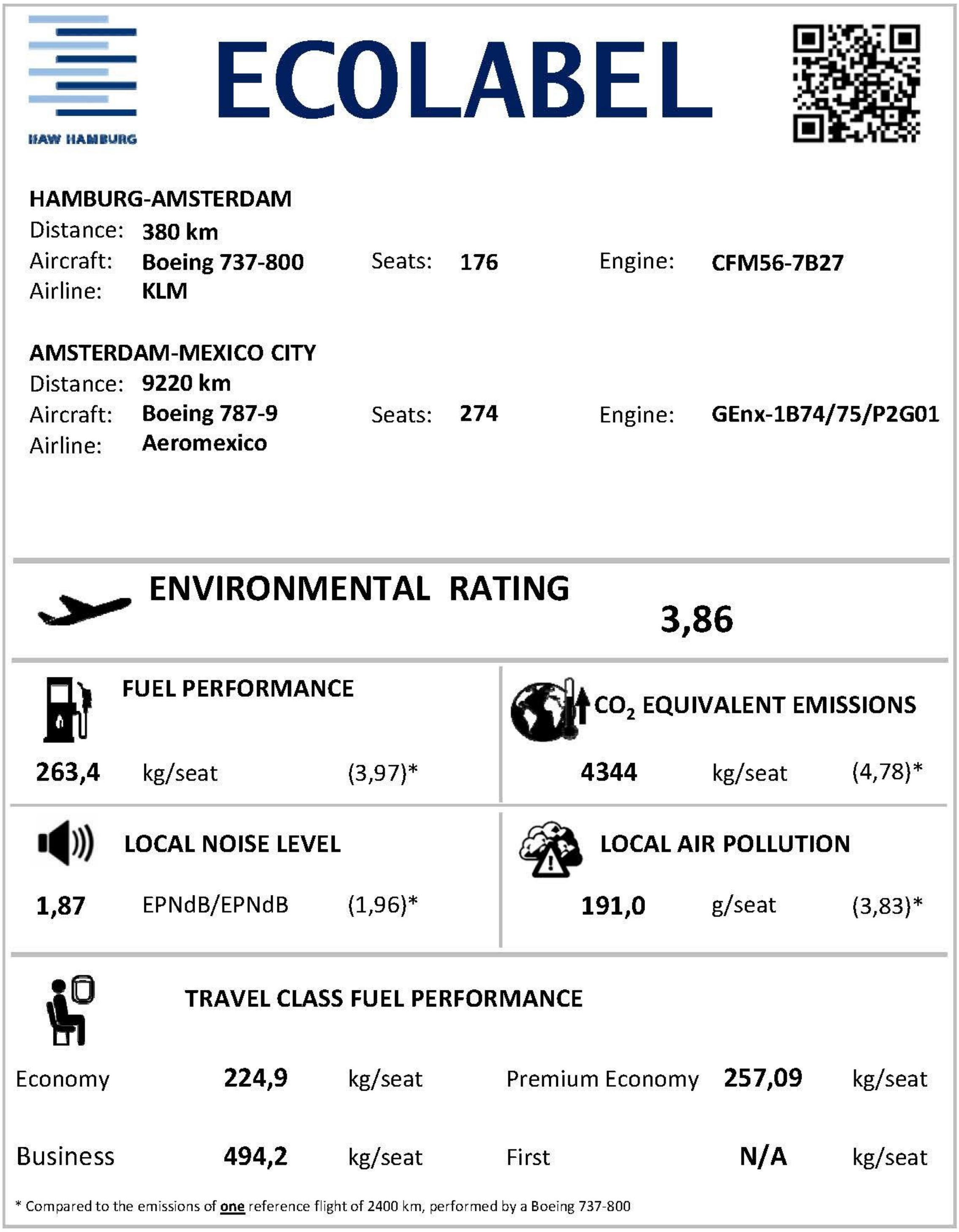

Figure D.73 Trip Emission Ecolabel Hamburg to Mexico City via Amsterdam by KLM and Aeromexico

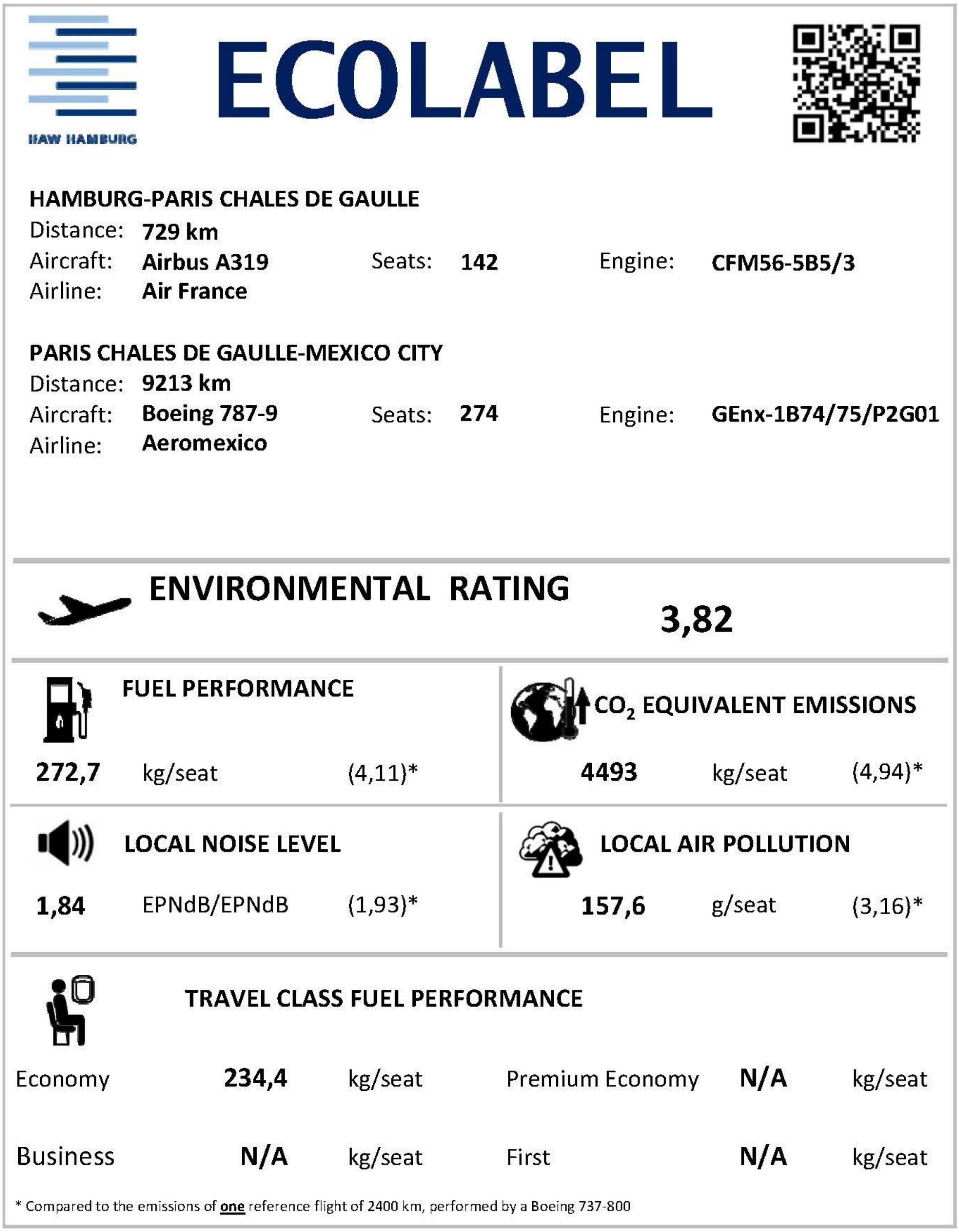

Figure D.74 Trip Emission Ecolabel Hamburg to Mexico City via Paris by Air France and Aeromexico

ECOLABEL

HAMBURG-FRANKFURT
Distance: **412 km**
Aircraft: **Airbus A321** Seats: **192** Engine: **V2533-A5**
Airline: **Lufthansa**

FRANKFURT-NEW YORK JFK
Distance: **6206 km**
Aircraft: **Airbus A380-800** Seats: **475** Engine: **Trent 970-84**
Airline: **Singapore Airlines**

NEW YORK JFK-MEXICO CITY
Distance: **3364 km**
Aircraft: **Boeing 787-9** Seats: **274** Engine: **GEnx-1B74/75/P2G01**
Airline: **Aeromexico**

ENVIRONMENTAL RATING **5,99**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
325,7	kg/seat	(4,91)*	**6894**	kg/seat	(7,59)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
2,79	EPNdB/EPNdB	(2,92)*	**346,4**	g/seat	(6,94)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**251,5**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**635,8**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.75 Trip Emission Ecolabel Hamburg to Mexico City via Frankfurt and New York by Lufthansa, Singapore Airlines and Aeromexico

HAW HAMBURG

ECOLABEL

HAMBURG-FRANKFURT

Distance:	**412 km**				
Aircraft:	**Airbus A321**	Seats:	**192**	Engine:	**V2533-A5**
Airline:	**Lufthansa**				

FRANKFURT-MEXICO CITY

Distance:	**9567 km**				
Aircraft:	**Boeing 747-8**	Seats:	**364**	Engine:	**GeNx-2B67**
Airline:	**Lufthansa**				

ENVIRONMENTAL RATING **3,20**

FUEL PERFORMANCE		
378,6	kg/seat	(5,7)*
CO_2 EQUIVALENT EMISSIONS		
1868	kg/seat	(2,06)*
LOCAL NOISE LEVEL		
1,88	EPNdB/EPNdB	(1,97)*
LOCAL AIR POLLUTION		
210,7	g/seat	(4,22)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**267,8**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**639,0**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.76 Trip Emission Ecolabel Hamburg to Mexico City via Frankfurt by Lufthansa

HAW HAMBURG

ECOLABEL

HAMBURG-FRANKFURT

Distance:	**412 km**				
Aircraft:	**Airbus A321**	Seats:	**192**	Engine:	**V2533-A5**
Airline:	**Lufthansa**				

FRANKFURT-WASHINGTON D.C.

Distance:	**6568 km**				
Aircraft:	**Boeing 747-8**	Seats:	**364**	Engine:	**GeNx-2B67**
Airline:	**Lufthansa**				

WASHINGTON D.C.-MEXICO CITY

Distance:	**3000 km**				
Aircraft:	**Airbus A320**	Seats:	**150**	Engine:	**V2527-A5**
Airline:	**United Airlines**				

ENVIRONMENTAL RATING **3,87**

FUEL PERFORMANCE

344,5 kg/seat (5,19)*

CO_2 EQUIVALENT EMISSIONS

2526 kg/seat (2,78)*

LOCAL NOISE LEVEL

2,81 EPNdB/EPNdB (2,95)*

LOCAL AIR POLLUTION

282,5 g/seat (5,66)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**261,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of one reference flight of 2400 km, performed by a Boeing 737-800

Figure D.77 Trip Emission Ecolabel Hamburg to Mexico City via Frankfurt and Washington D.C. by Lufthansa and United Airlines

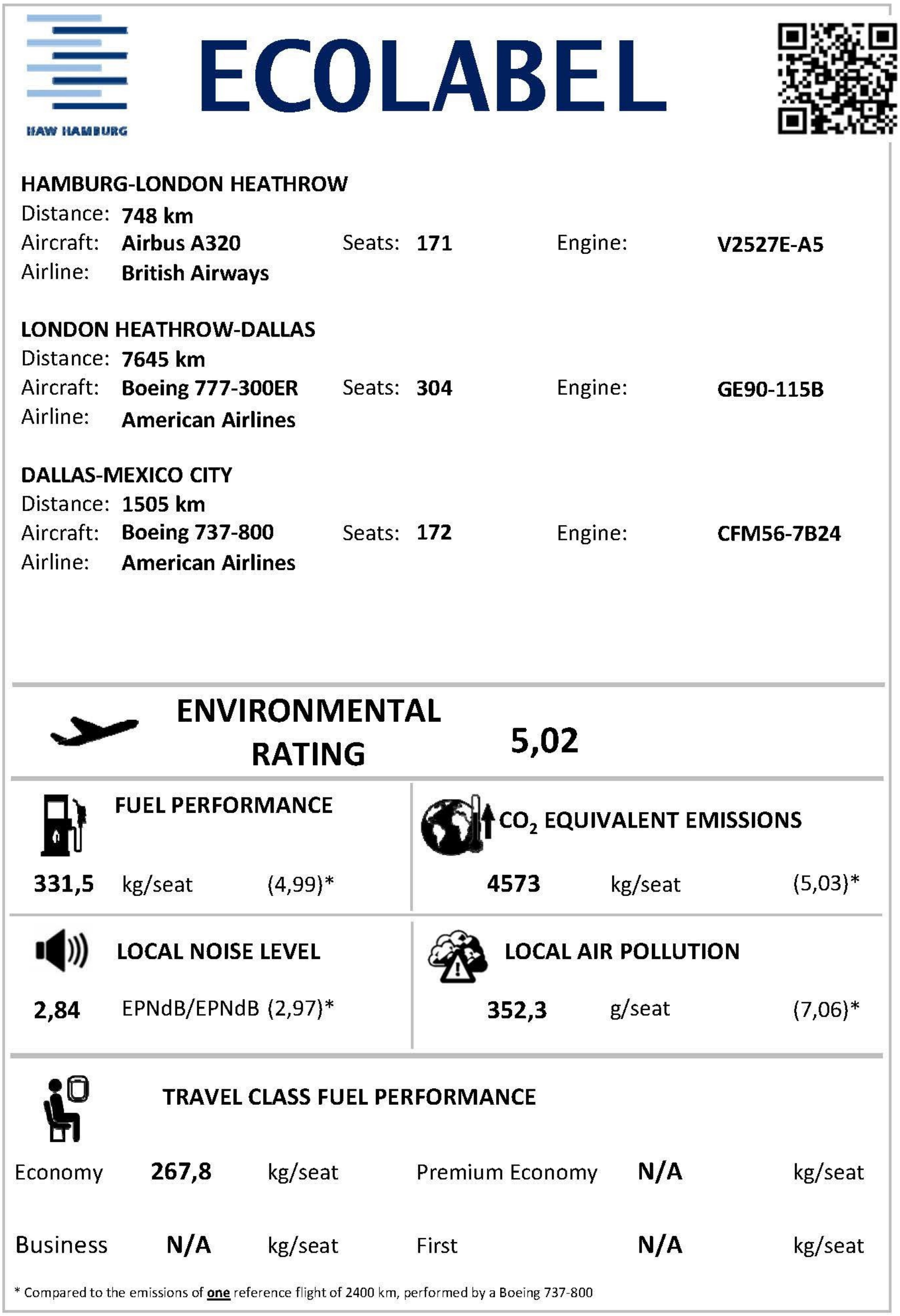

Figure D.78 Trip Emission Ecolabel Hamburg to Mexico City via London Heathrow and Dallas by British Airways and American Airlines

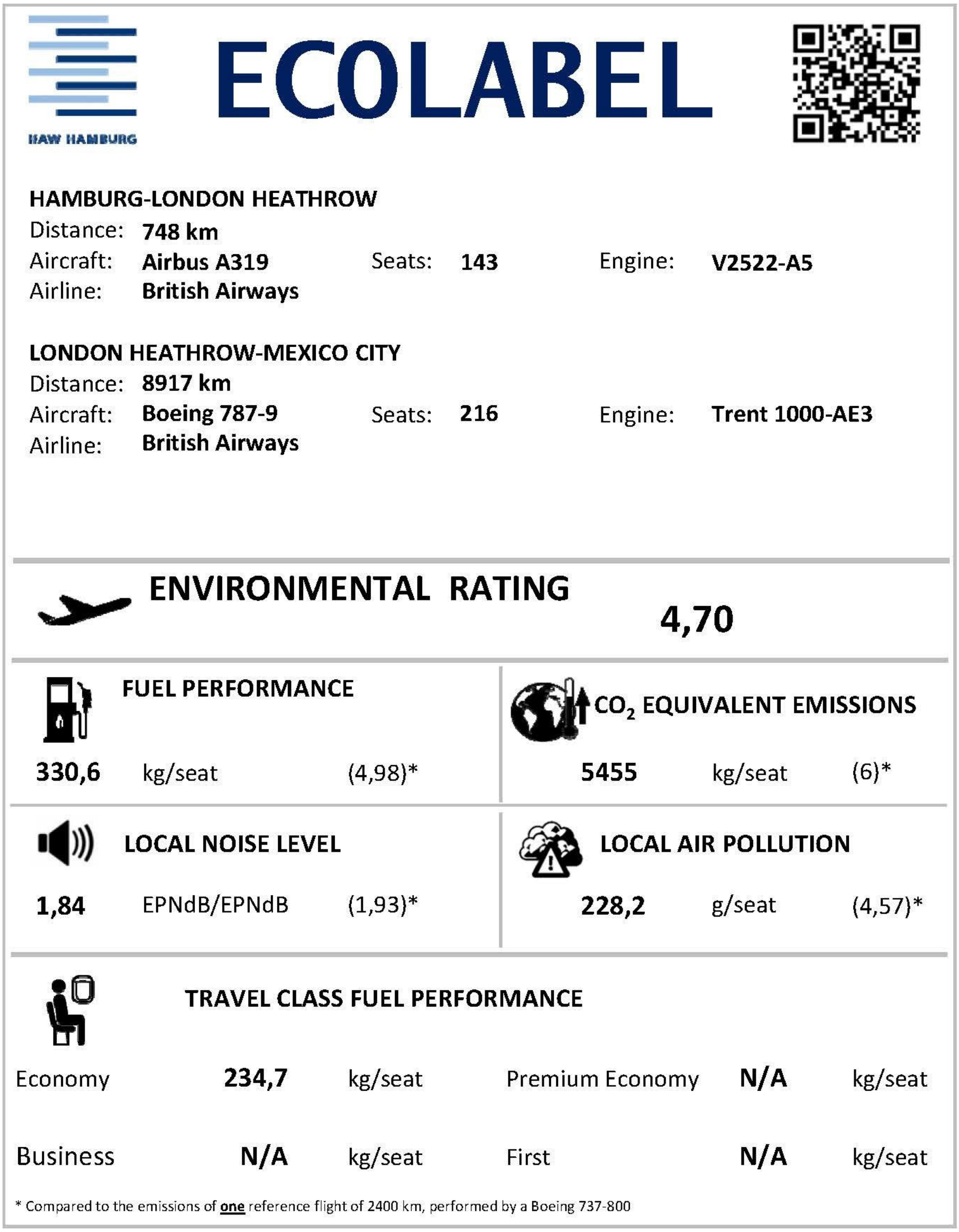

Figure D.79 Trip Emission Ecolabel Hamburg to Mexico City via London Heathrow by British Airways

HAW HAMBURG

ECOLABEL

HAMBURG-MÜNCHEN

Distance:	**600 km**
Aircraft:	**Airbus A320**
Seats:	**174**
Engine:	**CFM56-5B4/P**
Airline:	**Eurowings**

ENVIRONMENTAL RATING

0,60

FUEL PERFORMANCE

14,9 kg/seat (0,22)*

CO_2 EQUIVALENT EMISSIONS

220 kg/seat (0,24)*

LOCAL NOISE LEVEL

0,94 EPNdB/EPNdB (0,99)*

LOCAL AIR POLLUTION

64,8 g/seat (1,3)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**14,3**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**22,9**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.80 Trip Emission Ecolabel Hamburg to Munich by Eurowings

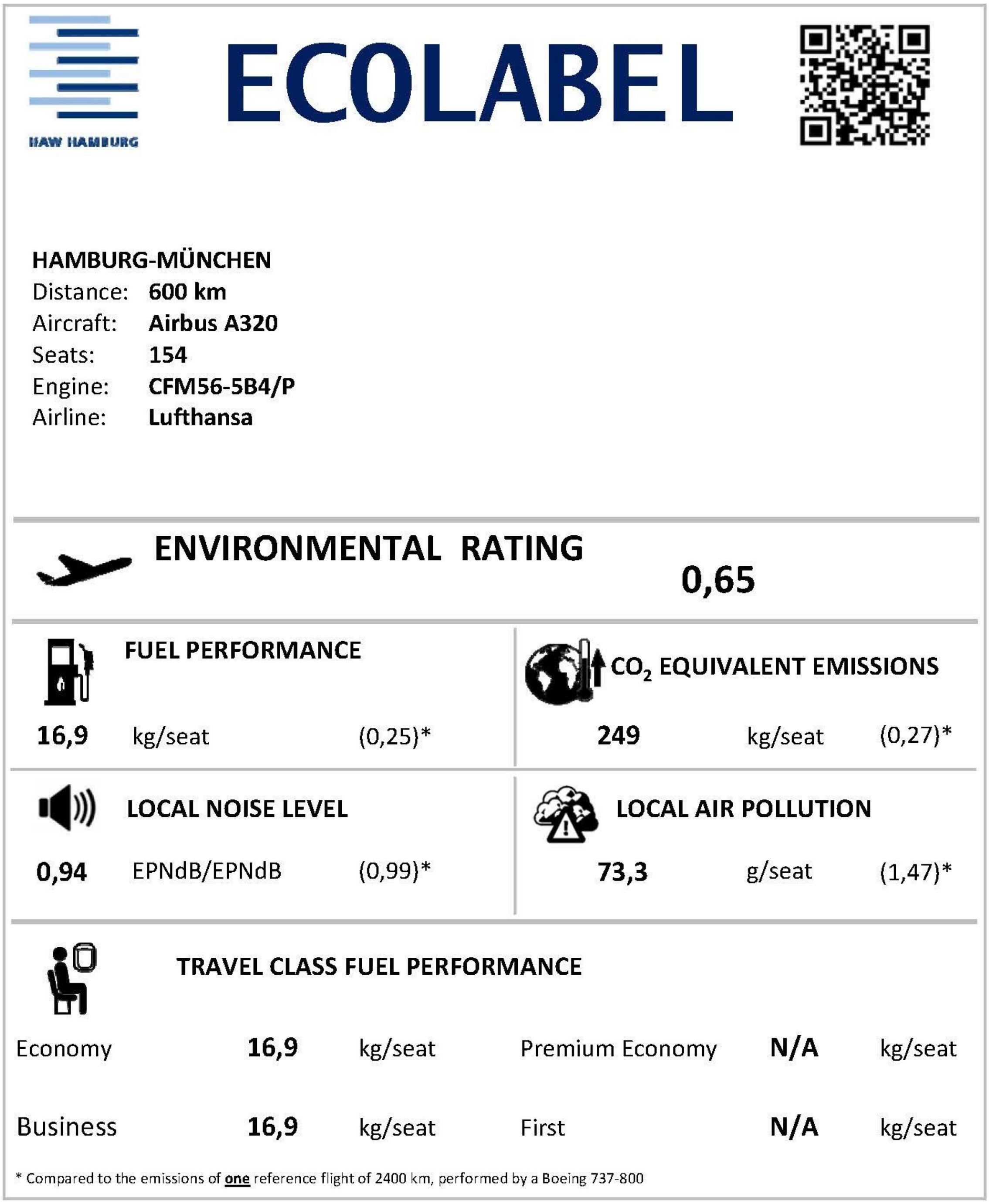

Figure D.81 Trip Emission Ecolabel Hamburg to Munich by Lufthansa

HAW HAMBURG

ECOLABEL

HAMBURG-MÜNCHEN

Distance:	**600 km**
Aircraft:	**Airbus A321**
Seats:	**192**
Engine:	**V2533-A5**
Airline:	**Lufthansa**

ENVIRONMENTAL RATING

0,68

FUEL PERFORMANCE				**CO_2 EQUIVALENT EMISSIONS**			
12,6	kg/seat	(0,19)*		**190**	kg/seat	(0,21)*	
LOCAL NOISE LEVEL				**LOCAL AIR POLLUTION**			
0,96	EPNdB/EPNdB	(1,01)*		**90,1**	g/seat	(1,8)*	

TRAVEL CLASS FUEL PERFORMANCE

Economy	**11,8**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**17,7**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.82 Trip Emission Ecolabel Hamburg to Munich by Lufthansa

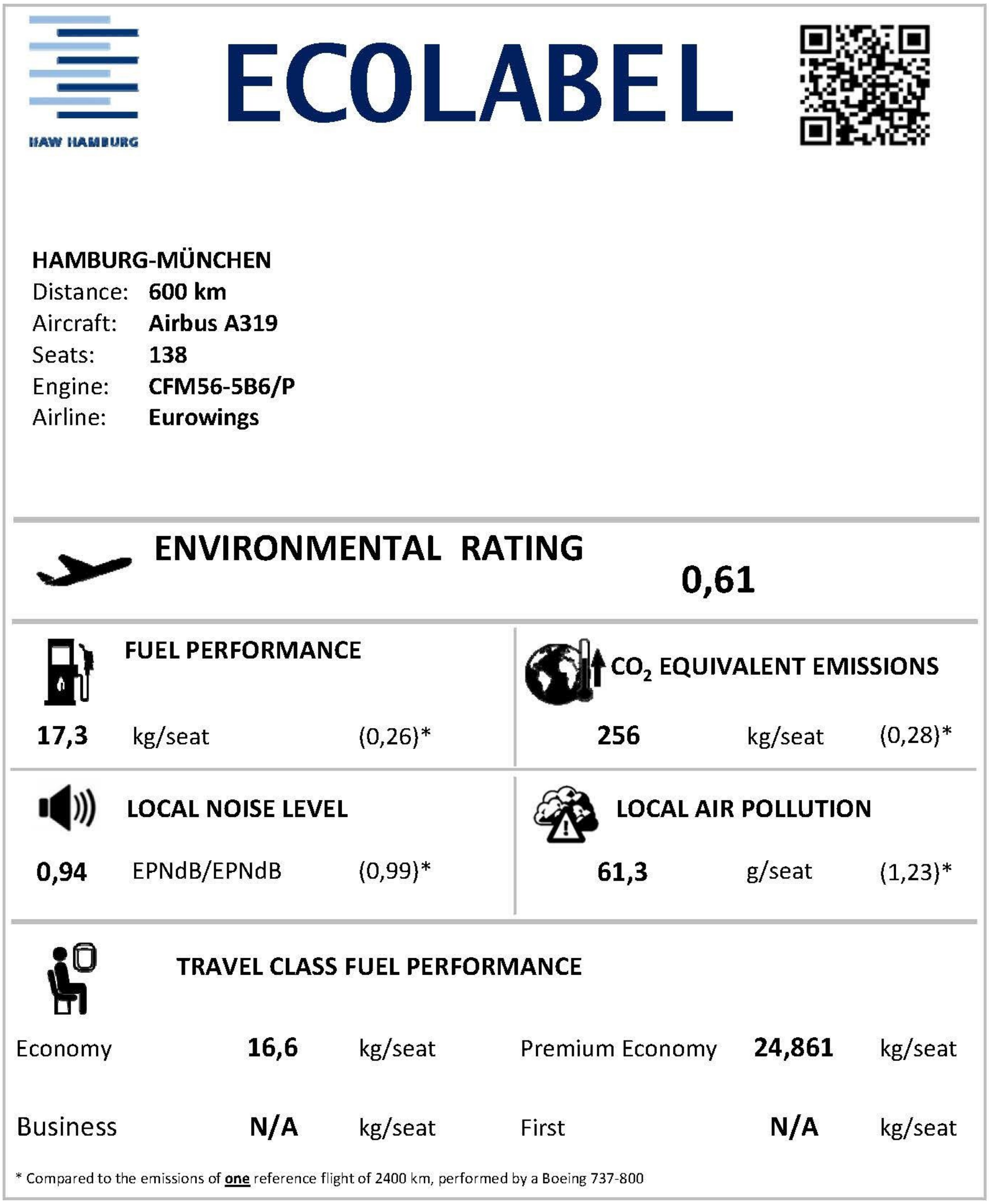

Figure D.83 Trip Emission Ecolabel Hamburg to Munich by Eurowings

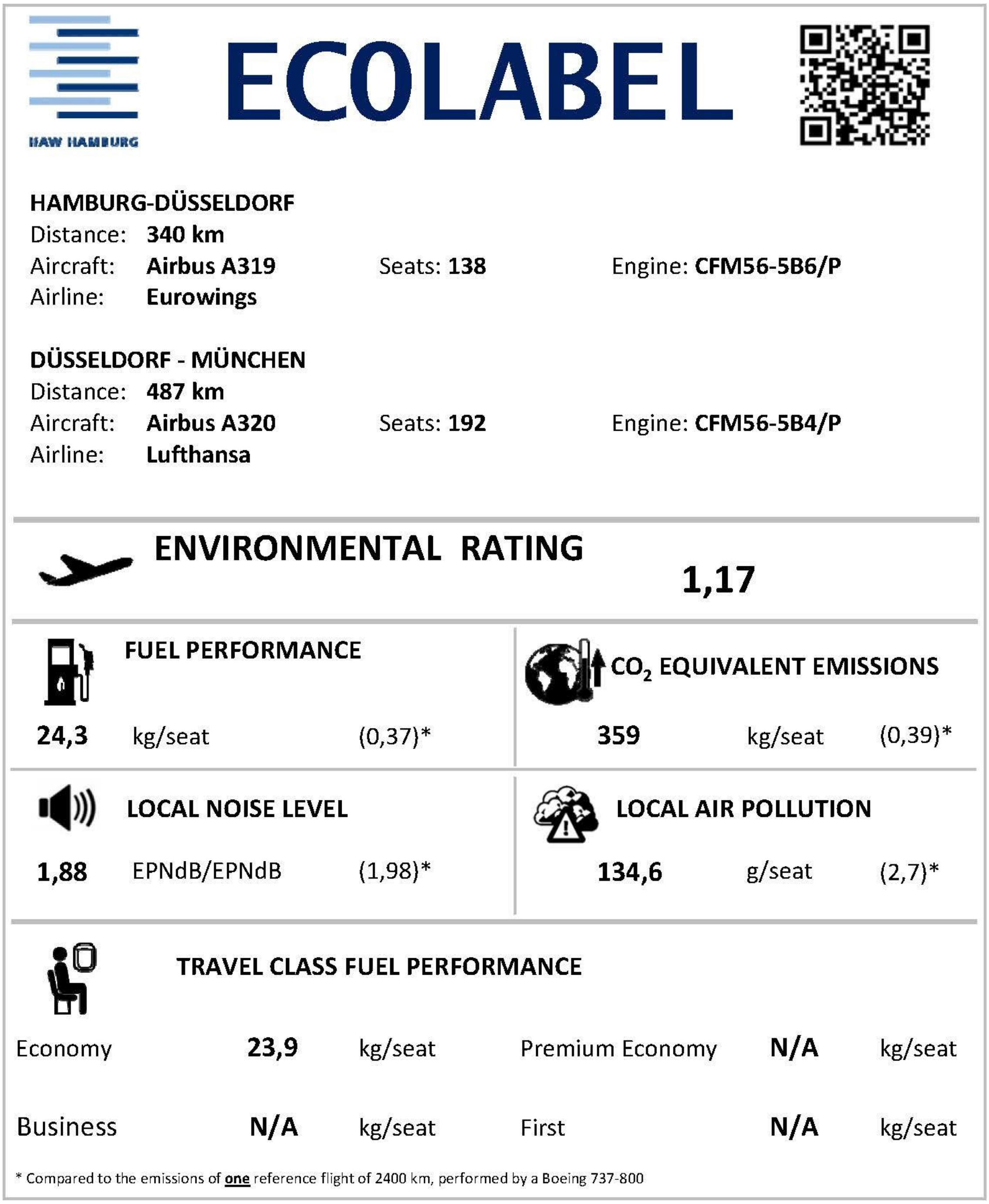

Figure D.84 Trip Emission Ecolabel Hamburg to Munich via Düsseldorf by Eurowings and Lufthansa

HAW HAMBURG

ECOLABEL

HAMBURG-RIGA
Distance: **959 km**
Aircraft: **Airbus A220-300** Seats: **145** Engine: **PW1524G-3**
Airline: **Air Baltic**

RIGA-MÜNCHEN
Distance: **1257 km**
Aircraft: **Airbus A220-300** Seats: **145** Engine: **PW1524G-3**
Airline: **Air Baltic**

ENVIRONMENTAL RATING **1,34**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
50,9	kg/seat	(0,77)*	**858**	kg/seat	(0,94)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,82	EPNdB/EPNdB	(1,9)*	**107,7**	g/seat	(2,16)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**50,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.85 Trip Emission Ecolabel Hamburg to Munich via Riga by Air Baltic

HAW HAMBURG

ECOLABEL

HAMBURG-KÖLN
Distance: **364 km**
Aircraft: **Airbus A320** Seats: **174** Engine: **CFM56-5B4/P**
Airline: **Eurowings**

KÖLN-MÜNCHEN
Distance: **437 km**
Aircraft: **Airbus A320** Seats: **154** Engine: **CFM56-5B4/P**
Airline: **Lufthansa**

ENVIRONMENTAL RATING **1,16**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
22,1	kg/seat	(0,33)*	**327**	kg/seat	(0,36)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,89	EPNdB/EPNdB	(1,98)*	**138,1**	g/seat	(2,77)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**21,7**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**27,2**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.86 Trip Emission Ecolabel Hamburg to Munich via Cologne by Eurowings and Lufthansa

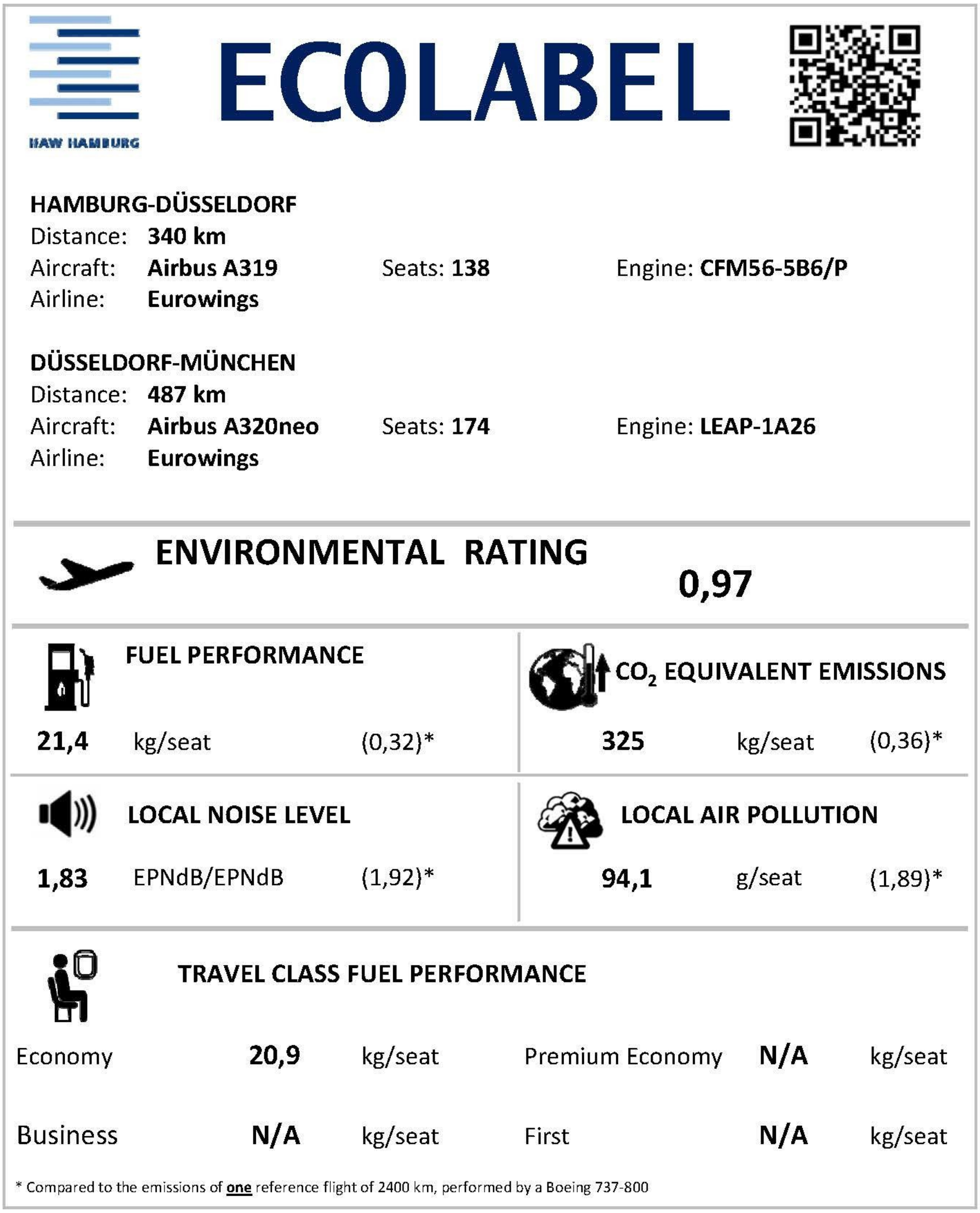

Figure D.87 Trip Emission Ecolabel Hamburg to Munich via Düsseldorf by Eurowings

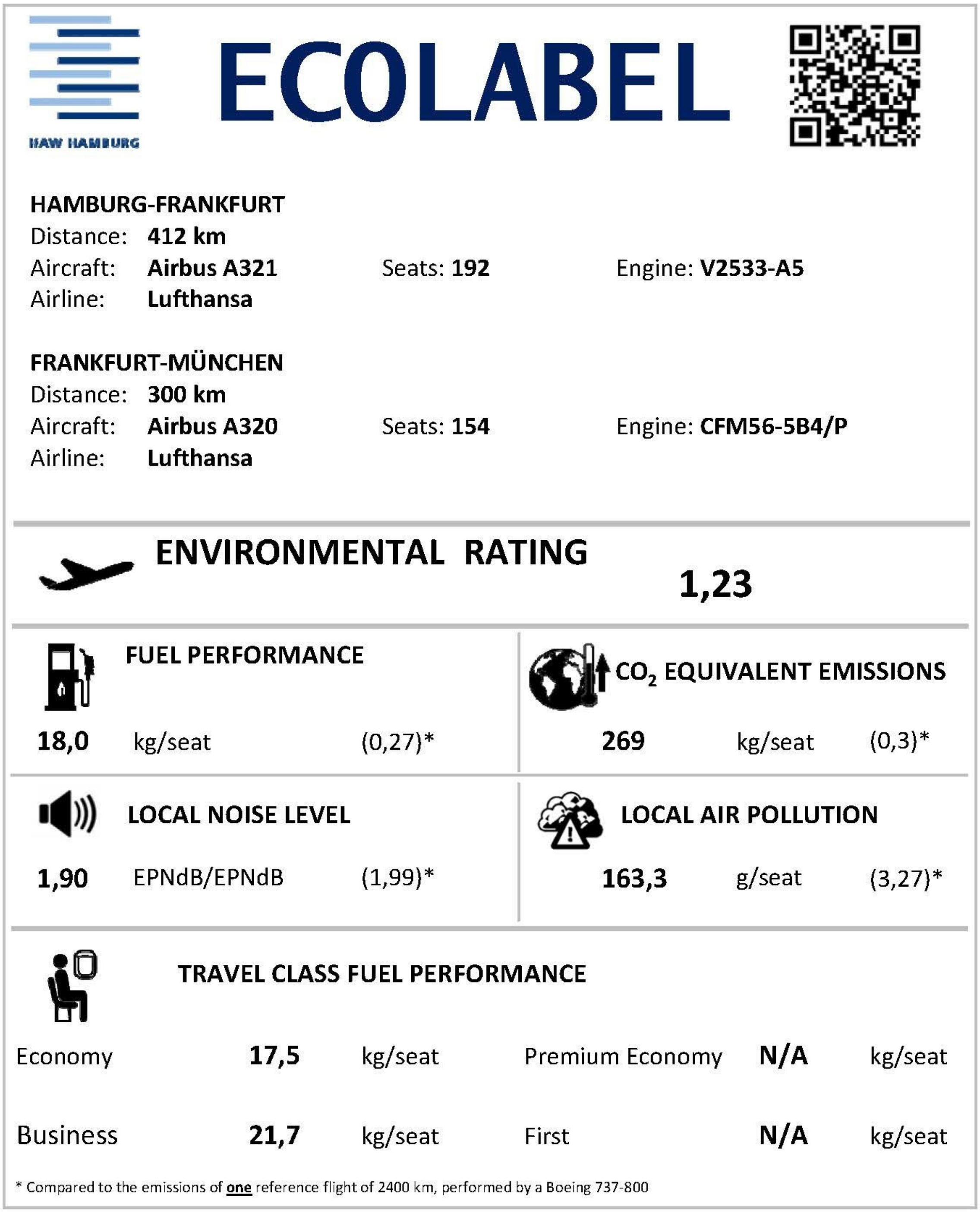

Figure D.88 Trip Emission Ecolabel Hamburg to Munich via Frankfurt by Lufthansa

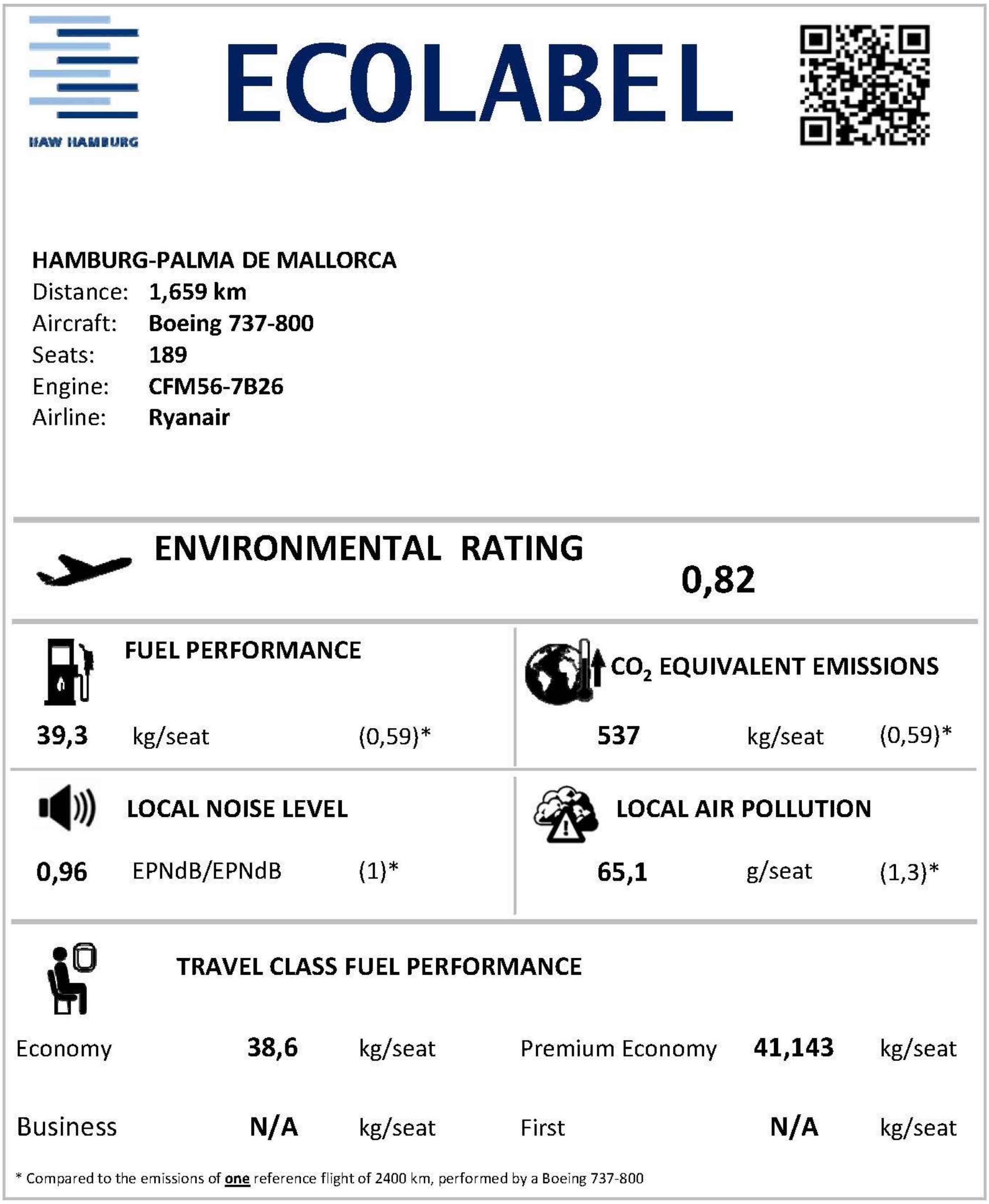

Figure D.89 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Ryanair

HAW HAMBURG

ECOLABEL

HAMBURG-PALMA DE MALLORCA

Distance:	**1,659 km**
Aircraft:	**Airbus A320**
Seats:	**174**
Engine:	**CFM56-5B4/P**
Airline:	**Eurowings**

ENVIRONMENTAL RATING **0,83**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
39,2	kg/seat	(0,59)*	**579**	kg/seat	(0,64)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
0,94	EPNdB/EPNdB	(0,99)*	**64,8**	g/seat	(1,3)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**37,7**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**60,3**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.90 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Eurowings

HAW HAMBURG

ECOLABEL

HAMBURG-PALMA DE MALLORCA

Distance: **1,659 km**
Aircraft: **Boeing 757-300**
Seats: **262**
Engine: **RB211-535E4B-37**
Airline: **Condor**

ENVIRONMENTAL RATING

1,08

FUEL PERFORMANCE				**CO_2 EQUIVALENT EMISSIONS**		
41,9	kg/seat	(0,63)*		**695**	kg/seat	(0,76)*
LOCAL NOISE LEVEL				**LOCAL AIR POLLUTION**		
0,93	EPNdB/EPNdB	(0,98)*		**112,9**	g/seat	(2,26)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**41,9**	kg/seat	Premium Economy	**41,851**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.91 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Condor

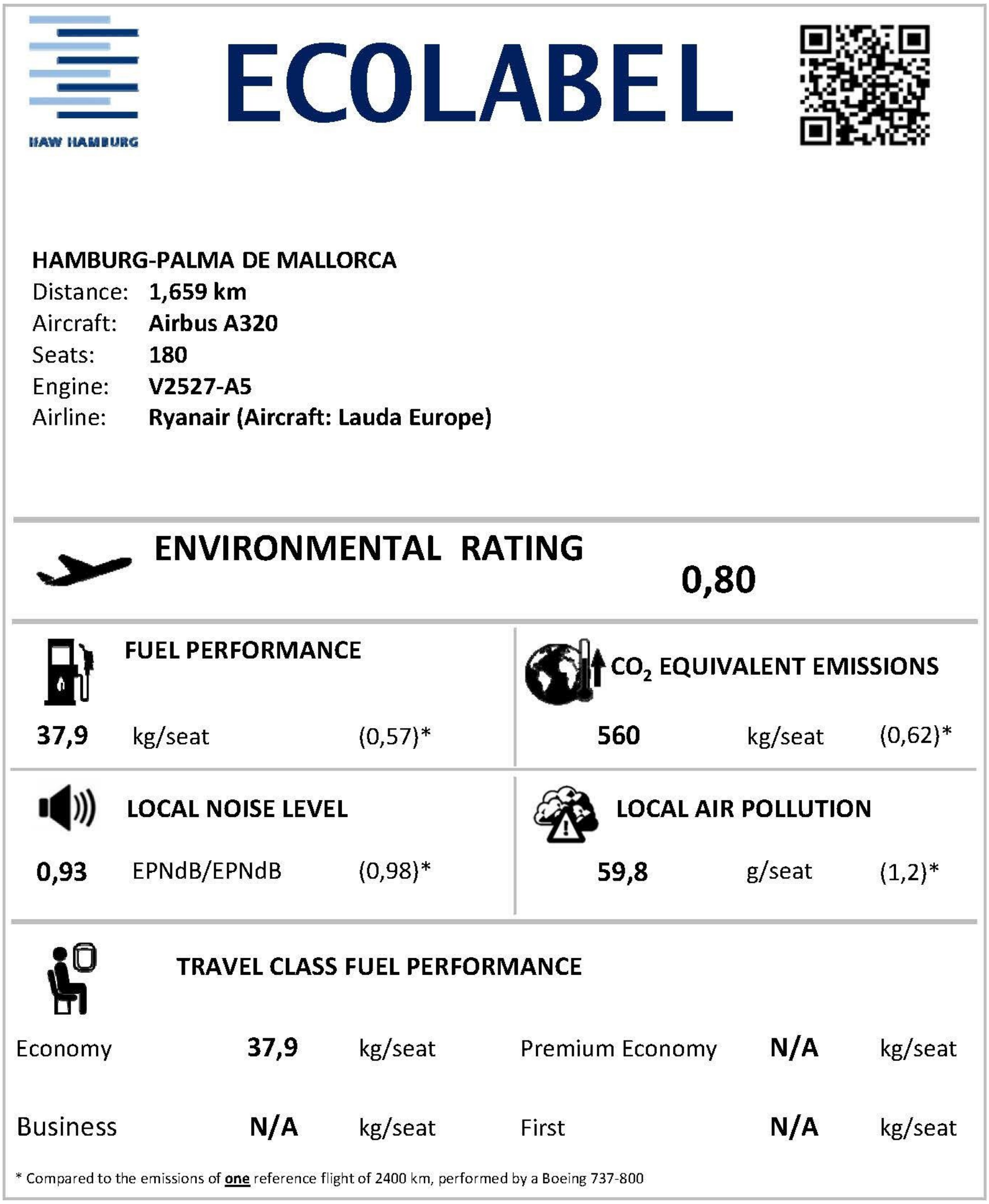

Figure D.92 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Ryanair (Aircraft from Lauda Europe)

HAW HAMBURG

ECOLABEL

HAMBURG-VALENCIA

Distance: **1,761 km**

Aircraft: **Airbus A319** Seats: **138** Engine: **CFM56-5B6/P**

Airline: **Eurowings**

VALENCIA-PALMA DE MALLORCA

Distance: **277 km**

Aircraft: **Boeing 737-800** Seats: **180** Engine: **CFM56-7B26**

Airline: **Air Europa**

ENVIRONMENTAL RATING **1,45**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
56,1	kg/seat	(0,84)*	**820**	kg/seat	(0,9)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,90	EPNdB/EPNdB	(1,99)*	**129,7**	g/seat	(2,6)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**53,9**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.93 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Valencia by Eurowings and Air Europa

ECOLABEL

HAW HAMBURG

HAMBURG-MÜNCHEN

Distance:	**600 km**		
Aircraft:	**Airbus A320**	Seats: **174**	Engine: **CFM56-5B4/P**
Airline:	**Eurowings**		

MÜNCHEN-PALMA DE MALLORCA

Distance:	**1,216 km**		
Aircraft:	**Airbus A320**	Seats: **174**	Engine: **CFM56-5B4/P**
Airline:	**Eurowings**		

ENVIRONMENTAL RATING **1,33**

FUEL PERFORMANCE		
44,0	kg/seat	(0,66)*
CO_2 EQUIVALENT EMISSIONS		
649	kg/seat	(0,71)*
LOCAL NOISE LEVEL		
1,89	EPNdB/EPNdB	(1,98)*
LOCAL AIR POLLUTION		
129,7	g/seat	(2,6)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**42,2**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**67,6**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.94 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Munich by Eurowings

HAW HAMBURG

ECOLABEL

HAMBURG-PALMA DE MALLORCA

Distance:	**1,659 km**
Aircraft:	**Airbus A319**
Seats:	**138**
Engine:	**CFM56-5B6/P**
Airline:	**Eurowings**

ENVIRONMENTAL RATING

0,88

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
45,5	kg/seat	(0,68)*	**672**	kg/seat	(0,74)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
0,94	EPNdB/EPNdB	(0,99)*	**61,3**	g/seat	(1,23)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**43,6**	kg/seat	Premium Economy	**65,364**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.95 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Eurowings

HAW HAMBURG

ECOLABEL

HAMBURG-BARCELONA

Distance: **1,493 km**

Aircraft: **Airbus A320** Seats: **174** Engine: **CFM56-5B4/P**

Airline: **Eurowings**

BARCELONA-PALMA DE MALLORCA

Distance: **202 km**

Aircraft: **Boeing 737-800** Seats: **180** Engine: **CFM56-7B26**

Airline: **Air Europa**

ENVIRONMENTAL RATING **1,32**

FUEL PERFORMANCE	**41,5**	kg/seat	(0,62)*
CO_2 EQUIVALENT EMISSIONS	**606**	kg/seat	(0,67)*
LOCAL NOISE LEVEL	**1,90**	EPNdB/EPNdB	(1,99)*
LOCAL AIR POLLUTION	**133,2**	g/seat	(2,67)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**40,0**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**62,2**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.96 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Barcelona by Eurowings and Air Europa

HAW HAMBURG

ECOLABEL

HAMBURG-BARCELONA

Distance:	**1,493 km**		
Aircraft:	**Airbus A320**	Seats: **180**	Engine: **CFM56-5B4/P**
Airline:	**Vueling**		

BARCELONA-PALMA DE MALLORCA

Distance:	**202 km**		
Aircraft:	**Airbus A320**	Seats: **180**	Engine: **CFM56-5B4/P**
Airline:	**Vueling**		

ENVIRONMENTAL RATING **1,28**

FUEL PERFORMANCE			**CO_2 EQUIVALENT EMISSIONS**		
39,8	kg/seat	(0,6)*	**588**	kg/seat	(0,65)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,89	EPNdB/EPNdB	(1,98)*	**125,4**	g/seat	(2,51)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**39,8**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800

Figure D.97 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Barcelona by Vueling

ECOLABEL

HAW HAMBURG

HAMBURG-KÖLN

Distance:	**364 km**		
Aircraft:	**Airbus A320**	Seats: **174**	Engine: **CFM56-5B4/P**
Airline:	**Eurowings**		

KÖLN-PALMA DE MALLORCA

Distance:	**1,304 km**		
Aircraft:	**Airbus A319**	Seats: **138**	Engine: **CFM56-5B6/P**
Airline:	**Eurowings**		

ENVIRONMENTAL RATING **1,33**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
45,5	kg/seat	(0,69)*	**673**	kg/seat	(0,74)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,88	EPNdB/EPNdB	(1,98)*	**126,2**	g/seat	(2,53)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**43,6**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**N/A**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of **one** reference flight of 2400 km, performed by a Boeing 737-800

Figure D.98 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Cologne by Eurowings

ECOLABEL

HAMBURG-MADRID

Distance: **1,780 km**

Aircraft: **Airbus A320** Seats: **162** Engine: **CFM56-5B6/3**

Airline: **Iberia**

MADRID-PALMA DE MALLORCA

Distance: **548 km**

Aircraft: **Airbus A321neo** Seats: **208** Engine: **LEAP-1A32**

Airline: **Iberia**

ENVIRONMENTAL RATING **1,35**

FUEL PERFORMANCE			CO_2 EQUIVALENT EMISSIONS		
57,2	kg/seat	(0,86)*	**890**	kg/seat	(0,98)*
LOCAL NOISE LEVEL			**LOCAL AIR POLLUTION**		
1,85	EPNdB/EPNdB	(1,94)*	**99,4**	g/seat	(1,99)*

TRAVEL CLASS FUEL PERFORMANCE

Economy	**56,5**	kg/seat	Premium Economy	**N/A**	kg/seat
Business	**62,1**	kg/seat	First	**N/A**	kg/seat

* Compared to the emissions of one reference flight of 2400 km, performed by a Boeing 737-800

Figure D.99 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Madrid by Iberia

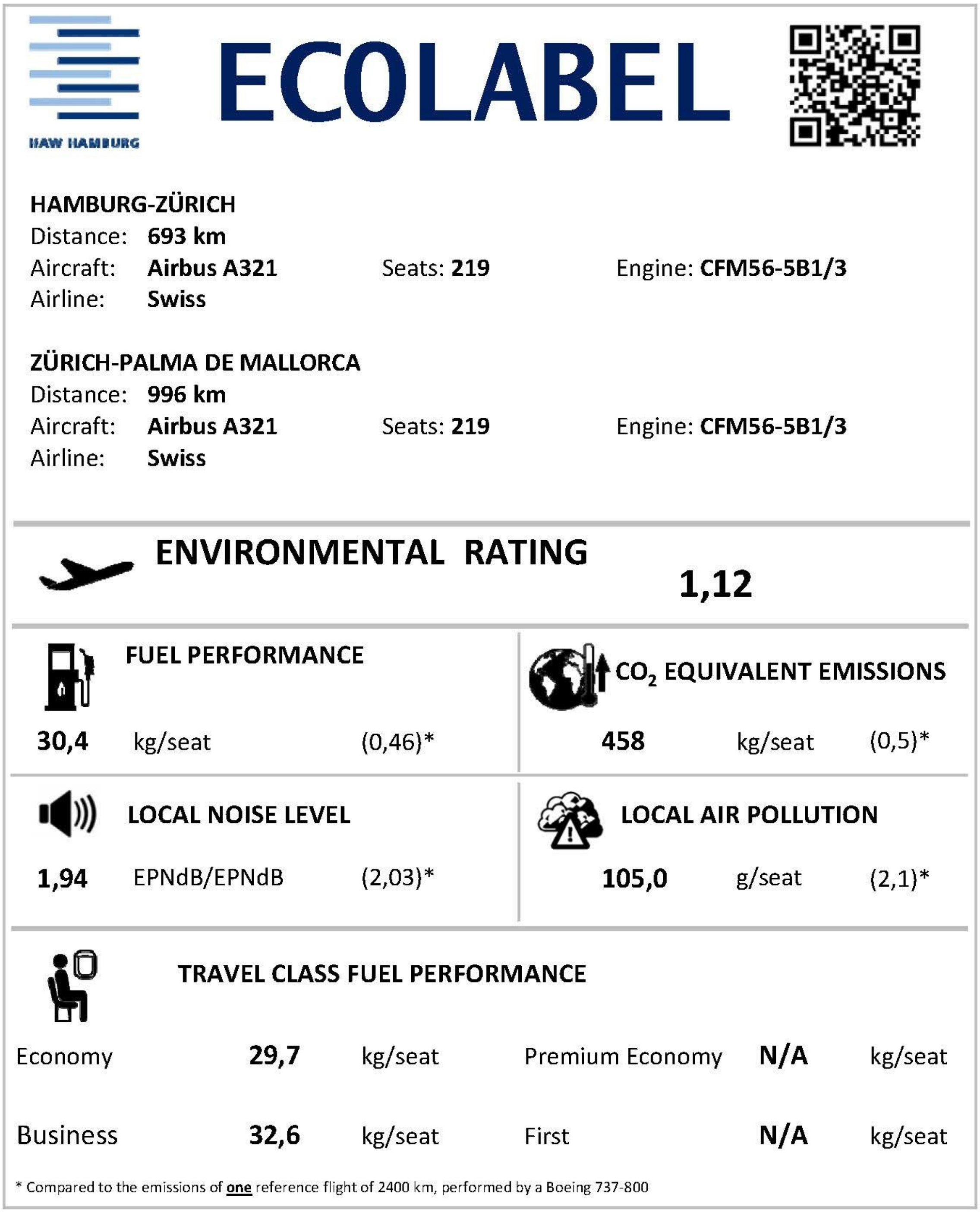

Figure D.100 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Zürich by Swiss

Appendix E – Detailed Tables of Trip Comparisons

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Table E.1 Comparison of flight connections from Hamburg to Munich

	Leg 1				Leg 2			Trip			
No.	**Airline**	**Aircraft**	**A/C Rating [-]**	**Stopover**	**Airline2**	**Aircraft2**	**A/C Rating2 [-]**	**Costs [€]**	**Duration [hh:mm]**	**Total Distance [km]**	**Environmental Rating [-]**
01	Eurowings	Airbus A320	6,97	-	-	-	-	64	01:25	600	0,60
03	Lufthansa	Airbus A321	6,93	-	-	-	-	83	01:20	600	0,65
05	Eurowings	Airbus A319	6,75	DUS	Lufthansa	Airbus A320	6,72	254	02:20	827	1,17
08	Eurowings	Airbus A319	6,75	DUS	Eurowings	Airbus A320neo	7,93	149	02:15	827	0,97
09	Lufthansa	Airbus A321	6,93	FRA	Lufthansa	Airbus A320	6,72	181	02:05	712	1,23

Table E.2 Comparison of flight connections from Hamburg to Palma de Mallorca

	Leg 1				Leg 2			Trip			
No.	**Airline**	**Aircraft**	**A/C Rating [-]**	**Stopover**	**Airline2**	**Aircraft2**	**A/C Rating2 [-]**	**Costs [€]**	**Duration [hh:mm]**	**Total Distance [km]**	**Environmental Rating [-]**
01	Ryanair	Boeing 737-800	6,87	-	-	-	-	83	02:35	1.659	0,82
03	Condor	Boeing 757-300	6,46	-	-	-	-	169	02:45	1.659	1,08
04	Ryanair	Airbus A320	7,12	-	-	-	-	134	02:35	1.659	0,80
07	Eurowings	Airbus A319	6,75	-	-	-	-	184	02:45	1.659	0,88
08	Eurowings	Airbus A320	6,97	BCN	Air Europa	Boeing 737-800	6,78	185	03:20	1.695	1,32
09	Vueling	Airbus A320	7,04	BCN	Vueling	Airbus A320	7,04	200	03:30	1.695	1,28

Table E.3 Comparison of flight connections from Hamburg to Gran Canaria

	Leg 1				Leg 2			
No.	**Airline**	**Aircraft**	**A/C Rating [-]**	**Stopover**	**Airline2**	**Aircraft2**	**A/C Rating2 [-]**	**Stopover2**
01	Lufthansa	Airbus A320	6,72	FRA	Eurowings Discover	Airbus A320	6,97	-
02	Iberia	Airbus A320	6,83	MAD	Iberia	Airbus A321neo	7,30	-
05	Swiss	Airbus A321	7,21	ZRH	Edelweiss Air	Airbus A320	6,97	-
06	KLM	Embraer E195-E2	7,61	AMS	Air Europa	Boeing 787-9	7,03	MAD
07	TAP Air Portugal	Embraer E190	5,74	LIS	TAP Air Portugal	Airbus A320	6,75	-
08	Eurowings	Airbus A319	6,75	ZRH	Edelweiss Air	Airbus A320	6,97	-
	Leg 3			Trip				
	Airline3	**Aircraft3**	**A/C Rating3 [-]**	**Costs [€]**	**Duration [hh:mm]**	**Total Distance [km]**	**Environmental Rating [-]**	
01	-	-	-	227	05:45	3.597	1,77	
02	-	-	-	235	05:45	3.545	1,63	
05	-	-	-	191	05:50	3.695	1,66	
06	Air Europa	Boeing 787-9	7,03	181	06:40	3.604	4,50	
07	-	-	-	201	05:50	3.536	2,07	
08	-	-	-	207	05:50	3.695	1,75	

Table E.4 Comparison of flight connections from Hamburg to Antalya

	Leg 1				Leg 2			Trip			
No.	**Airline**	**Aircraft**	**A/C Rating [-]**	**Stopover**	**Airline2**	**Aircraft2**	**A/C Rating2 [-]**	**Costs [€]**	**Duration [hh:mm]**	**Total Distance [km]**	**Environmental Rating [-]**
02	SunExpress	Boeing 737-800	6,87	-	-	-	-	110	03:35	2.456	0,98
03	Turkish Airlines	Boeing 737-800	6,40	-	-	-	-	140	03:35	2.456	1,18
04	Turkish Airlines	Boeing 737-800	6,40	SAW	Pegasus Airlines	Airbus A320neo	8,05	125	04:25	2.486	1,47
07	Turkish Airlines	Airbus A321	6,80	IST	Turkish Airlines	Airbus A330-300	6,29	151	04:40	2.474	1,87
09	Turkish Airlines	Airbus A330-300	6,29	IST	Turkish Airlines	Airbus A321	6,80	157	04:25	2.474	1,96
10	Lufthansa	Airbus A321	6,93	MUC	SunExpress	Boeing 737-800	6,87	188	04:20	2.603	1,57

Table E.5 Comparison of flight connections from Hamburg to New York

	Leg 1				Leg 2			Trip			
No.	**Airline**	**Aircraft**	**A/C Rating [-]**	**Stopover**	**Airline2**	**Aircraft2**	**A/C Rating2 [-]**	**Costs [€]**	**Duration [hh:mm]**	**Total Distance [km]**	**Environmental Rating [-]**
01	Lufthansa	Airbus A320neo	7,70	FRA	Condor	Boeing 767-300ER	6,67	469,00	09:55	6.618	2,51
02	Icelandair	Boeing 737 MAX 9	6,85	KEF	Icelandair	Boeing 767-300ER	6,82	503,00	09:30	6.345	2,64
05	Aer Lingus	Airbus A320	6,97	DUB	Aer Lingus	Airbus A321neo	6,91	676,00	09:50	6.214	2,56
06	Icelandair	Boeing 737 MAX 9	6,85	KEF	Icelandair	Boeing 737 MAX 9	7,00	503,00	09:30	6.359	2,64
08	KLM	Embraer E190	5,59	AMS	KLM	Boeing 787-10	7,17	716,00	09:10	6.264	2,58
09	Lufthansa	Airbus A320	6,72	FRA	Lufthansa	Boeing 747-8	7,47	1.245,00	09:40	6.640	2,51

Table E.6 Comparison of flight connections from Hamburg to Bonaire

	Leg 1				Leg 2			
No.	**Airline**	**Aircraft**	**A/C Rating [-]**	**Stopover**	**Airline2**	**Aircraft2**	**A/C Rating2 [-]**	**Stopover2**
01	KLM	Embraer E190	5,59	AMS	KLM	Boeing 777-300ER	6,52	AUA
03	Lufthansa	Airbus A320	6,72	FRA	United Airlines	Boeing 777-200ER	6,71	IAH
04	British Airways	Airbus A320	7,02	LHR	American Airlines	Boeing 777-300ER	5,78	MIA
05	British Airways	Airbus A321neo	7,31	LHR	British Airways	Airbus A380-800	4,90	MIA
06	KLM	Embraer E175	5,71	AMS	Delta Air Lines	Airbus A330-300	6,47	ATL
07	KLM	Embraer E175	5,71	AMS	Delta Air Lines	Airbus A350-900	7,21	ATL

	Leg 3			Trip			
	Airline3	**Aircraft3**	**A/C Rating3 [-]**	**Costs [€]**	**Duration [hh:mm]**	**Total Distance [km]**	**Environmental Rating [-]**
01	KLM	Boeing 777-300ER	6,52	629	11:35	8.457	4,32
03	United Airlines	Boeing 737-800	6,68	708	16:56	12.255	4,97
04	American Airlines	Airbus A319	6,57	1.704	14:31	9.839	5,07
05	American Airlines	Airbus A319	6,57	1.704	14:19	9.839	5,83
06	Delta Air Lines	Boeing 737-800	6,53	3.183	15:10	10.355	4,18
07	Delta Air Lines	Boeing 737-800	6,53	3.183	14:50	10.355	4,14
08	Delta Air Lines	Boeing 737-800	6,53	2.301	15:46	12.255	4,29

Table E.7 Comparison of flight connections from Hamburg to Bangkok

	Leg 1				Leg 2			Trip			
No.	Airline	Aircraft	A/C Rating [-]	Stopover	Airline2	Aircraft2	A/C Rating2 [-]	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	Finnair	Embraer E190	5,55	HEL	Finnair	Airbus A350-900	7,42	533	13:30	9.084	3,27
03	Lufthansa	Airbus A321	6,93	FRA	Thai Airways	Boeing 777-300ER	6,15	582	11:50	9.421	4,20
04	Lufthansa	Airbus A320	6,72	MUC	Thai Airways	Airbus A350-900	7,32	544	11:55	9.409	3,32
05	Swiss	Airbus A320neo	7,85	ZRH	Thai Airways	Boeing 787-8	7,17	582	12:25	9.757	3,48
06	Emirates	Airbus A380-800	5,07	DXB	Emirates	Boeing 777-300ER	6,19	695	13:05	9.797	5,41
08	Austrian Airlines	Airbus A320	6,81	VIE	Austrian Airlines	Boeing 777-200ER	7,01	1.088	11:30	9.228	3,39

Table E.8 Comparison of flight connections from Hamburg to Hong Kong

	Leg 1				Leg 2			
No.	Airline	Aircraft	A/C Rating [-]	Stopover	Airline2	Aircraft2	A/C Rating2 [-]	Stopover2
01	Lufthansa	Airbus A319	6,53	FRA	Cathay Pacific	Boeing 777-300ER	5,47	-
02	Turkish Airlines	Airbus A321	6,80	IST	Turkish Airlines	Boeing 777-300ER	6,15	-
03	Finnair	Embraer E190	5,55	HEL	Finnair	Airbus A350-900	7,42	BKK
05	Lufthansa	Airbus A320	6,72	MUC	Thai Airways	Airbus A350-900	7,32	BKK
06	Lufthansa	Airbus A319	6,53	FRA	Thai Airways	Boeing 777-300ER	6,15	BKK
07	Eurowings	Airbus A319	6,75	CDG	Cathay Pacific	Airbus A350-1000	6,12	-

	Leg 3			Trip			
	Airline3	Aircraft3	A/C Rating3 [-]	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	-	-	-	703	12:35	9.581	5,09
02	-	-	-	708	13:25	10.012	4,27
03	Cathay Pacific	Airbus A350-900	6,93	612	16:25	10.773	4,51
05	Thai Airways	Boeing 777-300ER	6,15	765	14:40	11.098	4,81
06	Thai Airways	Boeing 777-300ER	6,15	770	14:35	11.110	5,64
07	-	-	-	852	13:30	10.336	4,09

Table E.9 Comparison of flight connections from Hamburg to Mexico City

No.	Airline	Aircraft	A/C Rating [-]	Stopover	Airline2	Aircraft2	A/C Rating2 [-]	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	Turkish Airlines	Airbus A321	6,80	IST	Turkish Airlines	Boeing 777-300ER	6,15	956	17:15	13.422	5,22
02	KLM	Embraer E190	5,59	AMS	KLM	Boeing 787-9	7,20	1.064	12:34	9.600	3,51
03	Air France	Airbus A320	7,02	CDG	Air France	Boeing 777-300ER	5,70	1.066	13:30	9.942	3,93
05	KLM	Boeing 737-800	6,69	AMS	Aeromexico	Boeing 787-9	6,80	1.144	13:10	9.600	3,86
06	Air France	Airbus A319	6,98	CDG	Aeromexico	Boeing 787-9	6,80	1.150	13:50	9.942	3,82
08	Lufthansa	Airbus A321	6,93	FRA	Lufthansa	Boeing 747-8	7,47	1.400	13:10	9.979	3,20

Table E.10 Comparison of flight connections from Hamburg to Hurghada

No.	Airline	Aircraft	A/C Rating [-]	Stopover	Airline2	Aircraft2	A/C Rating2 [-]	Costs [€]	Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
01	Pegasus Airlines	Airbus A320neo	8,05	SAW	Pegasus Airlines	Boeing 737-800	6,87	180	05:55	3.600	1,50
03	Condor	Boeing 757-300	6,46	-	-	-	-	300	04:50	3.529	1,55
04	Turkish Airlines	Airbus A321	6,80	IST	Turkish Airlines	Boeing 737 MAX 8	6,81	327	06:00	3.588	1,97
05	Eurowings	Airbus A320	6,97	ZRH	Edelweiss Air	Airbus A320	6,97	339	05:55	3.840	1,78
06	Swiss	Airbus A321	7,21	ZRH	Edelweiss Air	Airbus A320	6,97	339	05:55	3.840	1,69