

Project

Analysis of Flight Routes and Hints for Passengers

Author: Christian Rösing

Supervisor:Prof. Dr.-Ing. Dieter Scholz, MSMESubmitted:2022-07-30

Faculty of Engineering and Computer Science Department of Automotive and Aeronautical Engineering DOI: https://doi.org/10.15488/xxxxx

URN: https://nbn-resolving.org/urn:nbn:de:gbv:18302-aero2022-07-30.018 Associated URLs: https://nbn-resolving.org/html/urn:nbn:de:gbv:18302-aero2022-07-30.018

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Published by Aircraft Design and Systems Group (AERO) Department of Automotive and Aeronautical Engineering Hamburg University of Applied Science

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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.



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.

Table of Contents

		Page
List of Fi	igures	
List of T	ables	
List of S	ymbols	
List of A	bbreviations	
List of A	ircraft, Airport and Airline Codes	
Definitio	ns	
1	Introduction	26
1 .1	Motivation	
1.1	Title Terminology	
1.2	Objectives	
1.5	-	
	Previous Research	
1.5	Structure of the Work	
2	Literature Review	
2.1	Master Thesis of MacDonald	
2.2	Bachelor Thesis of Haß	
2.3	Master Thesis of Van Endert	
2.4	Project of Sokour and Bähr	
2.5	Bachelor Thesis of Velasco	
2.6	Master Thesis of Hurtecant	
3	Routes for the Application	
3.1	Finding Routes and Flight Connections	
3.2	Flight Search Engine	
3.3	Evaluating the Information of the Flight Connections	
4	Generating New Ecolabels	
4.1	Research of the Aircraft Information	
4.2	Adding New Aircraft Combinations to the Database	
5	Generating Trip Emission Ecolabels	
5.1	Explanation of the Previous Acquired Calculators	
5.1.1	First Concept of Hurtecant	
5.1.2	Second Concept of Hurtecant	
5.2	Evaluation of the Two Trip Emission Ecolabels	
6	Comparison of Flight Connections	53
6.1	Domestic Flight from Hamburg to Munich	

6.2	Medium-Haul Flight from Hamburg to Palma de Mallorca	. 56
6.3	Medium-Haul Flight from Hamburg to Gran Canaria	. 59
6.4	Medium-Haul Flight from Hamburg to Antalya	. 62
6.5	Long-Haul Flight from Hamburg to New York	. 65
6.6	Long-Haul Flight from Hamburg to Bonaire	
6.7	Long-Haul Flight from Hamburg to Bangkok	. 71
6.8	Long-Haul Flight from Hamburg to Hong Kong	. 74
6.9	Long-Haul Flight from Hamburg to Mexico City	. 77
6.10	Medium-Haul Flight from Hamburg to Hurghada	. 80
7	Discussion	. 84
7.1	Domestic Flight from Hamburg to Munich	. 84
7.2	Medium-Haul Flight from Hamburg to Palma de Mallorca	. 84
7.3	Medium-Haul Flight from Hamburg to Gran Canaria	
7.4	Medium-Haul Flight from Hamburg to Antalya	
7.5	Long-Haul Flight from Hamburg to New York	. 86
7.6	Long-Haul Flight from Hamburg to Bonaire	
7.7	Long-Haul Flight from Hamburg to Bangkok	. 87
7.8	Long-Haul Flight from Hamburg to Hong Kong	. 87
7.9	Long-Haul Flight from Hamburg to Mexico City	. 88
7.10	Medium-Haul Flight from Hamburg to Hurghada	. 88
8	Summary and Conclusions	. 90
9	Recommendations	. 92
List of Refer	ences	. 93
Appendix A	Selected Routes and Flight Connections	. 96
Appendix B	New Generated Aircraft Combinations	. 99
Appendix C	Ecolabel for Aircraft	101
Appendix D	Trip Emission Ecolabels	198
Appendix E	Detailed Tables of Trip Comparisons	298

List of Figures

Figure 3.1	Example of a searched flight connection with Google Flights	
	(modified from Google 2022)	. 34
Figure 3.2	Example of additional information given by Flightradar24	
	(modified from Flightradar24 2022)	. 34
Figure 4.1	Seating details of Airbus A350-900 of Lufthansa from SeatGuru (2022)	. 35
Figure 4.2	General information about an aircraft from Airfleets (2022)	. 35
Figure 4.3	Ecolabel for Aircraft, example of an A320 of Lauda Europe	. 37
Figure 5.1	Ecolabel of an Airbus A319 from Eurowings	. 40
Figure 5.2	Ecolabel of a Boeing 737-800 from Air Europa	. 40
Figure 5.3	Trip Emission Ecolabel of the calculated example	. 44
Figure 5.4	Trip Emission Ecolabel of the calculated example	. 50
Figure 5.5	Trip Emission Ecolabel from Hamburg to Palma de Mallorca with layover	
	in Barcelona operated by Vueling	. 51
Figure 5.6	Ecolabel for Airbus A320 from Lauda Europe as direct flight from Ham-	
	burg to Palma de Mallorca	. 51
Figure 5.7	Trip Emission Ecolabel from Hamburg to Palma de Mallorca with layover	
	in Barcelona operated by Vueling	. 52
Figure 5.8	Trip Emission Ecolabel as direct flight from Hamburg to Palma de Mall-	
	orca operated by Ryanair with an aircraft from Lauda Europe	. 52
Figure 6.1	Flight connections from Hamburg to Munich (greatcirclemap.com)	. 54
Figure 6.2	Distribution of costs over duration of the flights from Hamburg to Munich	. 54
Figure 6.3	Distribution of costs over Environmental Rating of the flights from Ham-	
	burg to Munich	. 55
Figure 6.4	Distribution of the Environmental Rating over duration of the flights from	
	Hamburg to Munich	. 55
Figure 6.5	Distribution of the Environmental Rating over distance of the flights from	
	Hamburg to Munich	
Figure 6.6	Flight connections from Hamburg to Mallorca (greatcirclemap.com)	. 57
Figure 6.7	Distribution of costs over duration of the flights from Hamburg to Palma	
	de Mallorca	. 57
Figure 6.8	Distribution of costs over Environmental Rating of the flights from Ham-	
	burg to Palma de Mallorca	. 58
Figure 6.9	Distribution of the Environmental Rating over duration of the flights from	
	Hamburg to Palma de Mallorca	. 58
Figure 6.10	Distribution of the Environmental Rating over distance of the flights from	
	Hamburg to Palma de Mallorca	. 59
Figure 6.11	Flight connections from Hamburg to Gran Canaria (greatcirclemap.com)	. 60
Figure 6.12	Distribution of costs over duration of the flights from Hamburg to Gran	
	Canaria	. 60

Figure 6.13	Distribution of costs over Environmental Rating of the flights from Ham- burg to Gran Canaria
Figure 6.14	Distribution of the Environmental Rating over duration of the flights from
Figure 0.14	Hamburg to Gran Canaria
Figure 6.15	Distribution of the Environmental Rating over distance of the flights from
8	Hamburg to Gran Canaria
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 63
Figure 6.18	Distribution of costs over Environmental Rating of the flights from Ham-
8	burg to Antalya
Figure 6.19	Distribution of the Environmental Rating over duration of the flights from
8	Hamburg to Antalya
Figure 6.20	Distribution of the Environmental Rating over distance of the flights from
8	Hamburg to Antalya
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
8	York
Figure 6.23	Distribution of costs over Environmental Rating of the flights from Ham-
8	burg to New York
Figure 6.24	Distribution of the Environmental Rating over duration of the flights from
0	Hamburg to New York
Figure 6.25	Distribution of the Environmental Rating over distance of the flights from
0	Hamburg to New York
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 69
Figure 6.28	Distribution of costs over Environmental Rating of the flights from Ham-
	burg 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
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 Bang-
	kok
Figure 6.33	Distribution of costs over Environmental Rating of the flights from Ham-
	burg 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
Figure 6.36	Flight connections from Hamburg to Hong Kong (greatcirclemap.com)75

Figure 6.37	Distribution of costs over duration of the flights from Hamburg to Hong	
F' (20		. 75
Figure 6.38	Distribution of costs over Environmental Rating of the flights from Ham- burg to Hong Kong	
Figure 6.39	Distribution of the Environmental Rating over duration of the flights from	. / 0
	Hamburg to Hong Kong	. 76
Figure 6.40	Distribution of the Environmental Rating over distance of the flights from	
	Hamburg to Hong Kong	. 77
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	
i igui e oi iz	City	. 78
Figure 6.43	Distribution of costs over Environmental Rating of the flights from Ham-	. / 0
i igui e oi ie	burg to Mexico City	. 79
Figure 6.44	Distribution of the Environmental Rating over duration of the flights from	• • • •
i igui e oi i i	Hamburg to Mexico City	79
Figure 6.45	Distribution of the Environmental Rating over distance of the flights from	• • • •
1 igui e 0.15	Hamburg to Mexico City	80
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 Hur-	. 01
i igui e oi i i	ghada	81
Figure 6.48	Distribution of costs over Environmental Rating of the flights from Ham-	. 01
	burg to Hurghada	82
Figure 6.49	Distribution of the Environmental Rating over duration of the flights from	. 02
i igui e 0.17	Hamburg to Hurghada	82
Figure 6.50	Distribution of the Environmental Rating over distance of the flights from	. 02
1 igui e 0.50	Hamburg to Hurghada	83
	Tuniourg to Turginudu	. 05
Figure C.1	Ecolabel for Airbus A321neo of Aer Lingus	102
Figure C.2	Ecolabel for Airbus A320 of Aer Lingus	103
Figure C.3	Ecolabel for Boeing 787-9 of Aeromexico	104
Figure C.4	Ecolabel for Airbus A220-300 of Air Baltic	105
Figure C.5	Ecolabel for Airbus A320neo of Air Cairo	106
Figure C.6	Ecolabel for Boeing 737-800 of Air Europa	107
Figure C.7	Ecolabel for Boeing 787-9 of Air Europa	108
Figure C.8	Ecolabel for Airbus A319 of Air France	109
Figure C.9	Ecolabel for Airbus A320 of Air France	110
Figure C.10	Ecolabel for Boeing 777-300ER of Air France	111
Figure C.11	Ecolabel for Boeing 777-200ER of Air France	
Figure C.12	Ecolabel for Airbus A220-300 of Air France	113
Figure C.13	Ecolabel for Airbus A319 of American Airlines	114
Figure C.14	Ecolabel for Boeing 777-300ER of American Airlines	115
Figure C.15	Ecolabel for Boeing 737-800 of American Airlines	116

Figure C.16	Ecolabel for Airbus A320 of Austrian Airlines	117
Figure C.17	Ecolabel for Boeing 777-200ER of Austrian Airlines	118
Figure C.18	Ecolabel for ATR 72 of Binter Canarias	119
Figure C.19	Ecolabel for Airbus A321neo of British Airways	120
Figure C.20	Ecolabel for Airbus A319 of British Airways	121
Figure C.21	Ecolabel for Airbus A320 of British Airways	122
Figure C.22	Ecolabel for Airbus A380-800 of British Airways	123
Figure C.23	Ecolabel for Boeing 787-9 of British Airways	124
Figure C.24	Ecolabel for Airbus A350-1000 of Cathay Pacific	125
Figure C.25	Ecolabel for Airbus A350-900 of Cathay Pacific	126
Figure C.26	Ecolabel for Boeing 777-300ER of Cathay Pacific	127
Figure C.27	Ecolabel for Boeing 757-300 of Condor	128
Figure C.28	Ecolabel for Boeing 767-300ER of Condor	129
Figure C.29	Ecolabel for Boeing 737-800 of Corendon	130
Figure C.30	Ecolabel for Airbus A330-300 of Delta Air Lines	131
Figure C.31	Ecolabel for Airbus A350-900 of Delta Air Lines	132
Figure C.32	Ecolabel for Boeing 717-200 of Delta Air Lines	133
Figure C.33	Ecolabel for Boeing 737-800 of Delta Air Lines	134
Figure C.34	Ecolabel for Airbus A320 of Edelweiss Air	135
Figure C.35	Ecolabel for Boeing 737-800 of EgyptAir	136
Figure C.36	Ecolabel for Airbus A380-800 of Emirates	137
Figure C.37	Ecolabel for Boeing 777-300ER of Emirates	138
Figure C.38	Ecolabel for Airbus A320neo of Eurowings	139
Figure C.39	Ecolabel for Airbus A319 of Eurowings	140
Figure C.40	Ecolabel for Airbus A320 of Eurowings	141
Figure C.41	Ecolabel for Airbus A320 of Eurowings Discover	142
Figure C.42	Ecolabel for Boeing 777-300ER of EVA Air	143
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	146
Figure C.46	Ecolabel for Boeing 787-9 of Gulf Air	147
Figure C.47	Ecolabel for Airbus A321neo of Iberia	148
Figure C.48	Ecolabel for Airbus A319 of Iberia	149
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	152
Figure C.52	Ecolabel for Boeing 737 MAX 9 of Icelandair	153
Figure C.53	Ecolabel for Boeing 767-300ER of Icelandair	154
Figure C.54	Ecolabel for Boeing 777-300ER of KLM	
Figure C.55	Ecolabel for Boeing 787-10 of KLM	156
Figure C.56	Ecolabel for Boeing 737-800 of KLM	
Figure C.57	Ecolabel for Boeing 787-9 of KLM	158

Figure C.58	Ecolabel for Embraer E175 of KLM	
Figure C.59	Ecolabel for Embraer E190 of KLM	160
Figure C.60	Ecolabel for Embraer E195-E2 of KLM	161
Figure C.61	Ecolabel for Airbus A320 of Lauda Europe	162
Figure C.62	Ecolabel for Airbus A320neo of Lufthansa	163
Figure C.63	Ecolabel for Airbus A321neo of Lufthansa	164
Figure C.64	Ecolabel for Airbus A319 of Lufthansa	165
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	169
Figure C.69	Ecolabel for Airbus A330-300 of Malaysia Airlines	
Figure C.70	Ecolabel for Airbus A320neo of Pegasus Airlines	171
Figure C.71	Ecolabel for Boeing 737-800 of Pegasus Airlines	172
Figure C.72	Ecolabel for Airbus A350-900 of Qatar Airways	173
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	176
Figure C.76	Ecolabel for Airbus A321 of SriLankan Airlines	177
Figure C.77	Ecolabel for Airbus A330-300 of SriLankan Airlines	178
Figure C.78	Ecolabel for Boeing 737-800 of SunExpress	
Figure C.79	Ecolabel for Airbus A320neo of Swiss	180
Figure C.80	Ecolabel for Airbus A321 of Swiss	181
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	189
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	192
Figure C.92	Ecolabel for Airbus A320 of United Airlines	
Figure C.93	Ecolabel for Boeing 737-800 of United Airlines	194
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	197
Figure D.1	Trip Emission Ecolabel Hamburg to Antalya by Corendon	198
Figure D.2	Trip Emission Ecolabel Hamburg to Antalya by SunExpress	199

Figure D.3	Trip Emission Ecolabel Hamburg to Antalya by Turkish Airlines	200
Figure D.4	Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish	
	Airlines and Pegasus Airlines	201
Figure D.5	Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish	
	Airlines	202
Figure D.6	Trip Emission Ecolabel Hamburg to Antalya via Izmir by SunExpress	203
Figure D.7	Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish	
	Airlines	204
Figure D.8	Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish	
	Airlines	205
Figure D.9	Trip Emission Ecolabel Hamburg to Antalya via Istanbul by Turkish	
	Airlines	206
Figure D.10	Trip Emission Ecolabel Hamburg to Antalya via Munich by Luft-	
	hansa and SunExpress	
Figure D.11	Trip Emission Ecolabel Hamburg to Bangkok by Finnair	208
Figure D.12	Trip Emission Ecolabel Hamburg to Bangkok via Amsterdam by	
	Eurowings and EVA Air	209
Figure D.13	Trip Emission Ecolabel Hamburg to Bangkok via Frankfurt by Luft-	
	hansa and Thai Airways	210
Figure D.14	Trip Emission Ecolabel Hamburg to Bangkok via Munich by Luf-	
	thansa and Thai Airways	211
Figure D.15	Trip Emission Ecolabel Hamburg to Bangkok via Zürich by Swiss	
	and Thai Airways	
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	214
Figure D.18	Trip Emission Ecolabel Hamburg to Bangkok via Vienna by Austrian	
	Airlines	215
Figure D.19	Trip Emission Ecolabel Hamburg to Bangkok via Frankfurt and Colom-	
	bo by Lufthansa and SriLankan Airlines	216
Figure D.20	Trip Emission Ecolabel Hamburg to Bangkok via Frankfurt and Bah-	
	rain by Lufthansa and Gulf Air	217
Figure D.21	Trip Emission Ecolabel Hamburg to Bonaire via Amsterdam and Oranje-	
	stad by KLM	218
Figure D.22	Trip Emission Ecolabel Hamburg to Bonaire via London Heathrow and	
	Houston by Eurowings and United Airlines	219
Figure D.23	Trip Emission Ecolabel Hamburg to Bonaire via Frankfurt and Houston	
-	by Lufthansa and United Airlines	220
Figure D.24	Trip Emission Ecolabel Hamburg to Bonaire via London Heathrow and	
	Miami by British Airways and American Airlines	221
Figure D.25	Trip Emission Ecolabel Hamburg to Bonaire via London Heathrow and	
	Miami by British Airways and American Airlines	222

Figure D.26	Trip Emission Ecolabel Hamburg to Bonaire via Amsterdam and Atlanta	
	by KLM and Delta Air Lines	223
Figure D.27	Trip Emission Ecolabel Hamburg to Bonaire via Amsterdam and Atlanta	
	by KLM and Delta Air Lines	224
Figure D.28	Trip Emission Ecolabel Hamburg to Bonaire via Frankfurt and Houston	
	by Lufthansa and Delta Air Lines	225
Figure D.29	Trip Emission Ecolabel Hamburg to Hong Kong via Frankfurt by Luft-	
	hansa and Cathay Pacific	226
Figure D.30	Trip Emission Ecolabel Hamburg to Hong Kong via Istanbul by Turkish	
	Airlines	227
Figure D.31	Trip Emission Ecolabel Hamburg to Hong Kong via Helsinki and Bang-	
	kok by Finnair and Cathay Pacific	228
Figure D.32	Trip Emission Ecolabel Hamburg to Hong Kong via Dubai and Bangkok	
	by Emirates	229
Figure D.33	Trip Emission Ecolabel Hamburg to Hong Kong via Munich and Bang-	
	kok by Lufthansa and Thai Airways	230
Figure D.34	Trip Emission Ecolabel Hamburg to Hong Kong via Frankfurt and Bang-	
	kok by Lufthansa and Thai Airways	231
Figure D.35	Trip Emission Ecolabel Hamburg to Hong Kong via Paris by Eurowings	
	and Cathay Pacific	232
Figure D.36	Trip Emission Ecolabel Hamburg to Hong Kong via London Heathrow	
	by British Airways and Cathay Pacific	233
Figure D.37	Trip Emission Ecolabel Hamburg to Hong Kong via London Heathrow	
	and Doha by British Airways and Qatar Airways	234
Figure D.38	Trip Emission Ecolabel Hamburg to Hong Kong via Dubai and Kuala	
	Lumpur by Emirates and Malaysia Airlines	235
Figure D.39	Trip Emission Ecolabel Hamburg to Hurghada via Istanbul by Pegasus	
	Airlines	236
Figure D.40	Trip Emission Ecolabel Hamburg to Hurghada via Düsseldorf by Euro-	
-	wings	
Figure D.41	Trip Emission Ecolabel Hamburg to Hurghada by Condor	238
Figure D.42	Trip Emission Ecolabel Hamburg to Hurghada via Istanbul by Turkish	•••
-	Airlines	239
Figure D.43	Trip Emission Ecolabel Hamburg to Hurghada via Zürich by Eurowings	• • •
D: D (4)	and Edelweiss Air	240
Figure D.44	Trip Emission Ecolabel Hamburg to Hurghada via Zürich by Swiss and	0.41
D' D 4 7	Edelweiss Air.	241
Figure D.45	Trip Emission Ecolabel Hamburg to Hurghada via Munich by Lufthansa	0.42
	and Air Cairo	242
Figure D.46	Trip Emission Ecolabel Hamburg to Hurghada via Frankfurt and Cairo	0.42
	by Lufthansa and EgyptAir	243

Figure D.47	Trip Emission Ecolabel Hamburg to Hurghada via Frankfurt by Luft- hansa and Eurowings Discover	. 244
Figure D.48	Trip Emission Ecolabel Hamburg to New York via Frankfurt by Luft-	
8	hansa and Condor	. 245
Figure D.49	Trip Emission Ecolabel Hamburg to New York via Keflavik by Iceland- air	
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	
Figure D.52	Trip Emission Ecolabel Hamburg to New York via Dublin by Aer	
8	Lingus	. 249
Figure D.53	Trip Emission Ecolabel Hamburg to New York via Keflavik by Iceland- air	
Figure D.54	Trip Emission Ecolabel Hamburg to New York via Amsterdam and De-	
8	troit by KLM and Delta Air Lines	. 251
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 Luft-	
8	hansa	. 253
Figure D.57	Trip Emission Ecolabel Hamburg to New York via Lisbon by TAP	
0	Portugal	. 254
Figure D.58	Trip Emission Ecolabel Hamburg to New York via Munich by Lufthansa	. 255
Figure D.59	Trip Emission Ecolabel Hamburg to Gran Canaria via Frankfurt by Luft-	
0	hansa and Eurowings Discover	. 256
Figure D.60	Trip Emission Ecolabel Hamburg to Gran Canaria via Madrid by Iberia	. 257
Figure D.61	Trip Emission Ecolabel Hamburg to Gran Canaria via Barcelona by	
	Vueling	. 258
Figure D.62	Trip Emission Ecolabel Hamburg to Gran Canaria via Fuerteventura by	
	Condor and Binter Canarias	. 259
Figure D.63	Trip Emission Ecolabel Hamburg to Gran Canaria via Zürich by Swiss	
	and Edelweiss Air	. 260
Figure D.64	Trip Emission Ecolabel Hamburg to Gran Canaria via Amsterdam and	
	Madrid by KLM and Air Europa	. 261
Figure D.65	Trip Emission Ecolabel Hamburg to Gran Canaria via Lisbon by TAP	
	Air Portugal	. 262
Figure D.66	Trip Emission Ecolabel Hamburg to Gran Canaria via Zürich by Euro-	
	wings and Edelweiss Air	. 263
Figure D.67	Trip Emission Ecolabel Hamburg to Gran Canaria via Vienna by Aus-	
	trian Airlines	. 264
Figure D.68	Trip Emission Ecolabel Hamburg to Gran Canaria via Madrid and Vigo	
	by Iberia	. 265
Figure D.69	Trip Emission Ecolabel Hamburg to Mexico City via Istanbul by Turkish	
	Airlines	. 266

Figure D.70	Trip Emission Ecolabel Hamburg to Mexico City via Amsterdam by	
	KLM	. 267
Figure D.71	Trip Emission Ecolabel Hamburg to Mexico City via Paris by Air France	. 268
Figure D.72	Trip Emission Ecolabel Hamburg to Mexico City via Paris and Atlanta	
	by Air France and Delta Air Lines	. 269
Figure D.73	Trip Emission Ecolabel Hamburg to Mexico City via Amsterdam by	
	KLM and Aeromexico	. 270
Figure D.74	Trip Emission Ecolabel Hamburg to Mexico City via Paris by Air France	
	and Aeromexico	. 271
Figure D.75	Trip Emission Ecolabel Hamburg to Mexico City via Frankfurt and New	
	York by Lufthansa, Singapore Airlines and Aeromexico	. 272
Figure D.76	Trip Emission Ecolabel Hamburg to Mexico City via Frankfurt by Luft-	
	hansa	. 273
Figure D.77	Trip Emission Ecolabel Hamburg to Mexico City via Frankfurt and Wash-	
	ington D.C. by Lufthansa and United Airlines	. 274
Figure D.78	Trip Emission Ecolabel Hamburg to Mexico City via London Heathrow	
	and Dallas by British Airways and American Airlines	. 275
Figure D.79	Trip Emission Ecolabel Hamburg to Mexico City via London Heathrow	
	by British Airways	. 276
Figure D.80	Trip Emission Ecolabel Hamburg to Munich by Eurowings	. 277
Figure D.81	Trip Emission Ecolabel Hamburg to Munich by Lufthansa	. 278
Figure D.82	Trip Emission Ecolabel Hamburg to Munich by Lufthansa	. 279
Figure D.83	Trip Emission Ecolabel Hamburg to Munich by Eurowings	. 280
Figure D.84	Trip Emission Ecolabel Hamburg to Munich via Düsseldorf by Euro-	
	wings and Lufthansa	. 281
Figure D.85	Trip Emission Ecolabel Hamburg to Munich via Riga by Air Baltic	. 282
Figure D.86	Trip Emission Ecolabel Hamburg to Munich via Cologne by Eurowings	
	and Lufthansa	. 283
Figure D.87	Trip Emission Ecolabel Hamburg to Munich via Düsseldorf by Euro-	
	wings	. 284
Figure D.88	Trip Emission Ecolabel Hamburg to Munich via Frankfurt by Lufthansa	. 285
Figure D.89	Trip Emission Ecolabel Hamburg to Palma de Mallorca by Ryanair	. 286
Figure D.90	Trip Emission Ecolabel Hamburg to Palma de Mallorca by Eurowings	. 287
Figure D.91	Trip Emission Ecolabel Hamburg to Palma de Mallorca by Condor	. 288
Figure D.92	Trip Emission Ecolabel Hamburg to Palma de Mallorca by Ryanair	
	(Aircraft from Lauda Europe)	. 289
Figure D.93	Trip Emission Ecolabel Hamburg to Palma de Mallorca via Valencia by	
	Eurowings and Air Europa	. 290
Figure D.94	Trip Emission Ecolabel Hamburg to Palma de Mallorca via Munich by	
	Eurowings	. 291
Figure D.95	Trip Emission Ecolabel Hamburg to Palma de Mallorca by Eurowings	. 292

Figure D.96	Trip Emission Ecolabel Hamburg to Palma de Mallorca via Barcelona by	
	Eurowings and Air Europa	293
Figure D.97	Trip Emission Ecolabel Hamburg to Palma de Mallorca via Barcelona by	
	Vueling	294
Figure D.98	Trip Emission Ecolabel Hamburg to Palma de Mallorca via Cologne by	
	Eurowings	295
Figure D.99	Trip Emission Ecolabel Hamburg to Palma de Mallorca via Madrid by	
	Iberia	296
Figure D.100	Trip Emission Ecolabel Hamburg to Palma de Mallorca via Zürich by	
	Swiss	297

List of Tables

Table 6.1	Comparison of flights from Hamburg to Munich	. 53
Table 6.2	Comparison of flights from Hamburg to Palma de Mallorca	. 56
Table 6.3	Comparison of flights from Hamburg to Gran Canaria	. 59
Table 6.4	Comparison of flights from Hamburg to Antalya	. 62
Table 6.5	Comparison of flights from Hamburg to New York	. 65
Table 6.6	Comparison of flights from Hamburg to Bonaire	. 68
Table 6.7	Comparison of flights from Hamburg to Bangkok	. 71
Table 6.8	Comparison of flights from Hamburg to Hong Kong	. 74
Table 6.9	Comparison of flights from Hamburg to Mexico City	. 77
Table 6.10	Comparison of flights from Hamburg to Hurghada	. 80
Table A.1 Table B.1	The selected routes and flight connections for Trip Emission Ecolabel Aircraft combinations of airlines with engine type and cabin layout	
Table E.1	Comparison of flight connections from Hamburg to Munich	299
Table E.2	Comparison of flight connections from Hamburg to Palma de Mallorca	299
Table E.3	Comparison of flight connections from Hamburg to Gran Canaria	300
Table E.4	Comparison of flight connections from Hamburg to Antalya	300
Table E.5	Comparison of flight connections from Hamburg to New York	301
Table E.6	Comparison of flight connections from Hamburg to Bonaire	301
Table E.7	Comparison of flight connections from Hamburg to Bangkok	302
Table E.8	Comparison of flight connections from Hamburg to Hong Kong	302
Table E.9	Comparison of flight connections from Hamburg to Mexico City	303
Table E.10	Comparison of flight connections from Hamburg to Hurghada	303

List of Symbols

A	Local Air Pollution $\left[\frac{g}{kN}\right]$
Amax	LAP, max $\left[\frac{g}{kN}\right]$ (normalization constant from statistics)
A_{min}	LAP, min $\left[\frac{g}{kN}\right]$ (normalization constant from statistics)
E _{CO2}	CO_2 -equivalent emission $\left[\frac{\frac{kg}{km}}{seat}\right]$
E _{CO2} ,max	CO ₂ , max $\left[\frac{\frac{kg}{km}}{\text{seat}}\right]$ (normalization constant from statistics)
E _{CO2} ,min	CO ₂ , min $\left[\frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}\right]$ (normalization constant from statistics)
fmax	fuel, max $\left[\frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}\right]$ (normalization constant from statistics)
<i>f</i> min	fuel, min $\left[\frac{\frac{kg}{km}}{seat}\right]$ (normalization constant from statistics)
Ι	Indicator [var.]
N_{local}	Local Noise Level $\left[\frac{\text{EPNdB}}{\text{EPNdB}}\right]$
Nlocal,max,jet	LNL, max, jet $\left[\frac{\text{EPNdB}}{\text{EPNdB}}\right]$ (normalization constant from statistics)
Nlocal,min,jet	LNL, min, jet $\left[\frac{\text{EPNdB}}{\text{EPNdB}}\right]$ (normalization constant from statistics)
<i>n</i> flights	Number of flights [-]
nseats	Number of seats [-]
0	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 [-]
Senv.	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	Desing 727 MAY 0
D 57101	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
ТР	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.

CO₂-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 da- tabase and calculating new "Ecolabels for Aircraft" is described.
Chapter 5	This chapter gives information about how the "Trip Emission Ecolabel" is cal- culated 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 CO₂-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 $Ha\beta$ 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 Air-craft* 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 CO₂-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

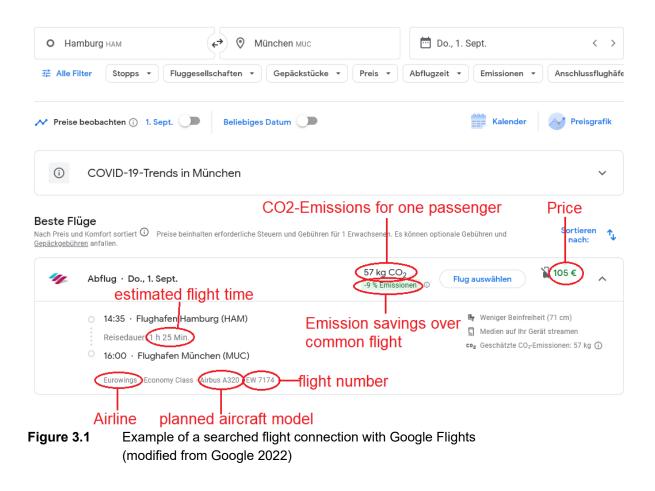
The flight search engine, which can be found on Google (2022), provides additional information of price, estimated flight time, layovers, operating airline, planned aircraft model, flight number, the estimated CO₂-Emission for one passenger and the additional or saved emission over a common flight. An 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 fu-

ture. 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.



	Airlin	е	\sim						
DATE			AIRCRAFT	FLIGHT TIME					
4 Jul 2022	Hamburg (HAM)	Munich (MUC)	320	-	14:35		16:00	Scheduled	
7 Jul 2022	Hamburg (HAM)	Munich (MUC)	320	-	14:35	-	16:00	Scheduled	
0 Jul 2022	Hamburg (HAM)	Munich (MUC)	A320(9H-MLR)	0:56	14:35	15:40	16:00	Landed 16:36	► Play
	days of EW7174 hi years) subscription		with an upgrade to	o a Silver (90 day	s), Gold (1	year), or		7-day FREE trial Learn more	

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

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



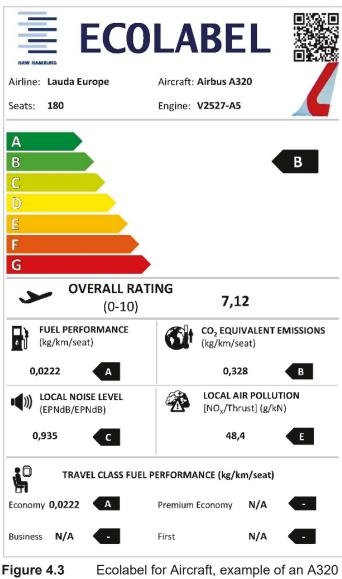
Figure 4.2 General information about an aircraft from Airfleets (2022)

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 *CO₂ Equivalent Emissions* (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).



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:

$$P_{f,avg} = \frac{P_{f,1} \cdot R_1 + P_{f,2} \cdot R_2 + \dots + P_{f,n} \cdot R_n}{R_1 + R_2 + \dots + R_n}$$
(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.

$$E_{CO_2,avg} = \frac{E_{CO_2,1} \cdot R_1 + E_{CO_2,2} \cdot R_2 + \dots + E_{CO_2,n} \cdot R_n}{R_1 + R_2 + \dots + R_n}$$
(5.2)

Equation (5.2) is used to calculate the average CO₂ equivalent emission ($E_{CO_2,avg}$). For the calculation, the CO₂ 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.

$$N_{local,avg} = \frac{N_{local,1} + N_{local,2} + \dots + N_{local,n}}{n_{flights}}$$
(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).

$$A_{avg} = \frac{A_1 + A_2 + \dots + A_n}{n_{flights}}$$
(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:

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

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

To get the normalized CO₂ equivalent emission ($E_{CO_2,norm.}$), Equation (5.6) shows, that the statistical minimum value of CO₂ equivalent emission ($E_{CO_2,min}$) is substracted from the average CO₂ equivalent emission ($E_{CO_2,avg}$) and divided by the subtraction of statistical maximum value of CO₂ equivalent emission ($E_{CO_2,avg}$) and $E_{CO_2,min}$.

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

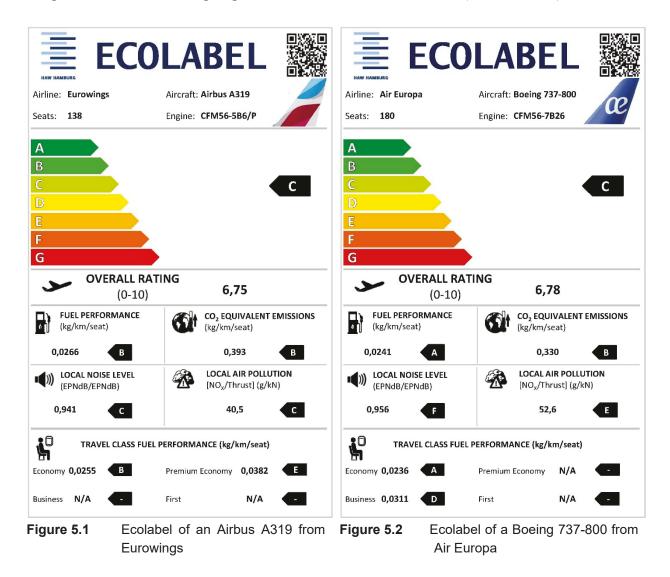
The normalized Local Noise Level ($N_{local,norm.}$) is calculated by Equation (5.7). To get the result, the statistical minimum value of the Local Noise Level for jets ($N_{local,min,jet}$) is subtracted from the average Local Noise Level ($N_{local,avg}$) and divided by the subtraction of the statistical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

$$O = (1 - (0.2 \cdot P_{f,norm.} + 0.4 \cdot E_{CO_2,norm.} + 0.2 \cdot N_{local,norm.} + 0.2 \cdot A_{norm.}) \cdot 10$$
(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).



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: $P_{f,1,\text{general}} = 0,0266 \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}; P_{f,2,\text{general}} = 0,0241 \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}; R_1 = 1761 \text{ km}; R_2 = 277 \text{ km}$

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

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

$$P_{f,avg,general} = 0,0262 \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$$
(5.10)

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

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

$$P_{f,avg,EC} = \frac{0,0255 \cdot 1761 + 0,0236 \cdot 277}{1761 + 277} \cdot \frac{\frac{\text{kg}}{\text{seat}} \cdot \text{km}}{\text{km}}$$
$$P_{f,avg,EC} = 0,0252 \frac{\text{kg}}{\text{seat}}$$
(5.11)

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

$$E_{CO_2,avg} = \frac{E_{CO_2,1} \cdot R_1 + E_{CO_2,2} \cdot R_2 + \dots + E_{CO_2,n} \cdot R_n}{R_1 + R_2 + \dots + R_n}$$
$$E_{CO_2,avg} = \frac{0,393 \cdot 1761 + 0,330 \cdot 277}{1761 + 277} \cdot \frac{\frac{\text{kg}}{\text{km}} \cdot \text{km}}{\text{km}}$$

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

From Equation (5.3) with: $N_{local,1} = 0.941 \frac{\text{EPNdB}}{\text{EPNdB}}$; $N_{local,2} = 0.956 \frac{\text{EPNdB}}{\text{EPNdB}}$; $n_{flights} = 2$

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

$$N_{local,avg} = \frac{0,941 + 0,956}{2} \cdot \frac{\frac{\text{EPNdB}}{\text{EPNdB}}}{1}$$
$$N_{local,avg} = 0,949 \frac{\text{EPNdB}}{\text{EPNdB}}$$
(5.13)

From Equation (5.4) with: $A_1 = 40.5 \frac{g}{kN}$; $A_2 = 52.6 \frac{g}{kN}$; $n_{flights} = 2$

$$A_{avg} = \frac{A_1 + A_2 + \dots + A_n}{n_{flights}}$$
$$A_{avg} = \frac{40,5 + 52,6}{2} \cdot \frac{g}{kN}$$
$$A_{avg} = 46,55 \frac{g}{kN}$$
(5.14)

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

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

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

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

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

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

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

$$E_{CO_2,norm.} = 0,313$$
 (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: $A_{avg} = 46,55 \frac{g}{kN}$; $A_{min} = 20,4348 \frac{g}{kN}$; $A_{max} = 214,2387 \frac{g}{kN}$

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

$$A_{norm.} = \frac{46,55 - 20,4348}{214,2387 - 20,4348} \cdot \frac{\frac{g}{kN}}{\frac{g}{kN}}$$
$$A_{norm.} = 0,135 \tag{5.18}$$

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

$$O = (1 - (0.2 \cdot P_{f,norm.} + 0.4 \cdot E_{CO_2,norm.} + 0.2 \cdot N_{local,norm.} + 0.2 \cdot A_{norm.}) \cdot 10$$

$$O = (1 - (0.2 \cdot 0.1967 + 0.4 \cdot 0.313 + 0.2 \cdot 0.716 + 0.2 \cdot 0.135) \cdot 10$$

$$O = 6.65$$

(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.

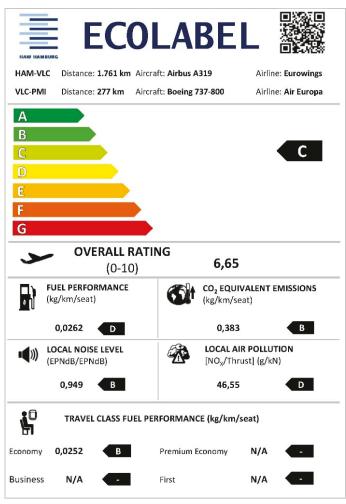


Figure 5.3 Trip Emission Ecolabel of the calculated example

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:

$$P_{f,total} = P_{f,1} \cdot R_1 + P_{f,2} \cdot R_2 + \dots + P_{f,n} \cdot R_n$$
(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.

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

Equation (5.21) is used to calculate the total amount of CO₂ equivalent emission ($E_{CO_2,total}$) per seat into the atmosphere by adding the multiplication of CO₂ 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).

$$N_{local,total} = N_{local,1} + N_{local,2} + \dots + N_{local,n}$$
(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.

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

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

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

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

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

$$S_{Env.} = 0.2 \cdot r_{P_f} + 0.4 \cdot r_{E_{CO_2}} + 0.2 \cdot r_{L_{noise}} + 0.2 \cdot r_A$$
(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: $P_{f,1,\text{general}} = 0,02661 \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $P_{f,2,\text{general}} = 0,02412 \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $R_1 = 1761 \text{ km}$; $R_2 = 277 \text{ km}$

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

$$P_{f,total,general} = (0,02661 \cdot 1761 + 0,02412 \cdot 277) \cdot \frac{\underline{\text{kg}}}{\underline{\text{km}}} \cdot \underline{\text{km}}$$

$$P_{f,total,general} = 56,1 \frac{\underline{\text{kg}}}{\underline{\text{seat}}}$$
(5.30)

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

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

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

$$P_{f,total,EC} = 53,9 \frac{\text{kg}}{\text{seat}}$$
(5.31)

From Equation (5.21) with: $E_{CO_{2},1} = 0.3933 \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $E_{CO_{2},2} = 0.3300 \frac{\frac{\text{kg}}{\text{km}}}{\text{seat}}$; $R_{1} = 1761 \text{ km}$; $R_{2} = 277 \text{ km}$

$$E_{CO_{2},total} = E_{CO_{2},1} \cdot R_{1} + E_{CO_{2},2} \cdot R_{2} + \dots + E_{CO_{2},n} \cdot R_{n}$$

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

$$E_{CO_2,total} = 820,3 \ \frac{\text{kg}}{\text{seat}}$$
(5.32)

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

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

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

$$N_{local,total} = 1,897 \frac{\text{EPNdB}}{\text{EPNdB}}$$
(5.33)

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

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

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

$$A_{total} = 129,7 \frac{g}{seat}$$
(5.34)

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

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

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

$$r_{P_{f}} = 0,84$$
(5.35)

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

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

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

$$r_{E_{CO_2}} = 0,90$$
(5.36)

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

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

$$r_{L_{noise}} = \frac{1,897}{0,954} \cdot \frac{\frac{\text{EPNdB}}{\text{EPNdB}}}{\frac{\text{EPNdB}}{\text{EPNdB}}}$$
$$r_{L_{noise}} = 1,99 \tag{5.37}$$

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

$$r_{A} = \frac{A_{total}}{A_{ref}}$$

$$r_{A} = \frac{129.7}{49.9} \cdot \frac{g}{\frac{seat}{seat}}$$

$$r_{A} = 2,60$$
(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.

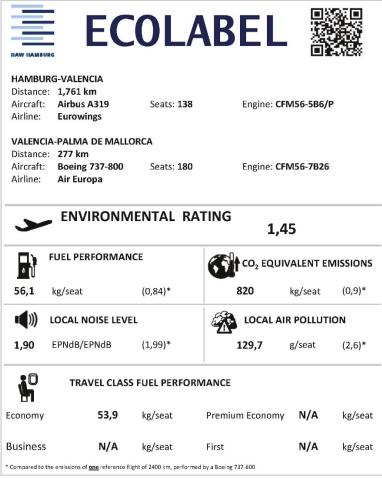


Figure 5.4 Trip Emission Ecolabel of the calculated example

5.2 Evaluation of the Two Trip Emission Ecolabels

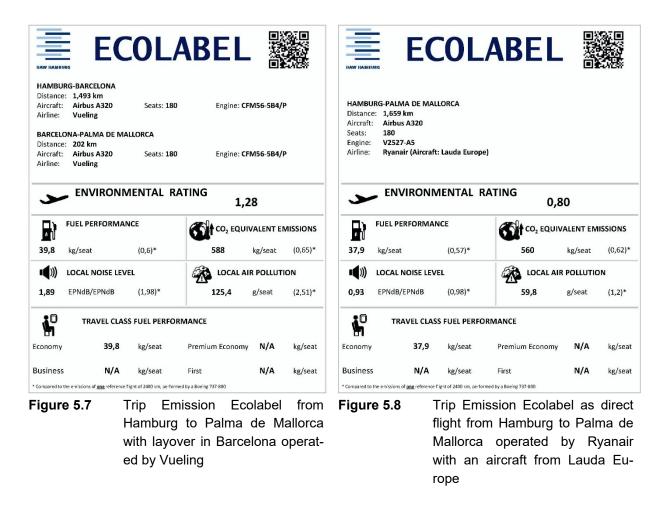
To reveal some shortcomings of the first concept, described in Section 5.1.1, another example was calculated. The result of the first calculation, done like in Section 5.1.1, is shown in Figure 5.5. Calculated is a flight connection of Vueling with a layover in Barcelona and both flights executed by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

	OLABEL)LABEL 🧱
HAM-BCN Distance: 1493	Aircraft: Airbus A320 Airline: Vueling	Airline: Lauda Europe	Aircraft: Airbus A320
BCN-PMI Distance: 202	Aircraft: Airbus A320 Airline: Vueling	Seats: 180	Engine: V2527-A5
A B C D E F G	В	A B C D E F	В
Soverall (0-1	lo) 7,04	G OVERALL RA (0-10)	7 1 2
(kg/km/seat)	(kg/km/seat)	FUEL PERFORMANCE (kg/km/seat)	CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
0,0222 C	0,328 B	0,0222 A	0,328 B
(EPNdB/EPNdB)	[NO _x /Thrust] (g/kN)	(EPNdB/EPNdB)	ECCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
0,943 A	47,00 E	0,935 C	48,4 E
	UEL PERFORMANCE (kg/km/seat)	TRAVEL CLASS FU	EL PERFORMANCE (kg/km/seat)
conomy 0,0222 A	Premium Economy N/A	Economy 0,0222 A	Premium Economy N/A
usiness N/A -	First N/A	Business N/A -	First N/A -
bui	p Emission Ecolabel from Ham- rg to Palma de Mallorca with lay- er in Barcelona operated by Vuel-	Lau	olabel for Airbus A320 fro uda Europe as direct flig m Hamburg to Palma o Illorca

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.

51



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

			0	0		
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
 Comparison of flights from Hamburg to Munich

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.

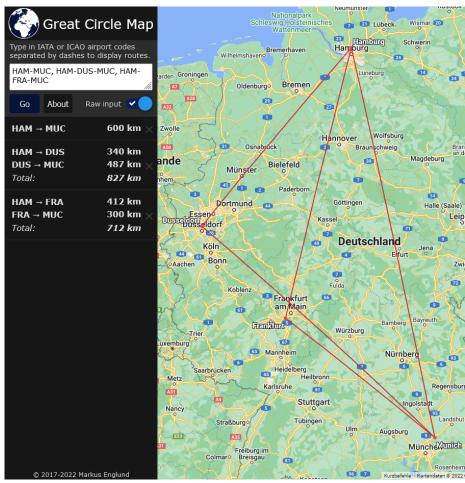


Figure 6.1 Flight connections from Hamburg to Munich (greatcirclemap.com)

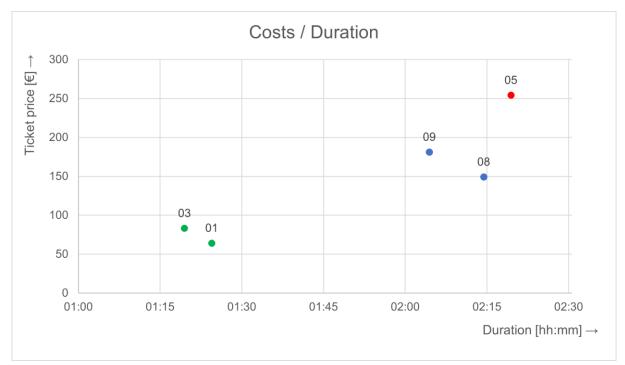


Figure 6.2 Distribution of costs over duration of the flights from Hamburg to Munich

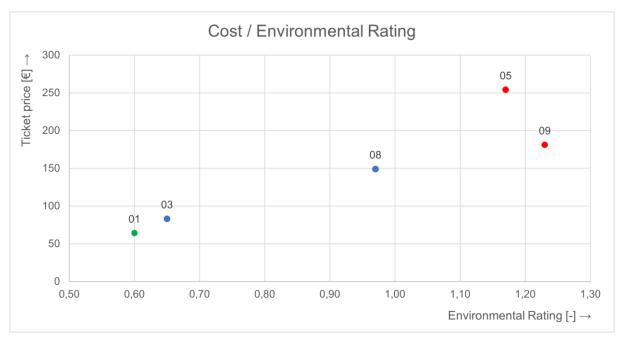


Figure 6.3 Distribution of costs over Environmental Rating of the flights from Hamburg to Munich

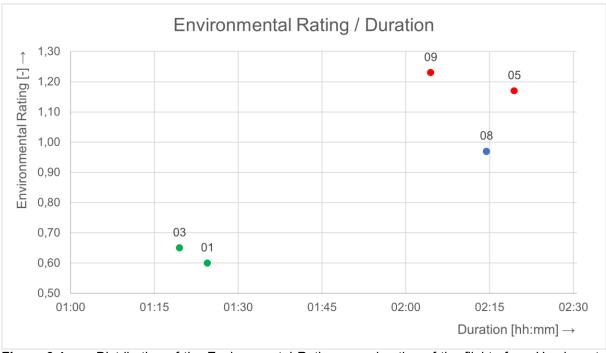


Figure 6.4 Distribution of the Environmental Rating over duration of the flights from Hamburg to Munich

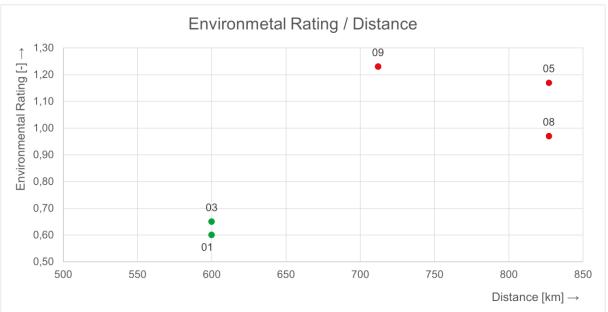


Figure 6.5 Distribution of the Environmental Rating over distance of the flights from Hamburg to Munich

6.2 Medium-Haul Flight from Hamburg to Palma de Mallorca

Tab	Table 0.2 Companison of highls non-rhanburg to r anna de Maliorea									
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
 Comparison of flights from Hamburg to Palma de Mallorca

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.

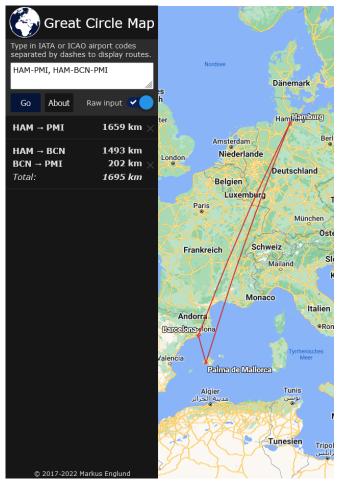


Figure 6.6 Flight connections from Hamburg to Mallorca (greatcirclemap.com)

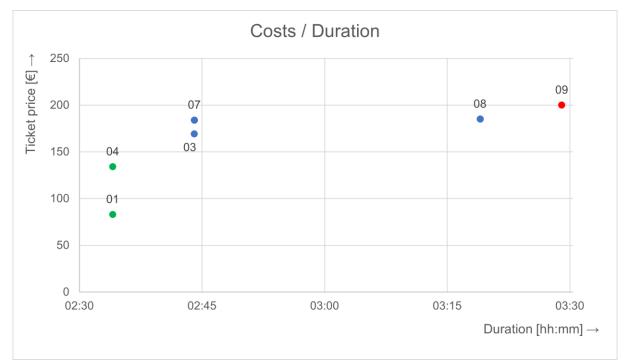


Figure 6.7 Distribution of costs over duration of the flights from Hamburg to Palma de Mallorca

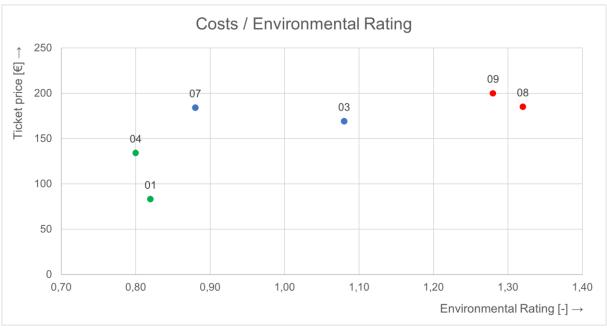
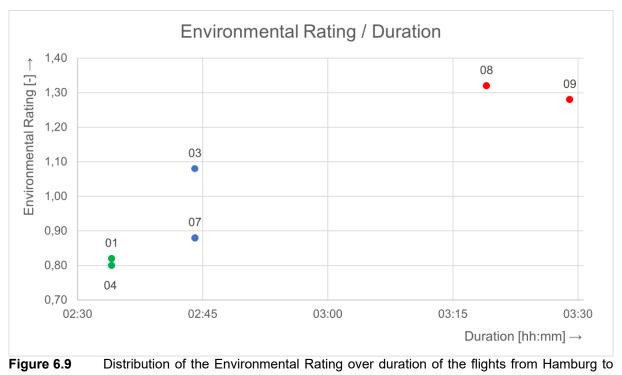


Figure 6.8 Distribution of costs over Environmental Rating of the flights from Hamburg to Palma de Mallorca



Palma de Mallorca

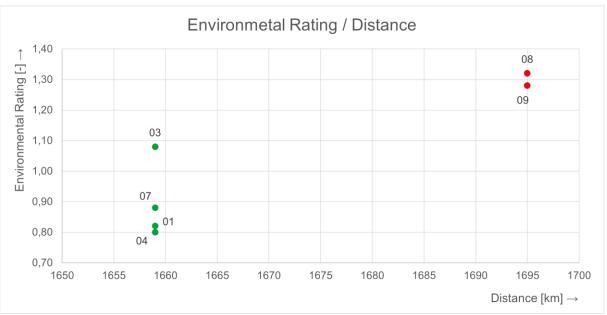


Figure 6.10 Distribution of the Environmental Rating over distance of the flights from Hamburg to Palma de Mallorca

6.3 Medium-Haul Flight from Hamburg to Gran Canaria

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
 Comparison of flights from Hamburg to Gran Canaria

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.

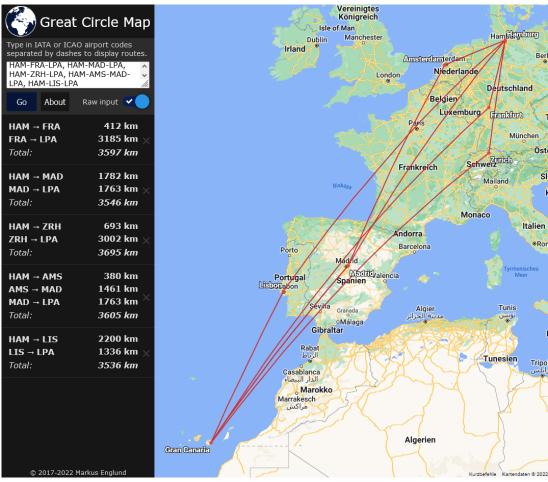


Figure 6.11 Flight connections from Hamburg to Gran Canaria (greatcirclemap.com)

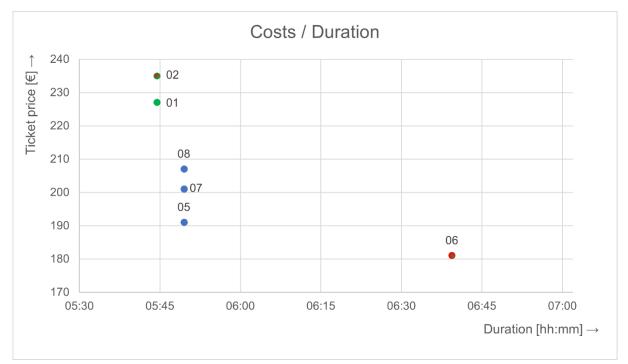


Figure 6.12 Distribution of costs over duration of the flights from Hamburg to Gran Canaria

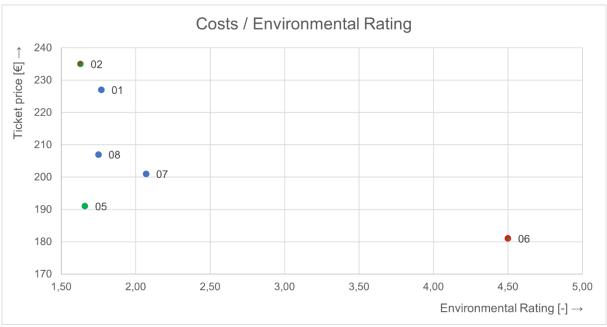


Figure 6.13 Distribution of costs over Environmental Rating of the flights from Hamburg to Gran Canaria

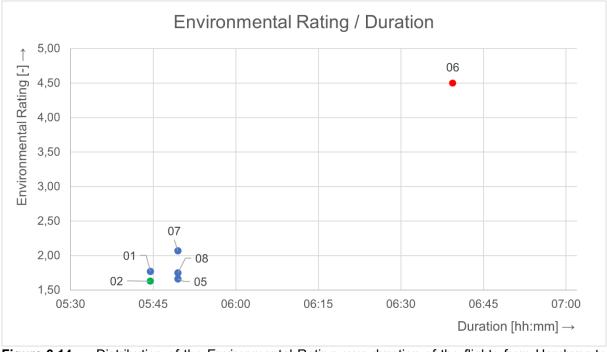


Figure 6.14 Distribution of the Environmental Rating over duration of the flights from Hamburg to Gran Canaria

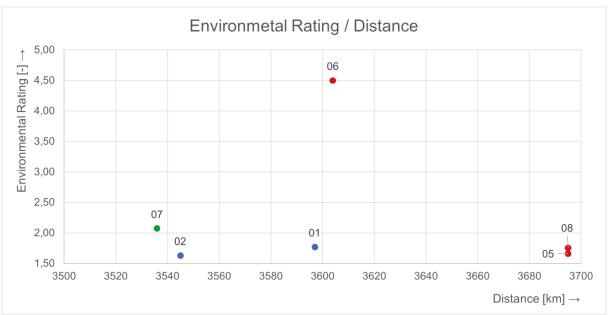


Figure 6.15 Distribution of the Environmental Rating over distance of the flights from Hamburg to Gran Canaria

6.4 Medium-Haul Flight from Hamburg to Antalya

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

 Table 6.4
 Comparison of flights from Hamburg to Antalya

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.

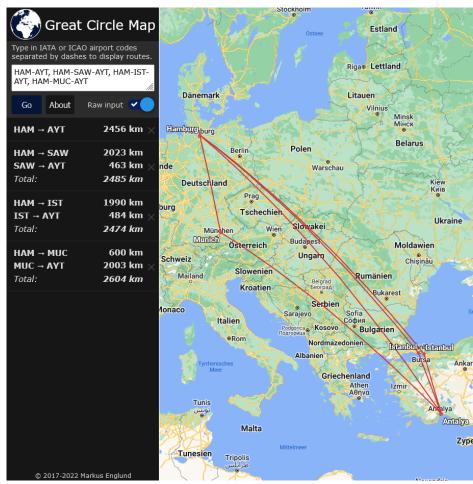


Figure 6.16 Flight connections from Hamburg to Antalya (greatcirclemap.com)

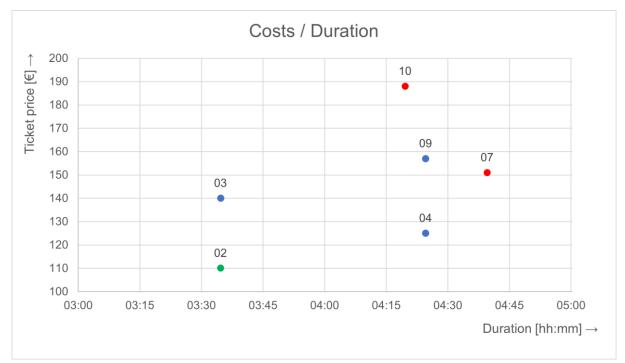


Figure 6.17 Distribution of costs over duration of the flights from Hamburg to Antalya

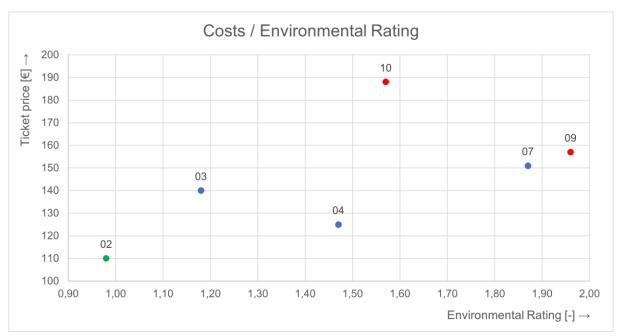


Figure 6.18 Distribution of costs over Environmental Rating of the flights from Hamburg to Antalya

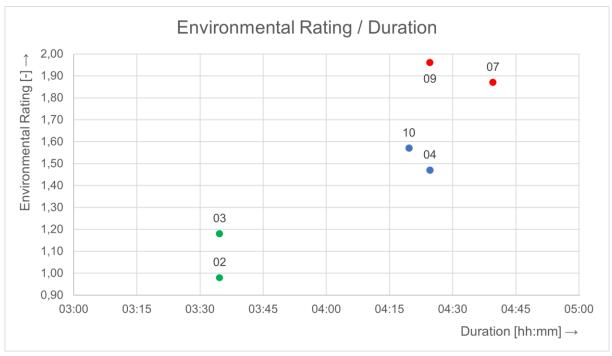


Figure 6.19 Distribution of the Environmental Rating over duration of the flights from Hamburg to Antalya

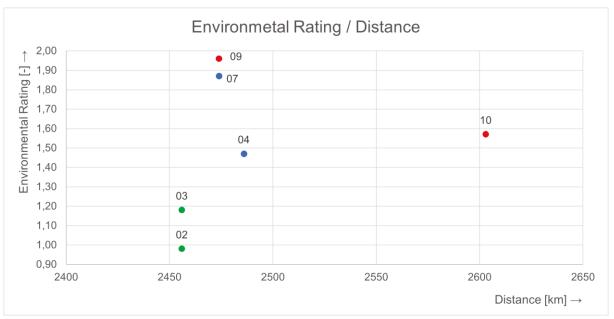


Figure 6.20 Distribution of the Environmental Rating over distance of the flights from Hamburg to Antalya

6.5 Long-Haul Flight from Hamburg to New York

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 6.5Comparison of flights from Hamburg to New York

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.

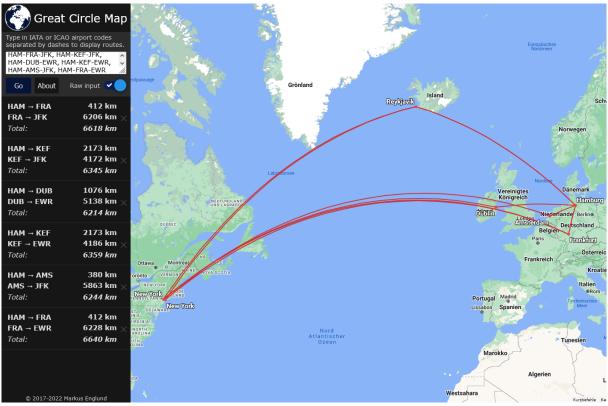


Figure 6.21 Flight connections from Hamburg to New York (greatcirclemap.com)

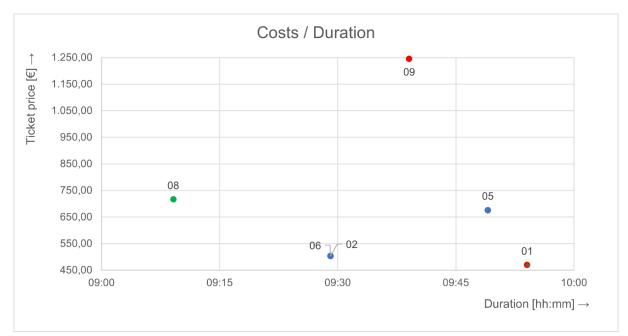


Figure 6.22 Distribution of costs over duration of the flights from Hamburg to New York

66

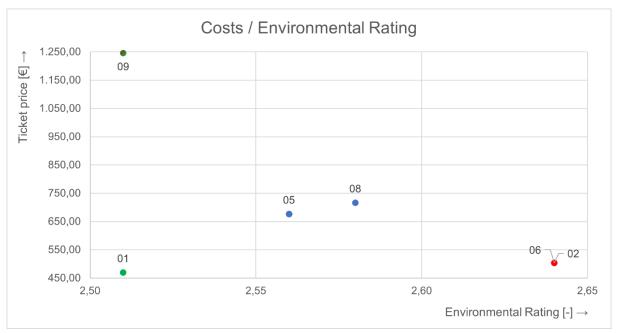


Figure 6.23 Distribution of costs over Environmental Rating of the flights from Hamburg to New York

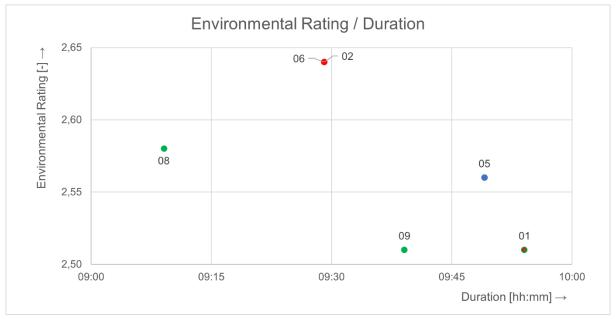


Figure 6.24 Distribution of the Environmental Rating over duration of the flights from Hamburg to New York

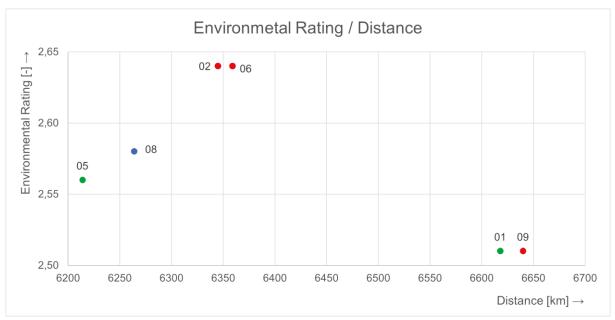


Figure 6.25 Distribution of the Environmental Rating over distance of the flights from Hamburg to New York

6.6 Long-Haul Flight from Hamburg to Bonaire

No.	Airlines	Stopover 1	Stopover 2	Costs	Duration	Total Distance	Environmental			
				[€]	[hh:mm]	[km]	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
 Comparison of flights from Hamburg to Bonaire

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)

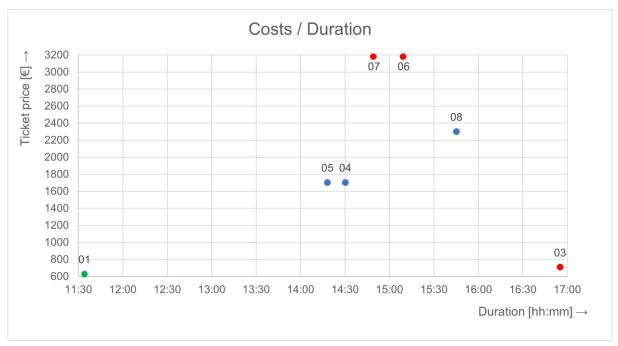


Figure 6.27 Distribution of costs over duration of the flights from Hamburg to Bonaire

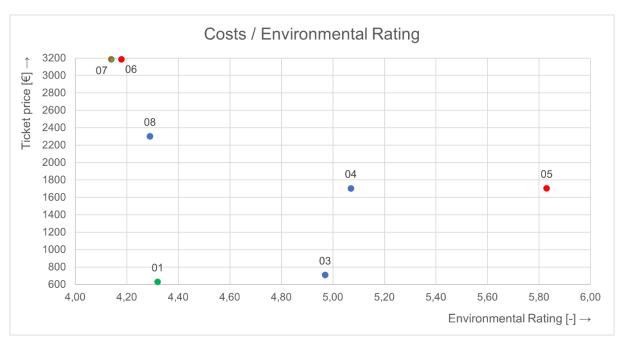


Figure 6.28 Distribution of costs over Environmental Rating of the flights from Hamburg to Bonaire

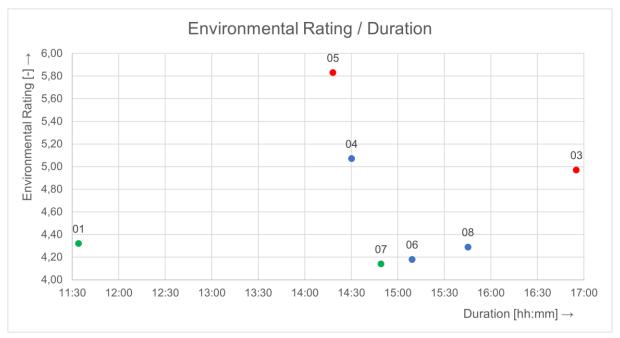


Figure 6.29 Distribution of the Environmental Rating over duration of the flights from Hamburg to Bonaire

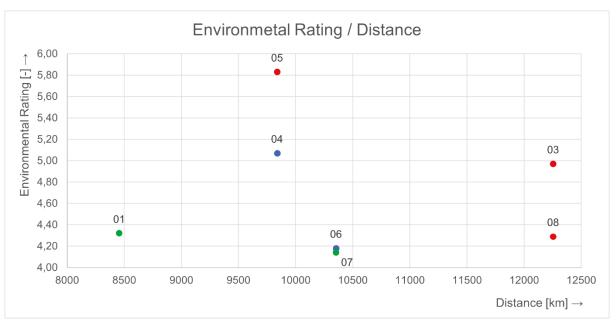


Figure 6.30 Distribution of the Environmental Rating over distance of the flights from Hamburg to Bonaire

6.7 Long-Haul Flight from Hamburg to Bangkok

	Tuble en Comparison et highes i en Hamburg to Burgkok								
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
 Comparison of flights from Hamburg to Bangkok

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.

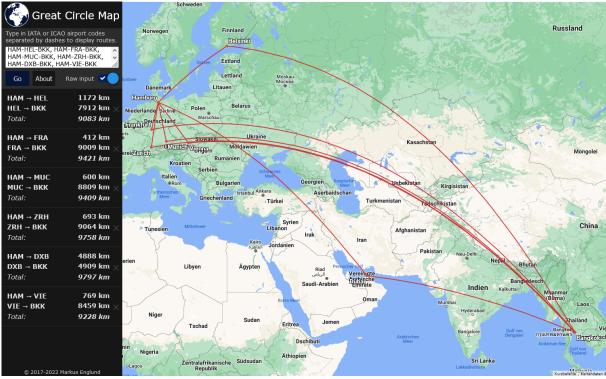


Figure 6.31 Flight connections from Hamburg to Bangkok (greatcirclemap.com)

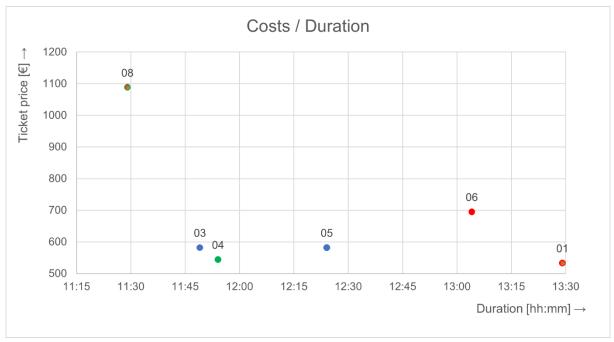


Figure 6.32 Distribution of costs over duration of the flights from Hamburg to Bangkok

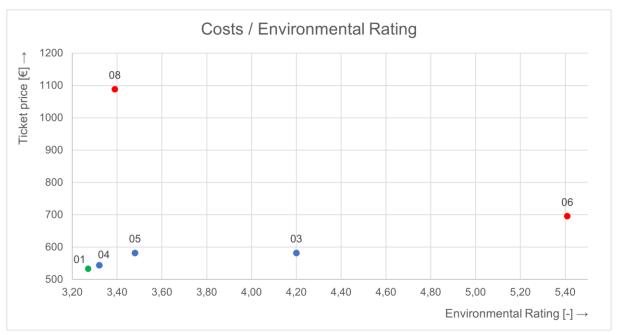


Figure 6.33 Distribution of costs over Environmental Rating of the flights from Hamburg to Bangkok

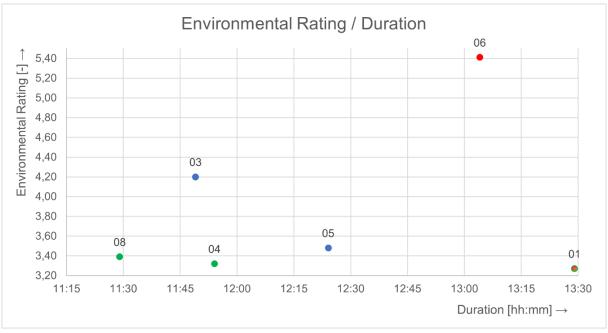


Figure 6.34 Distribution of the Environmental Rating over duration of the flights from Hamburg to Bangkok

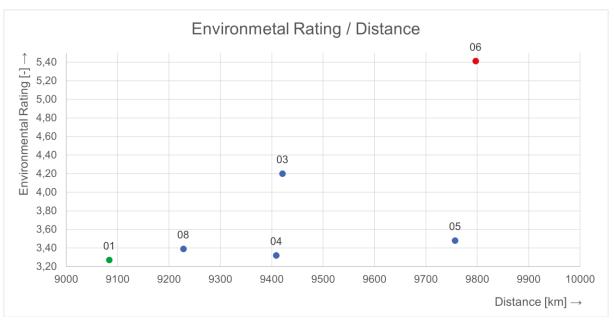


Figure 6.35 Distribution of the Environmental Rating over distance of the flights from Hamburg to Bangkok

6.8 Long-Haul Flight from Hamburg to Hong Kong

ius											
No.	Airlines	Stopover 1	Stopover 2	Costs	Duration	Total Distance	Environmental				
				[€]	[hh:mm]	[km]	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
 Comparison of flights from Hamburg to Hong Kong

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.

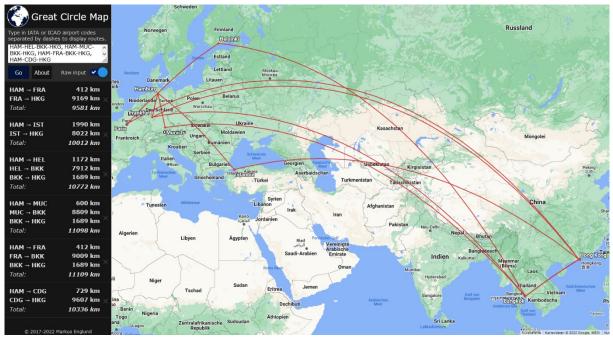


Figure 6.36 Flight connections from Hamburg to Hong Kong (greatcirclemap.com)

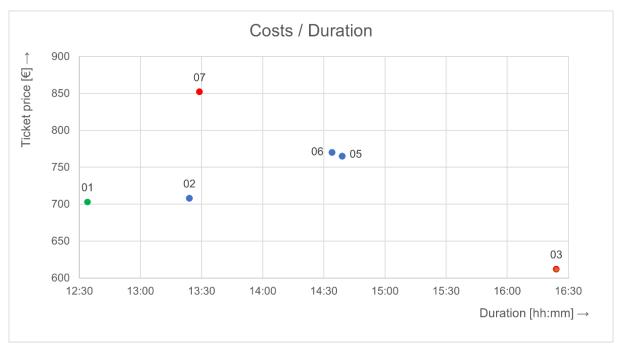


Figure 6.37 Distribution of costs over duration of the flights from Hamburg to Hong Kong

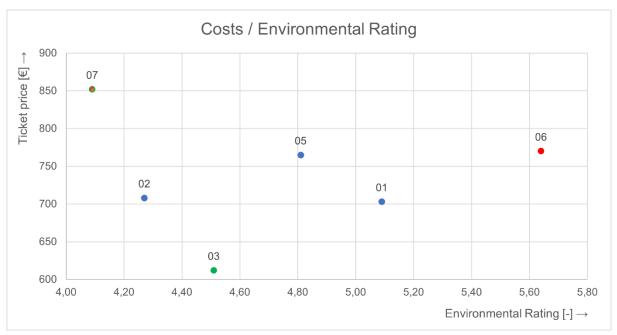


Figure 6.38 Distribution of costs over Environmental Rating of the flights from Hamburg to Hong Kong

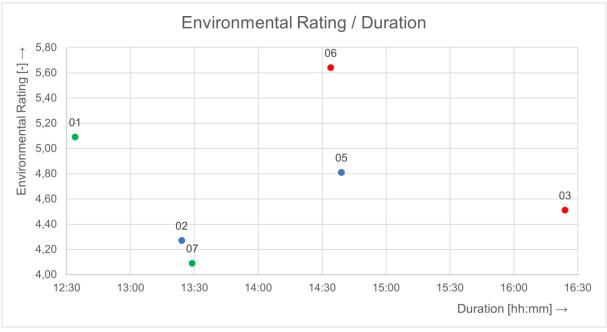


Figure 6.39 Distribution of the Environmental Rating over duration of the flights from Hamburg to Hong Kong

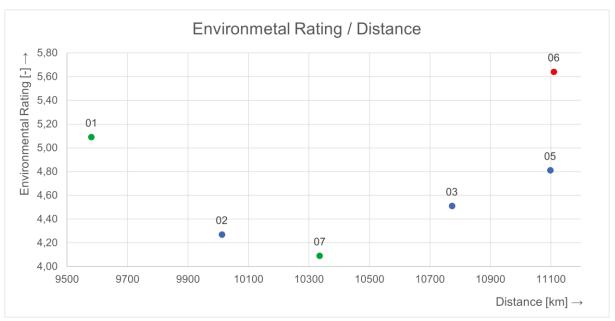


Figure 6.40 Distribution of the Environmental Rating over distance of the flights from Hamburg to Hong Kong

6.9 Long-Haul Flight from Hamburg to Mexico City

			in or mg		inibuly to Mexico	Only
No.	Airlines	Stopover		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
 Comparison of flights from Hamburg to Mexico City

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)

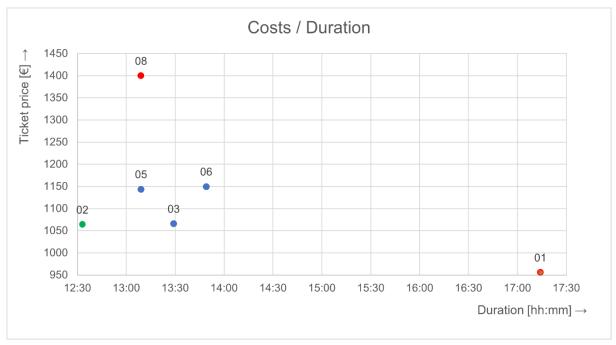


Figure 6.42 Distribution of costs over duration of the flights from Hamburg to Mexico City

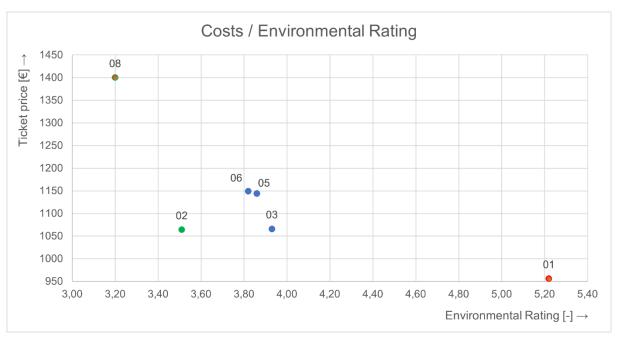


Figure 6.43 Distribution of costs over Environmental Rating of the flights from Hamburg to Mexico City

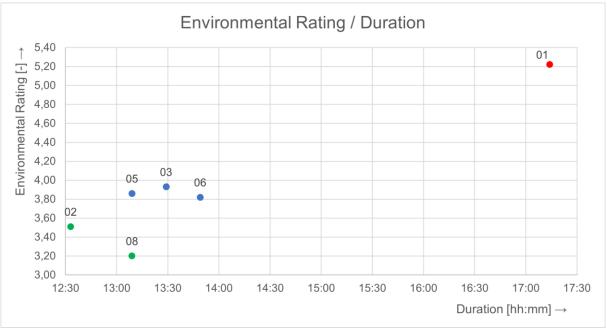


Figure 6.44 Distribution of the Environmental Rating over duration of the flights from Hamburg to Mexico City

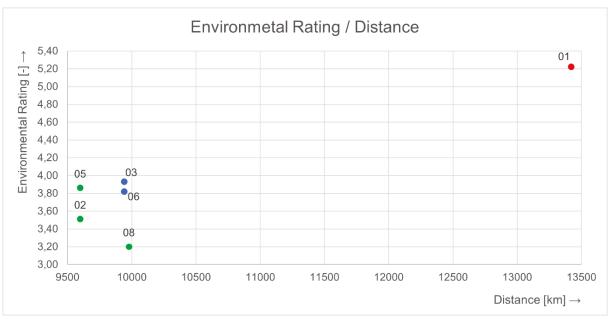


Figure 6.45 Distribution of the Environmental Rating over distance of the flights from Hamburg to Mexico City

6.10 Medium-Haul Flight from Hamburg to Hurghada

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
 Comparison of flights from Hamburg to Hurghada

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.

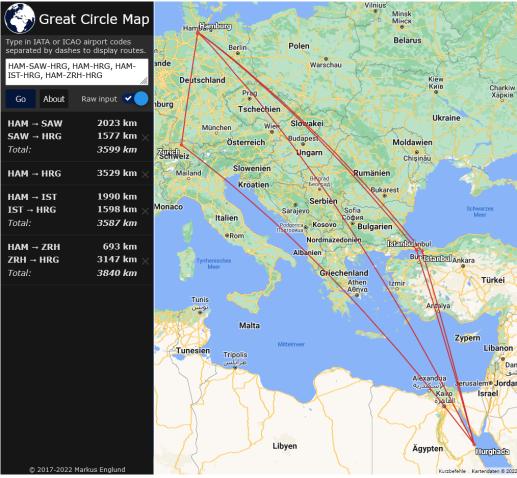


Figure 6.46 Flight connections from Hamburg to Hurghada (greatcirclemap.com)

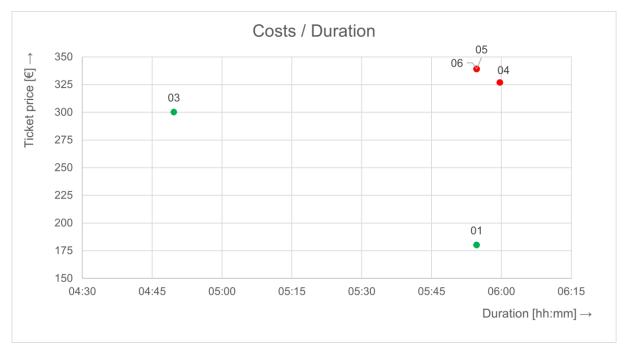


Figure 6.47 Distribution of costs over duration of the flights from Hamburg to Hurghada

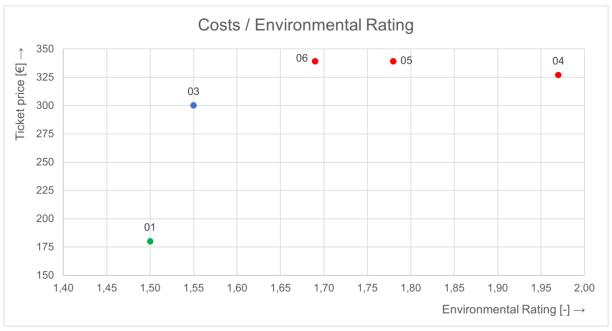


Figure 6.48 Distribution of costs over Environmental Rating of the flights from Hamburg to Hurghada

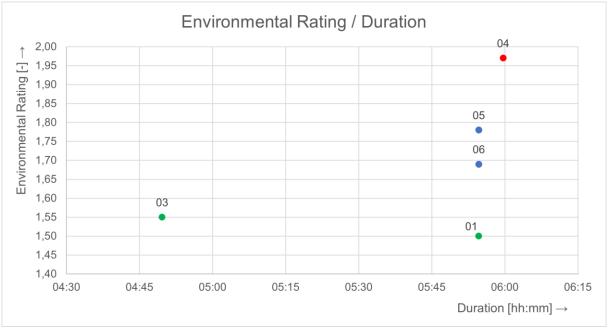


Figure 6.49 Distribution of the Environmental Rating over duration of the flights from Hamburg to Hurghada

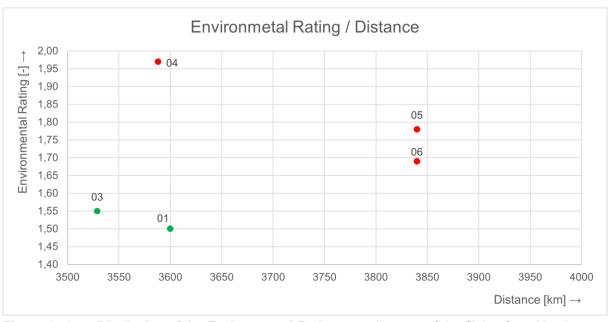


Figure 6.50 Distribution of the Environmental Rating over distance of the flights from Hamburg to Hurghada

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 $64 \\\in$ 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 ildelta 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 ildelta cheaper 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 \in . The cheapest flight option with 83 \in 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 \in 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 \in 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 \in . 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 $151 \in$ 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 $469 \in$ 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 \in 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 \in . 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 $3.183 \in$ 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 $629 \in$ 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 $1.704 \in$, 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 $533 \notin$, 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 \notin 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 $852 \in$. 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 \in , 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 op-

tion 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 \in . 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 \in , 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 \in , 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 \in . 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 \in , 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 $180 \in$ 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 $327 \notin$. The most expensive options are from Eurowings, Swiss and Edelweiss. Both connections go via Zürich and the ticket price is $339 \notin$. 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 \notin . 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 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 CO₂ 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 CO₂-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.

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Appendix A – Selected Routes and Flight Connections

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	-	-	-
angkok							1	
-	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	СМВ	SriLankan Airlines	A321
	Lufthansa	A321	FRA	Gulf Air	A21N	BAH	Gulf Air	B789
onaire								
	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
long 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	-	-	-
		1	1		1	1	1	1

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
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	-	-	-
		1.0.0			2.00			

Destination	Airline 1. Leg	Aircraft	Layover 1	Airline 2. Leg	Aircraft	Layover 2	Airline 3. Leg	Aircraft
		1. Leg			2. Leg			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

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

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
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

GEnx-1B74/75/P2G01

CFM56-7B24

GE90-90B

V2527-A5

149

108

145

96

39

42

72

42

21

16

0

0

48

0

50

12

Boeing 787-9

Airbus A320

Boeing 737-800

Boeing 777-200ER

United Airlines

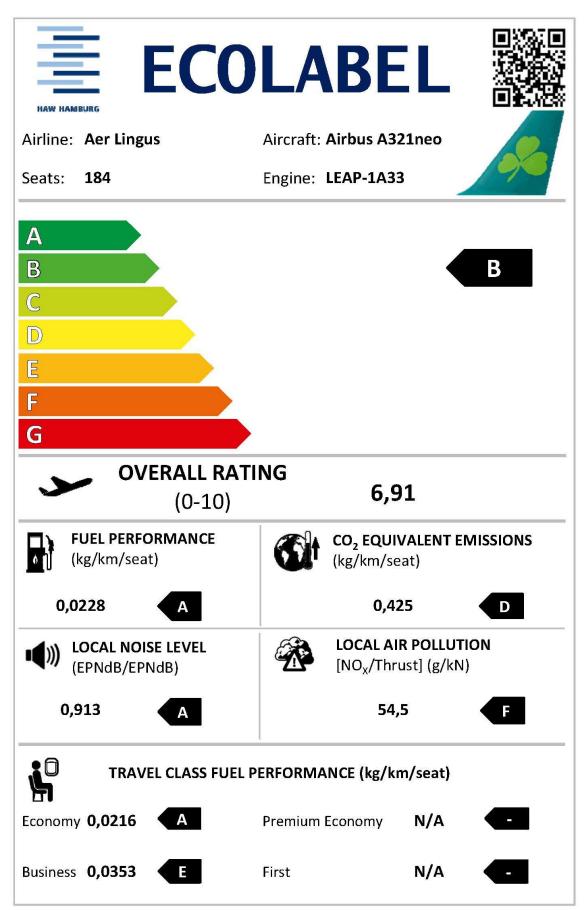
United Airlines

United Airlines

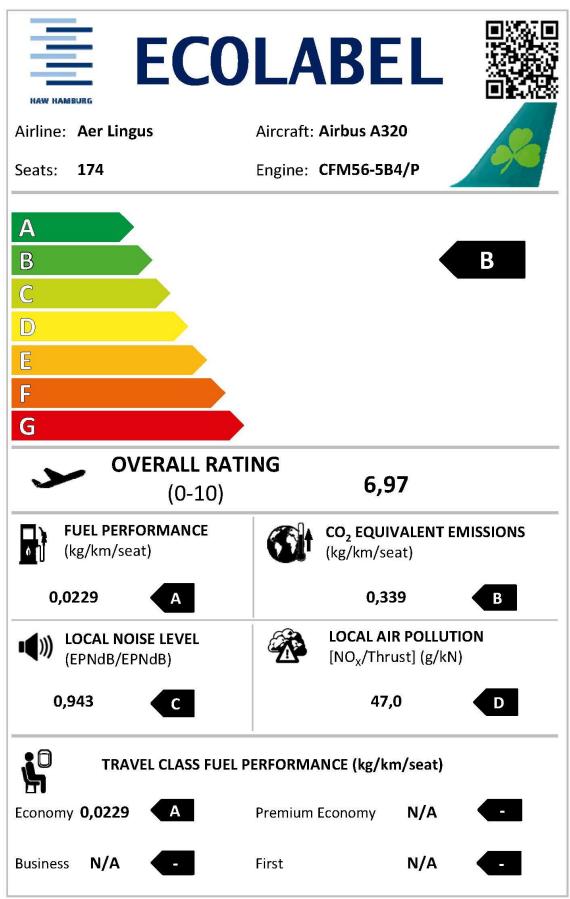
United Airlines

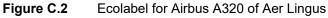
Appendix C – Ecolabel for Aircraft

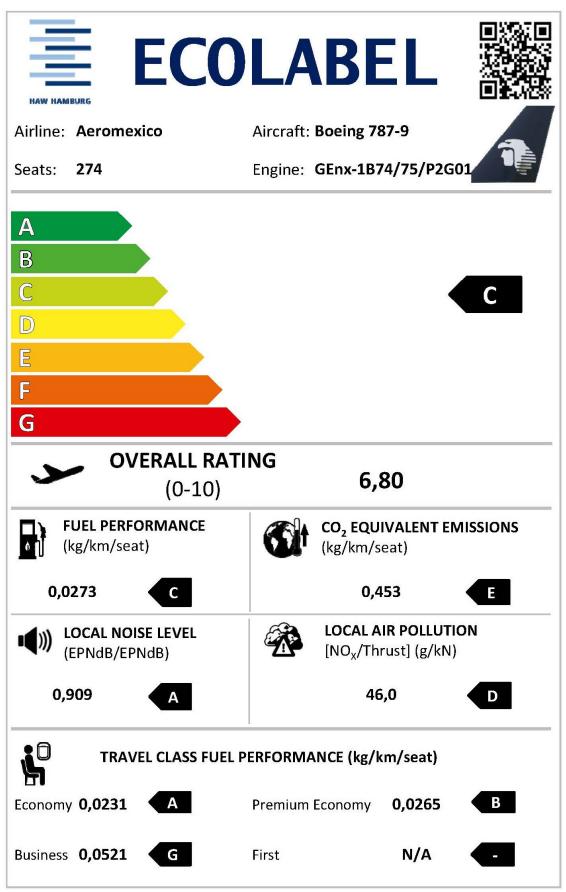
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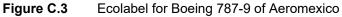


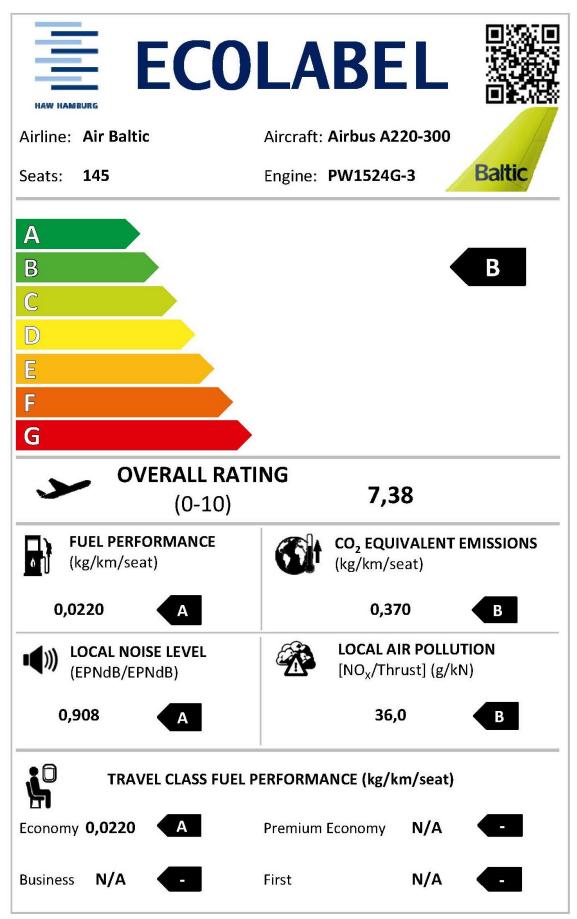




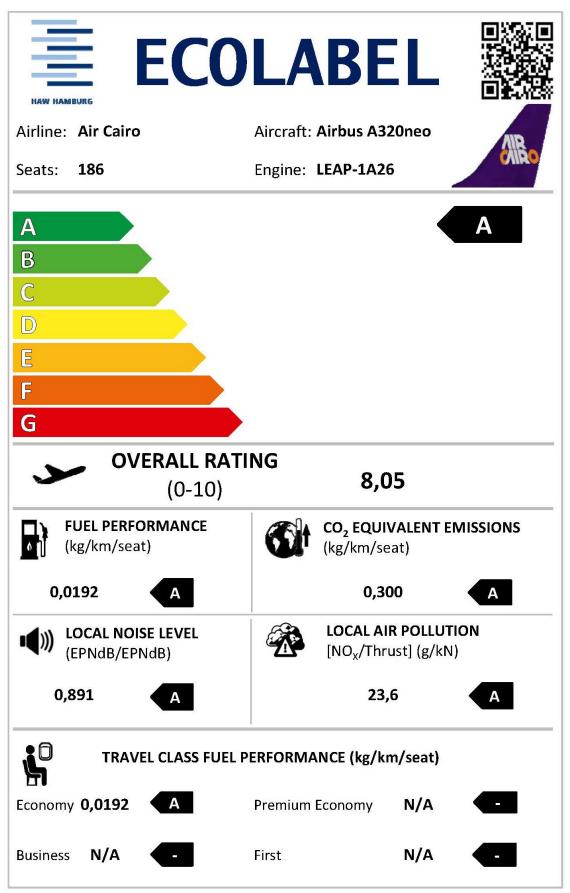


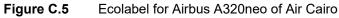


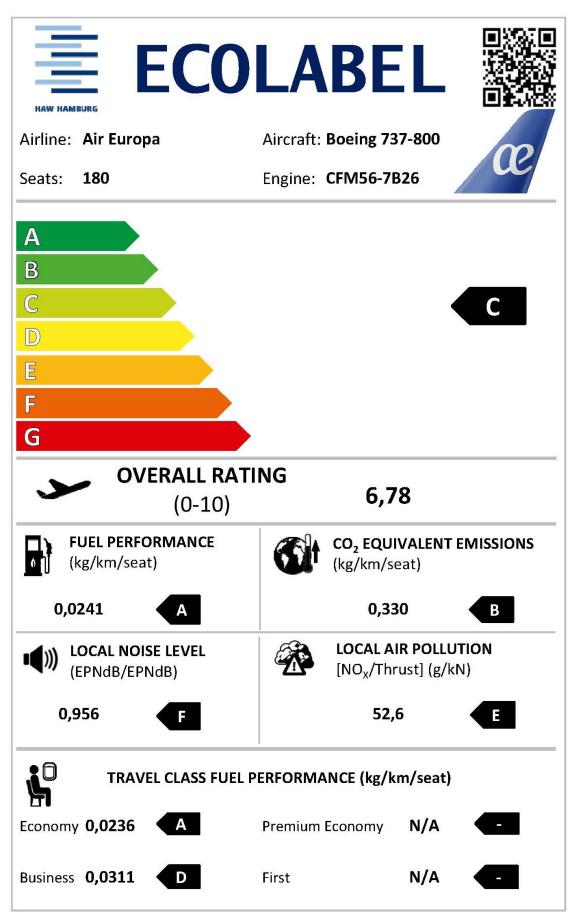


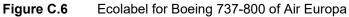


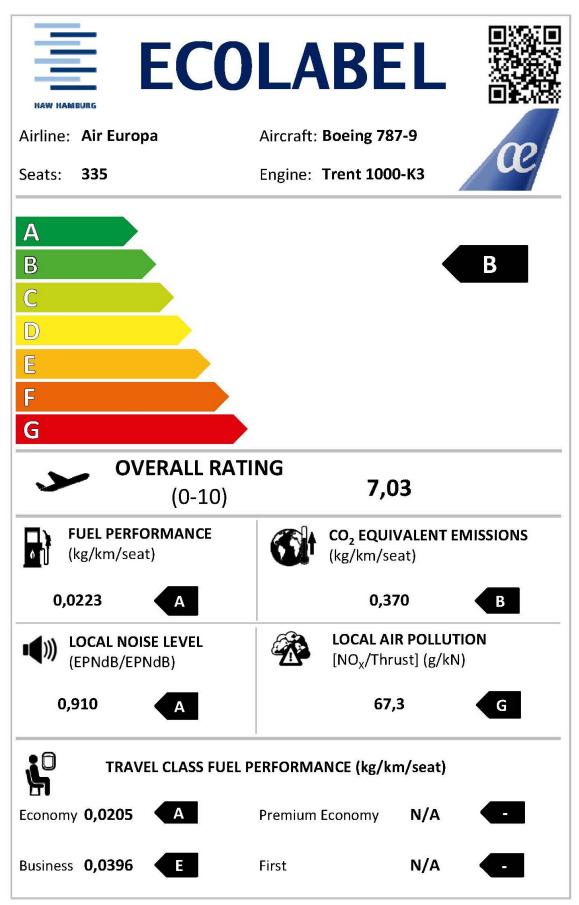




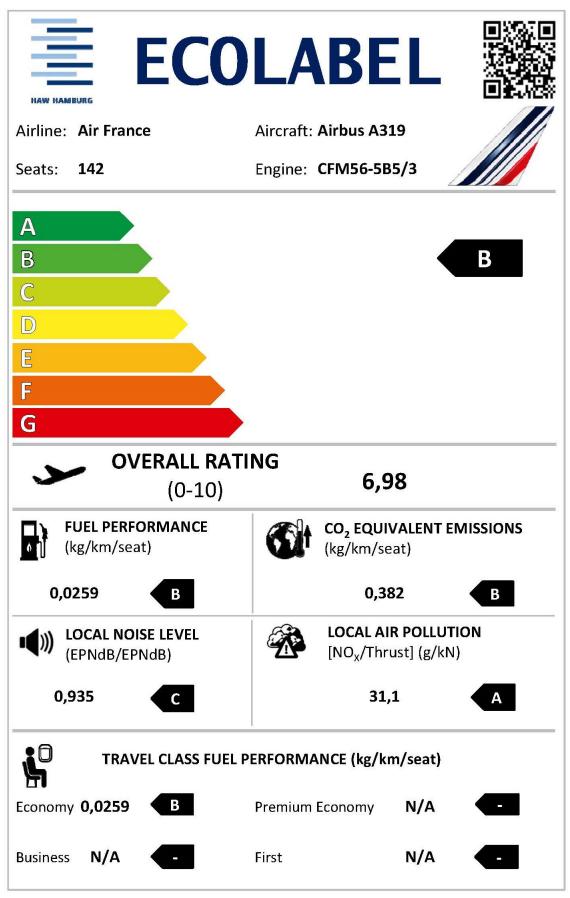


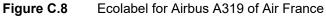


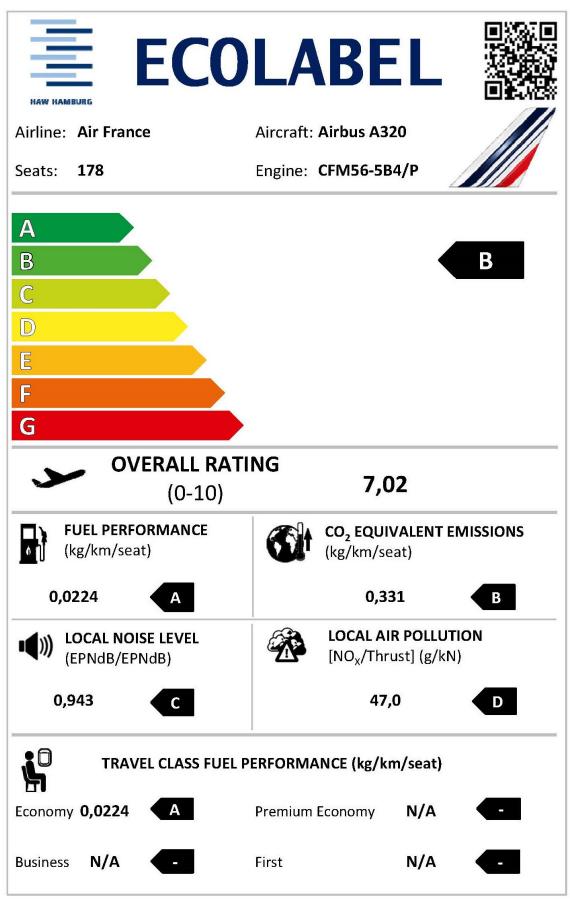


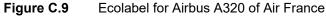












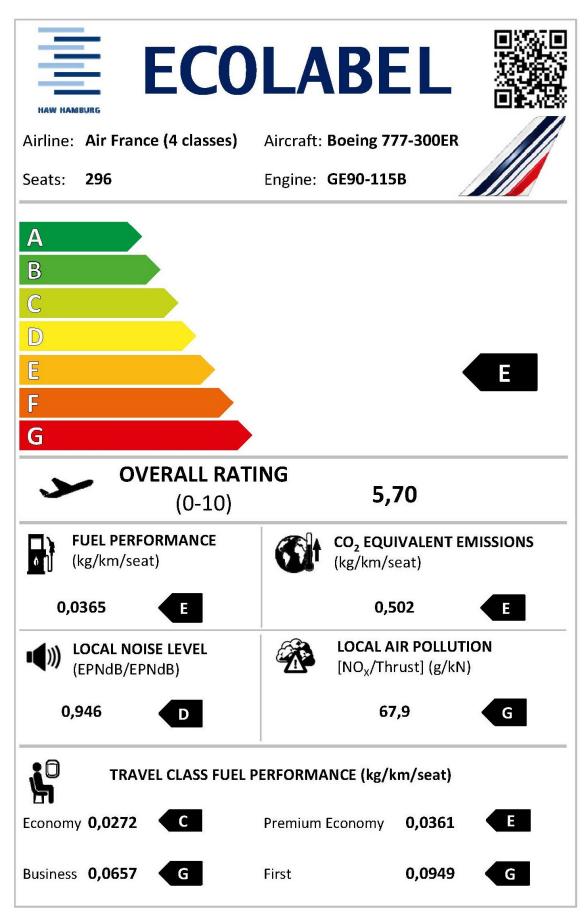


Figure C.10 Ecolabel for Boeing 777-300ER of Air France

ECO	
Airline: Air France	Aircraft: Boeing 777-200ER
Seats: 280	Engine: GE90-90B
A B C D E F G	C
OVERALL RATI (0-10)	NG 6,81
FUEL PERFORMANCE (kg/km/seat)	CO₂ EQUIVALENT EMISSIONS (kg/km/seat)
0,0263 B	0,357 B
0,0263 B LOCAL NOISE LEVEL (EPNdB/EPNdB)	0,357 B EDCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
	LOCAL AIR POLLUTION
 LOCAL NOISE LEVEL (EPNdB/EPNdB) 0,927 	LOCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
 LOCAL NOISE LEVEL (EPNdB/EPNdB) 0,927 	Image: Description of the second system Image: Description of the second system Image: Description of the second system 63,5

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

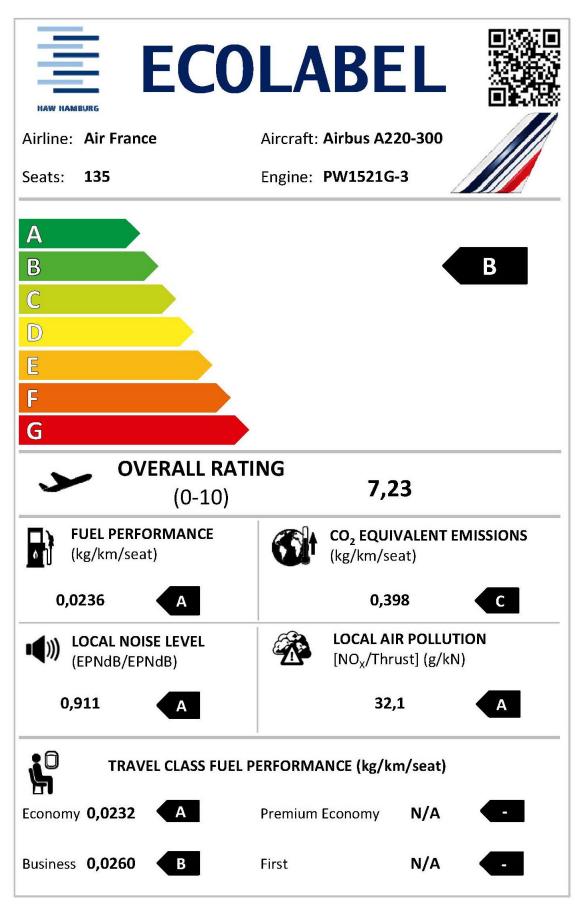


Figure C.12 Ecolabel for Airbus A220-300 of Air France

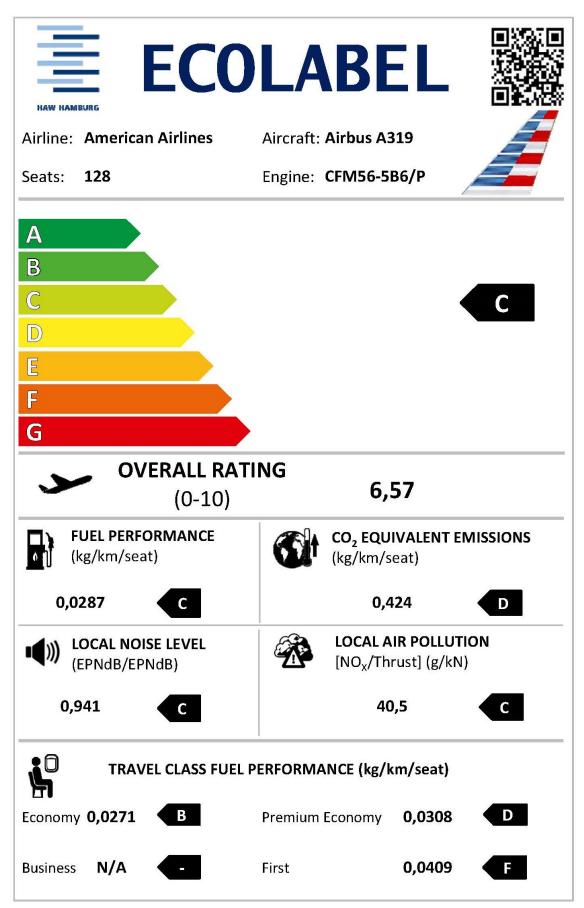


Figure C.13 Ecolabel for Airbus A319 of American Airlines

HAW HAMBURG ECO	
Airline: American Airlines	Aircraft: Boeing 777-300ER
Seats: 304	Engine: GE90-115B
A	
B	
С	
D	
E	E
F G	
(0-10)	5,78
(0-10)	5,78
(0-10) FUEL PERFORMANCE (kg/km/seat)	5,78 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0356 E LOCAL NOISE LEVEL	5,78 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,489 E LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 D	5,78 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,489 E COCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 E (kg/km/seat) 0,0356 D	5,78CO2 EQUIVALENT EMISSIONS (kg/km/seat)0,489E0,489EIOCAL AIR POLLUTION [NOX/Thrust] (g/kN)67,9G

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

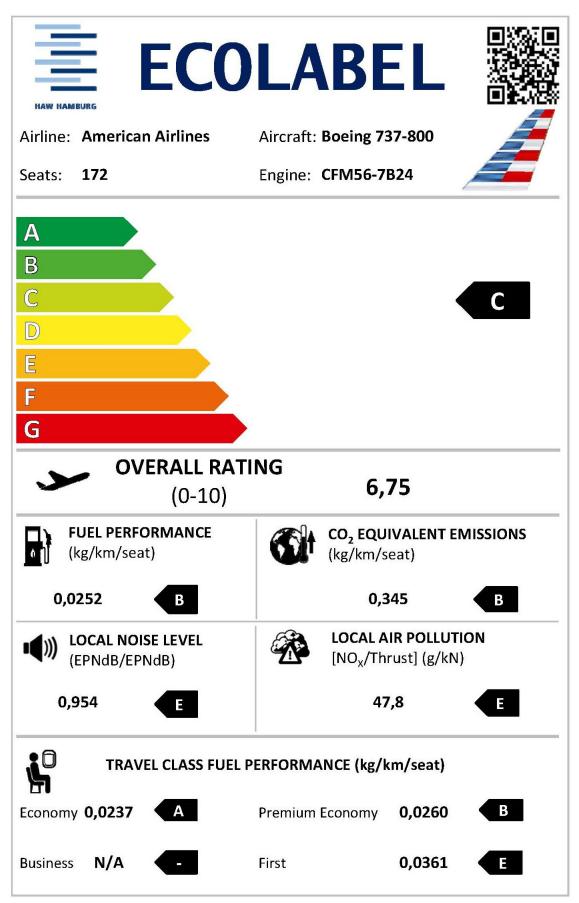


Figure C.15 Ecolabel for Boeing 737-800 of American Airlines

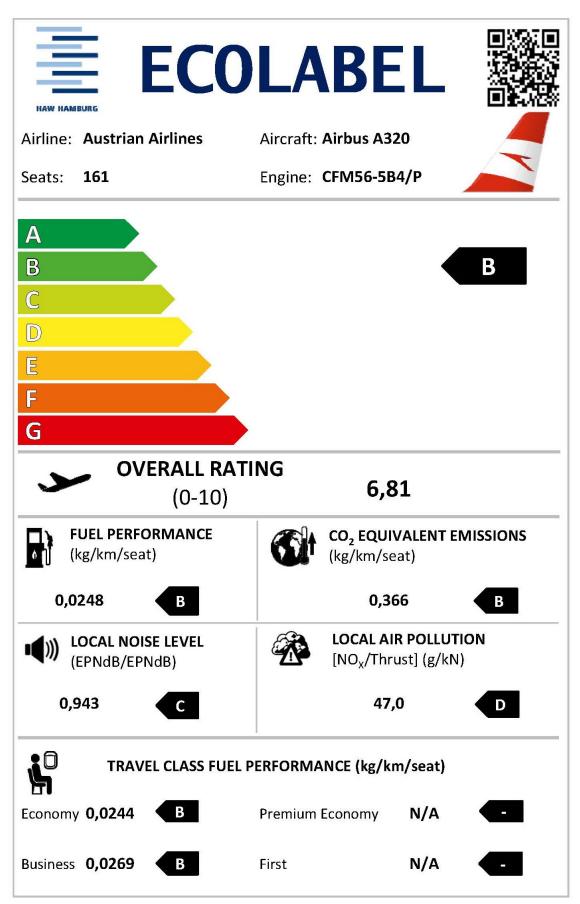


Figure C.16 Ecolabel for Airbus A320 of Austrian Airlines

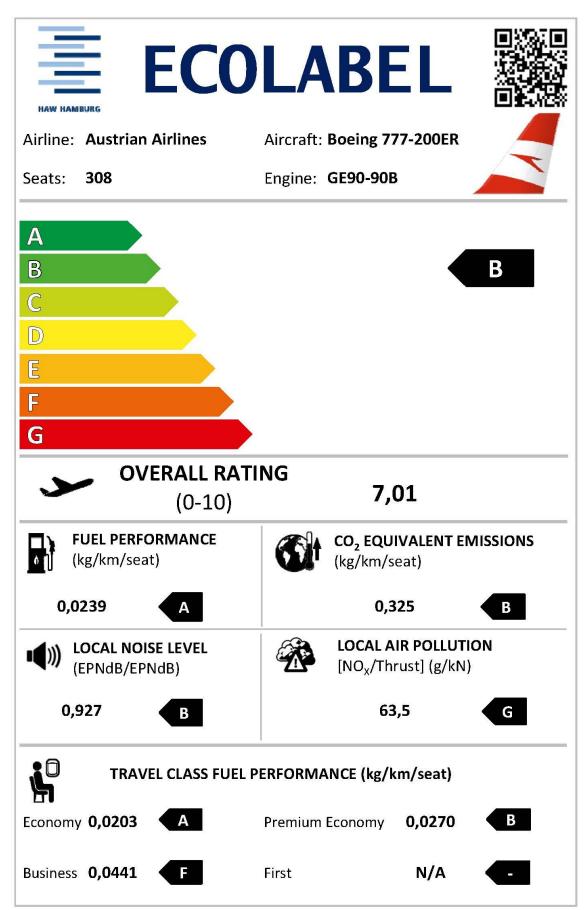


Figure C.17 Ecolabel for Boeing 777-200ER of Austrian Airlines

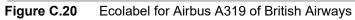
HAW HAMEURG ECO	
Airline: Binter Canarias	Aircraft: ATR 72
Seats: 72	Engine: PW127M
A B C D E F G	В
OVERALL RATI (0-10)	NG 7,13
FUEL PERFORMANCE (kg/km/seat)	CO₂ EQUIVALENT EMISSIONS (kg/km/seat)
0,0300 D	0,113 A
(EPNdB/EPNdB)	LOCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
0,895 A	Unknown -
TRAVEL CLASS FUEL P	ERFORMANCE (kg/km/seat)
Economy 0,0300	Premium Economy N/A -
Business N/A -	First N/A -



ECO	
Airline: British Airways	Aircraft: Airbus A321neo
Seats: 210	Engine: LEAP-1A32
A B C D E F G	В
OVERALL RATI (0-10)	NG 7,31
FUEL PERFORMANCE (kg/km/seat)	CO₂ EQUIVALENT EMISSIONS (kg/km/seat)
0,0200 A	0,373 B
(EPNdB/EPNdB)	LOCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
0,913 A	42,1 C
TRAVEL CLASS FUEL P	ERFORMANCE (kg/km/seat)
Economy 0,0199 A	Premium Economy 0,0206 A
Business N/A -	First N/A -

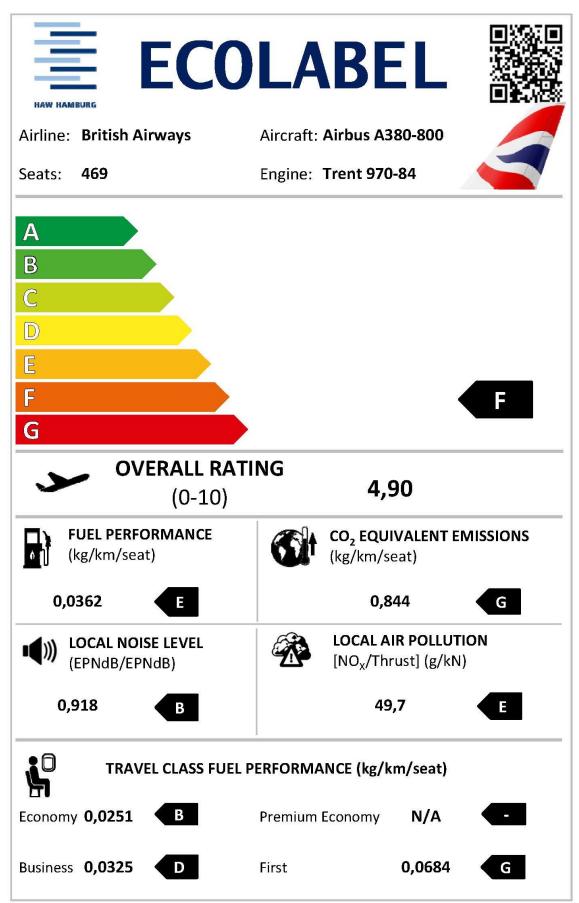
Figure C.19 Ecolabel for Airbus A321neo of British Airways

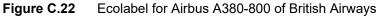
ECO	
Airline: British Airways	Aircraft: Airbus A319
Seats: 143	Engine: V2522-A5
A B C D E F G	C
OVERALL RATI	NG 6,80
FUEL PERFORMANCE (kg/km/seat)	CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
is according over prove of provering developments benefits inclusion	
هر (kg/km/seat)	(kg/km/seat)
<pre>(kg/km/seat) 0,0257 B LOCAL NOISE LEVEL</pre>	(kg/km/seat) 0,380 B LOCAL AIR POLLUTION
 (kg/km/seat) 0,0257 B (b) LOCAL NOISE LEVEL (EPNdB/EPNdB) 0,939 	(kg/km/seat) 0,380 B Image: state
 (kg/km/seat) 0,0257 B (b) LOCAL NOISE LEVEL (EPNdB/EPNdB) 0,939 	<pre>(kg/km/seat) 0,380 B COCAL AIR POLLUTION [NOx/Thrust] (g/kN) 46,0 D</pre>

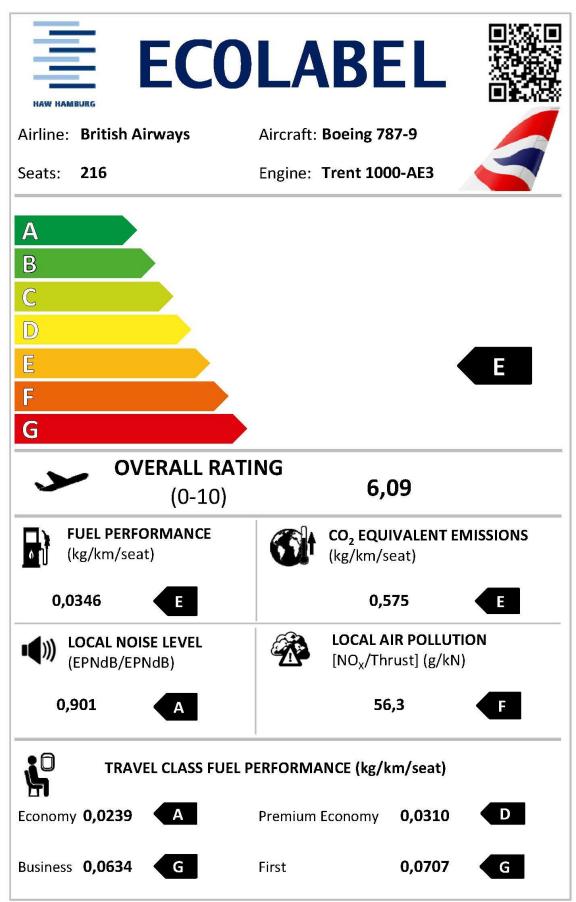


ECO	
Airline: British Airways	Aircraft: Airbus A320
Seats: 171	Engine: V2527E-A5
A B C D E F G	В
OVERALL RATI (0-10)	NG 7,02
FUEL PERFORMANCE (kg/km/seat)	CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
The excepte-rear proof an interaction for the second fraction for the second se	
(kg/km/seat)	(kg/km/seat)
(kg/km/seat) 0,0233 A LOCAL NOISE LEVEL	(kg/km/seat) 0,345 B LOCAL AIR POLLUTION
 (kg/km/seat) 0,0233 A (kg/km/seat) (kg/km/se	(kg/km/seat) 0,345 B Image: Constraint of the search of the
 (kg/km/seat) 0,0233 A (kg/km/seat) (kg/km/se	<pre>(kg/km/seat) 0,345 B COCAL AIR POLLUTION [NOx/Thrust] (g/kN) 48,4 E</pre>

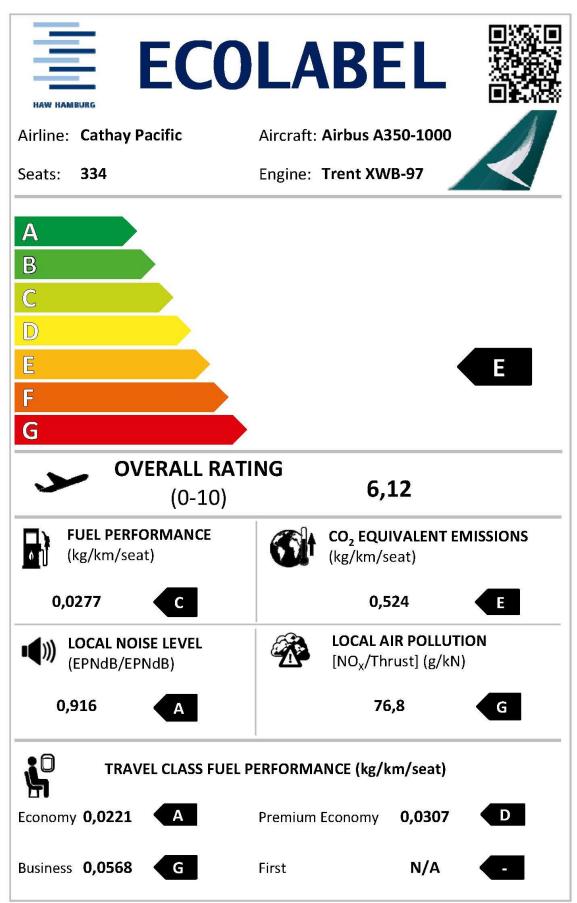




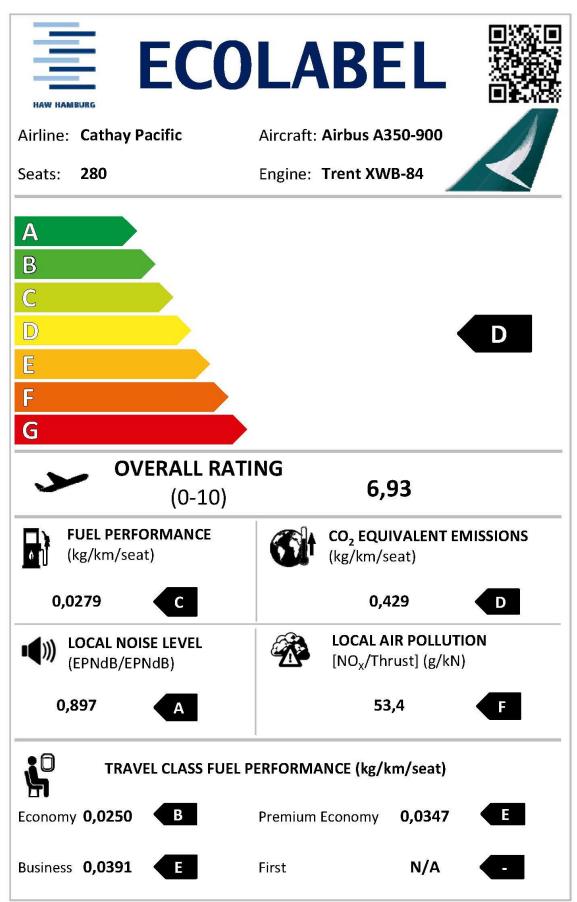


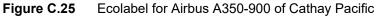






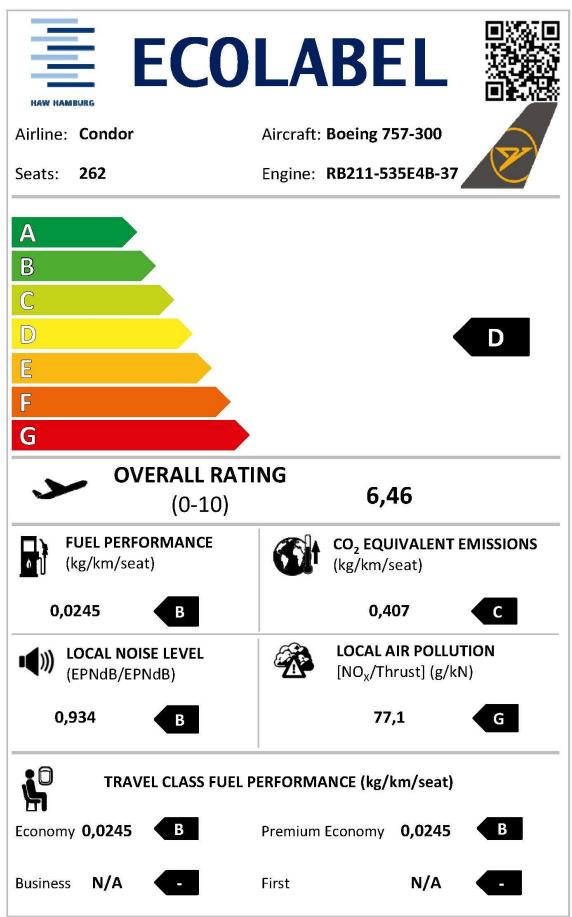


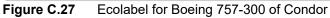


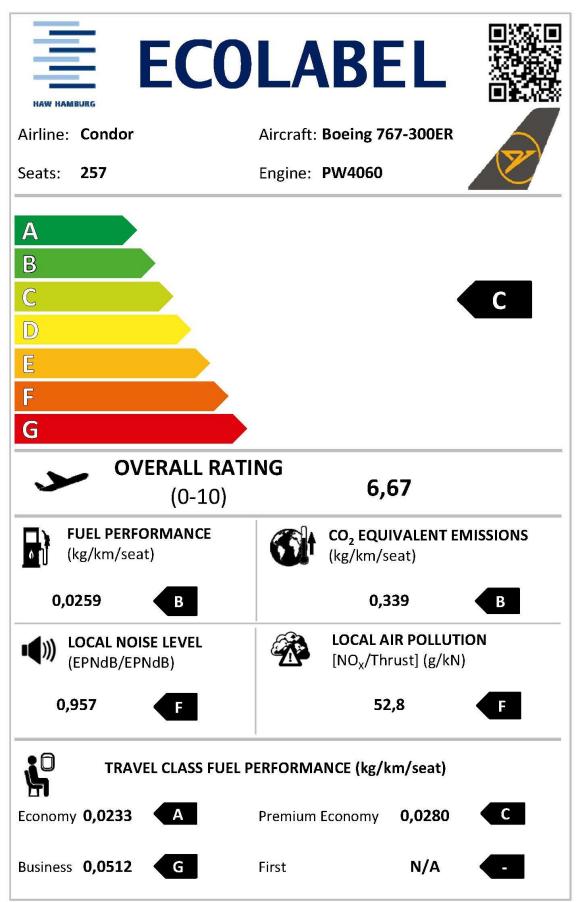


HAW HAMBURG ECO	
Airline: Cathay Pacific	Aircraft: Boeing 777-300ER
Seats: 275	Engine: GE90-115B
A B C D E F	E
G	
(0-10)	NG 5,47
(0-10)	5,47
(0-10) FUEL PERFORMANCE (kg/km/seat)	5,47 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0393 E LOCAL NOISE LEVEL	5,47 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,540 E LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0393 E (kg/km/seat) 0,0393 E (kg/km/seat) 0,0393 E 0,0393 E 0,0395 E 0,005 E 0,0	5,47 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,540 E CO2 EQUIVALENT EMISSIONS (kg/km/seat) 0,540 E LOCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0393 E (kg/km/seat) 0,0393 E (kg/km/seat) 0,0393 E 0,0393 E 0,0395 E 0,005 E 0,0	5,47 CO2 EQUIVALENT EMISSIONS (kg/km/seat) 0,540 E 0,540 E E LOCAL AIR POLLUTION [NOx/Thrust] (g/kN) 67,9 G

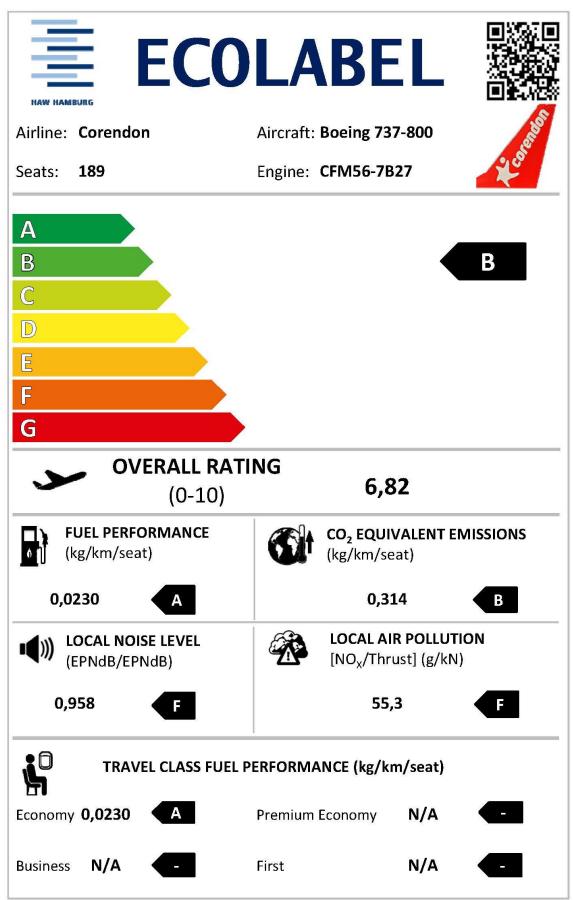
Figure C.26 Ecolabel for Boeing 777-300ER of Cathay Pacific

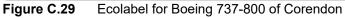


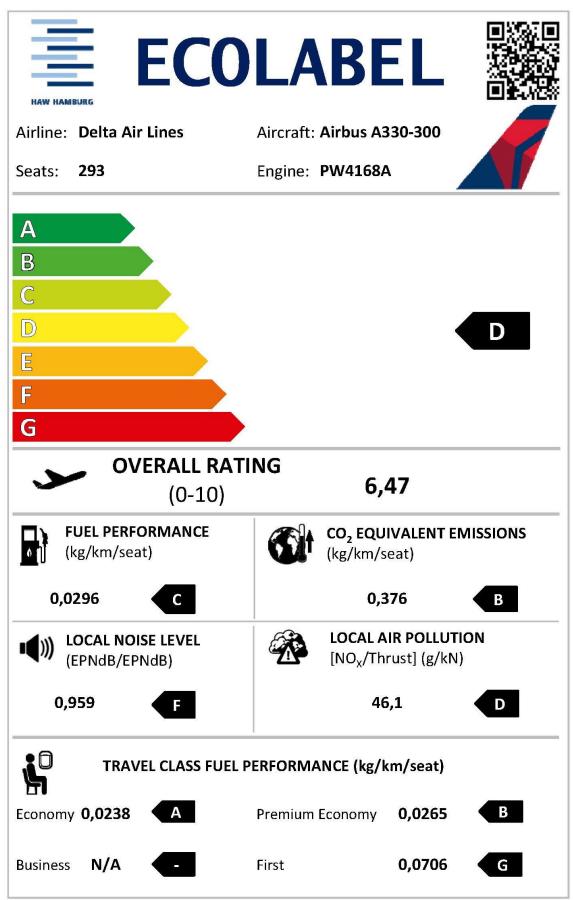


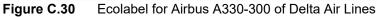


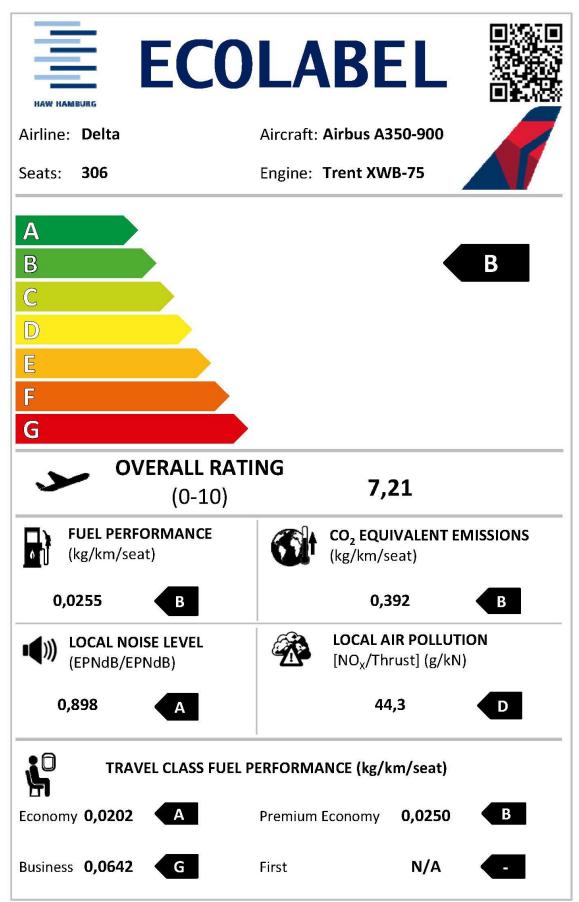


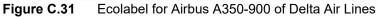












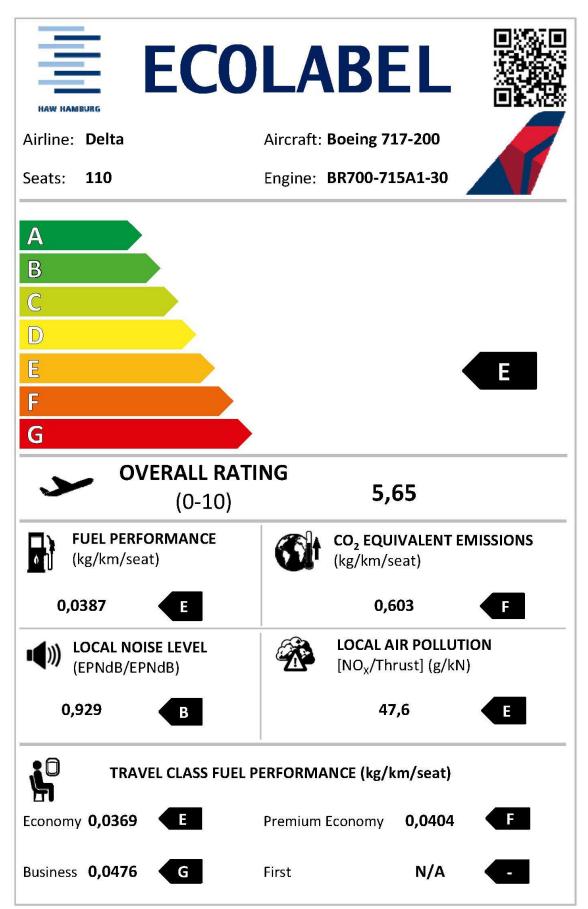


Figure C.32 Ecolabel for Boeing 717-200 of Delta Air Lines

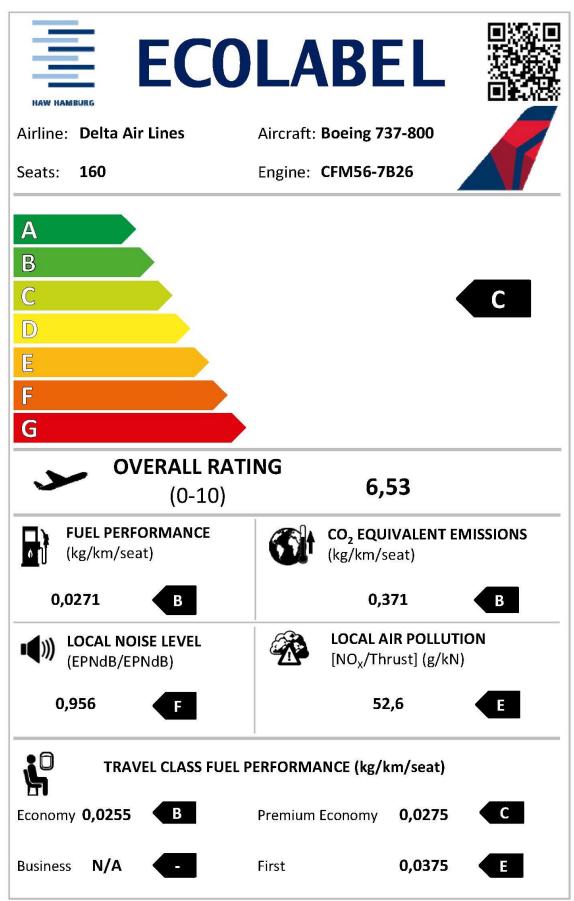
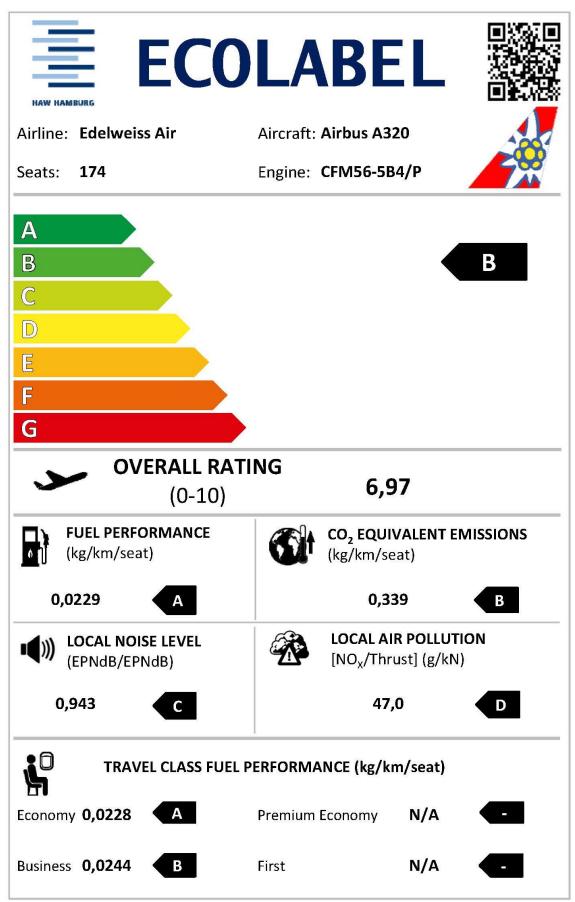
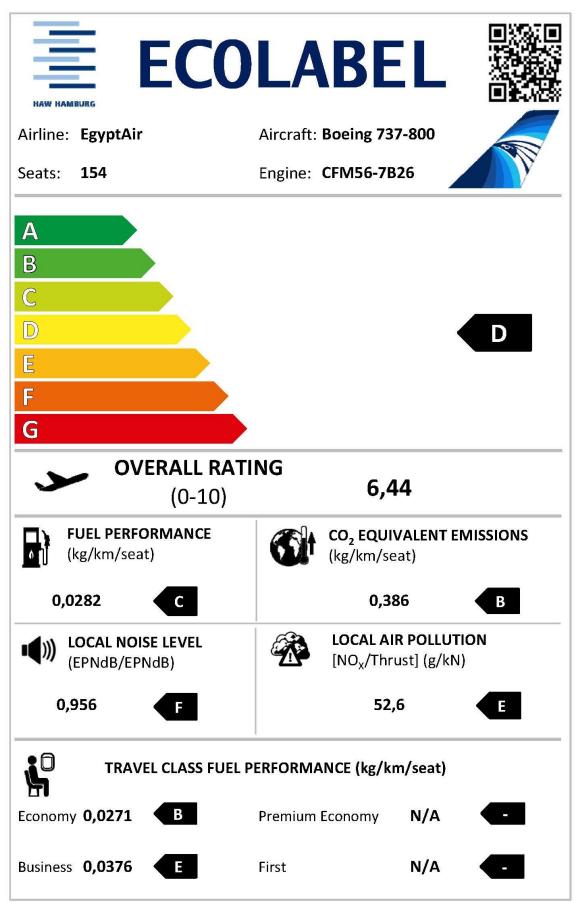
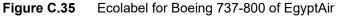


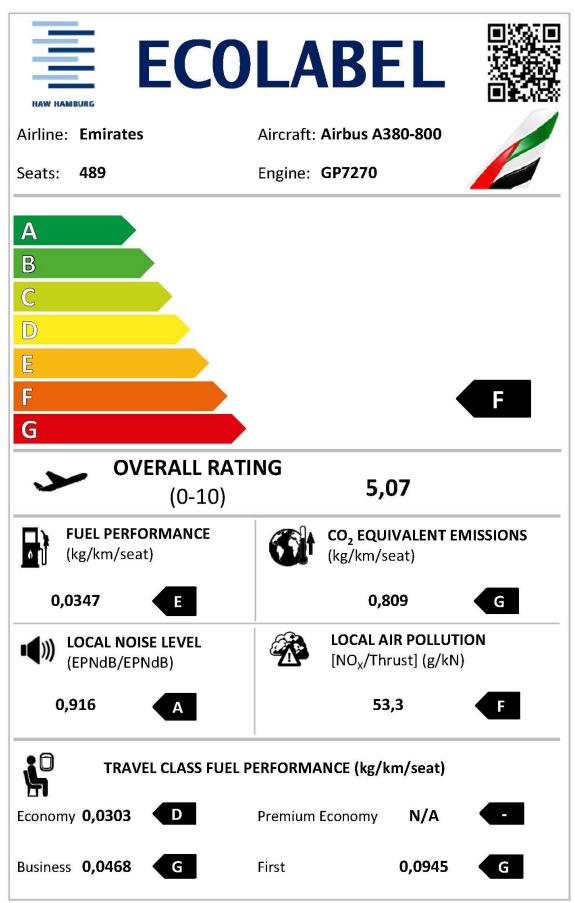
Figure C.33 Ecolabel for Boeing 737-800 of Delta Air Lines













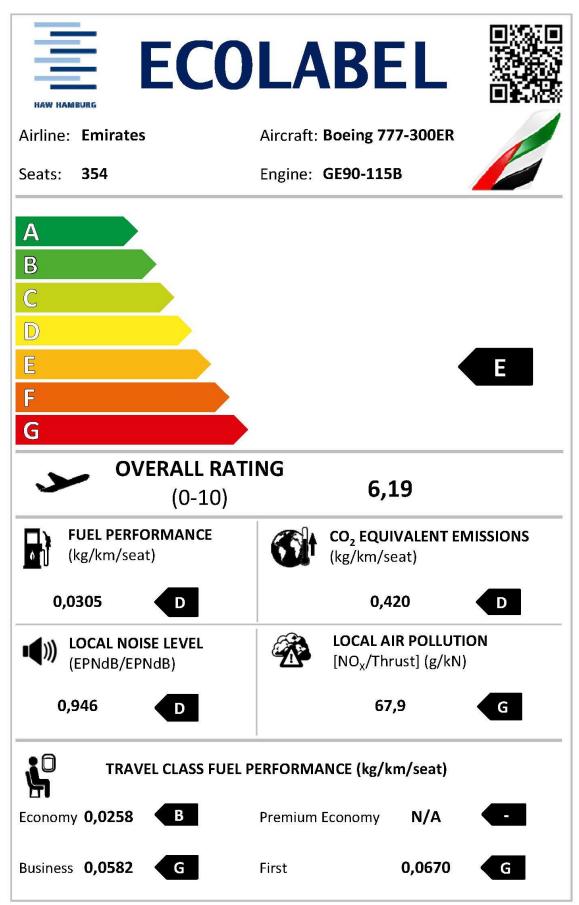
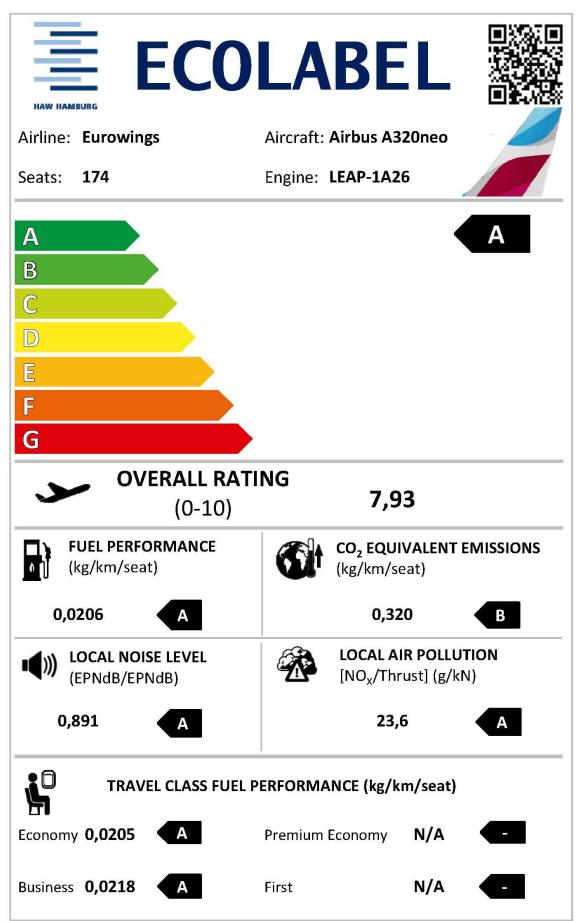
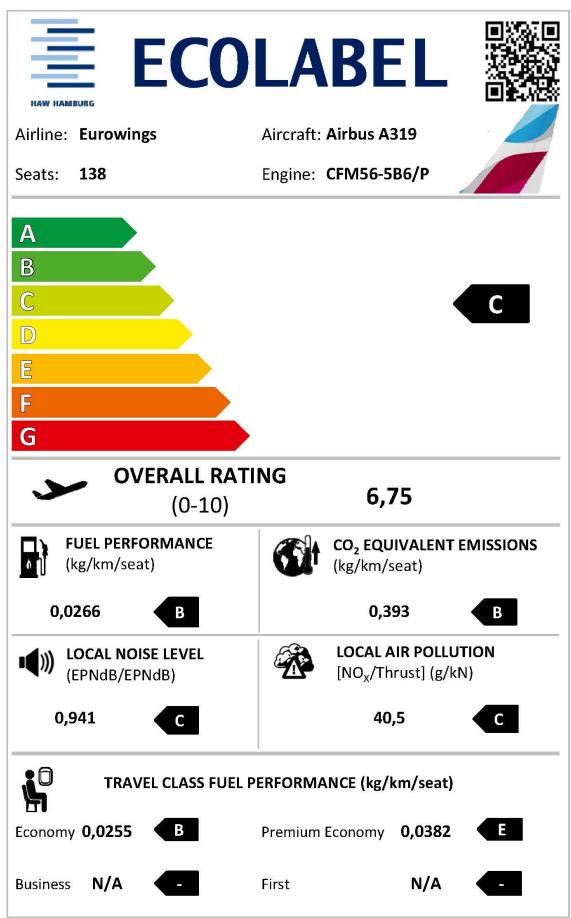
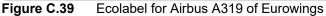


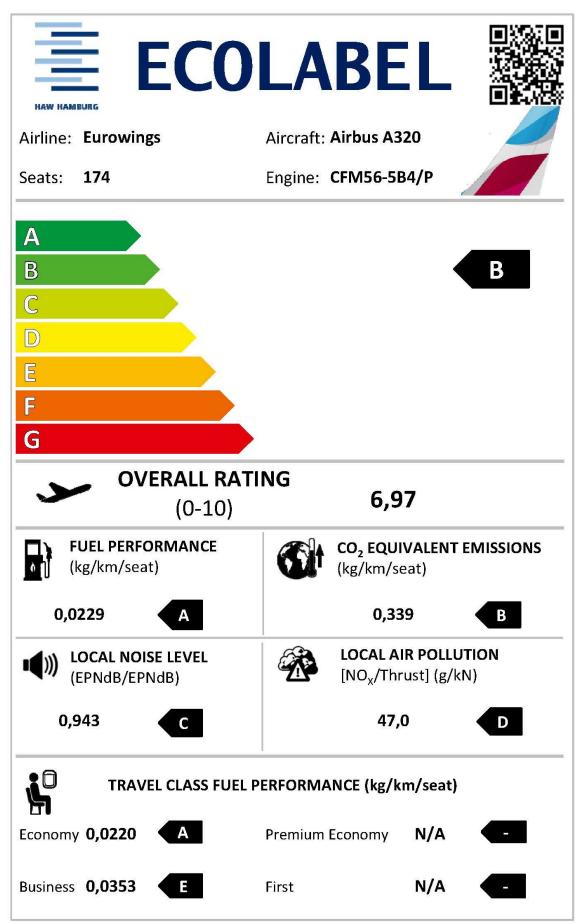
Figure C.37 Ecolabel for Boeing 777-300ER of Emirates

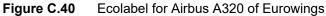


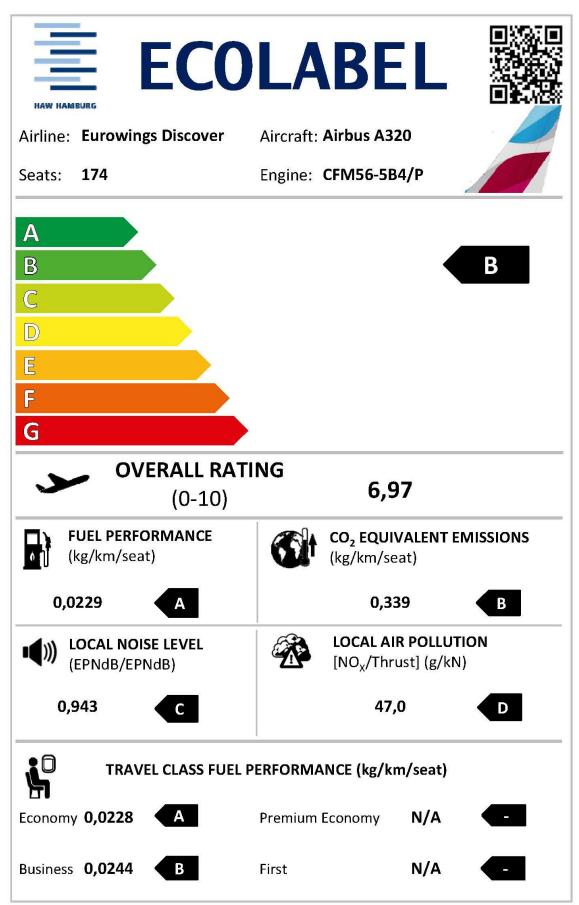


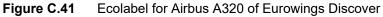


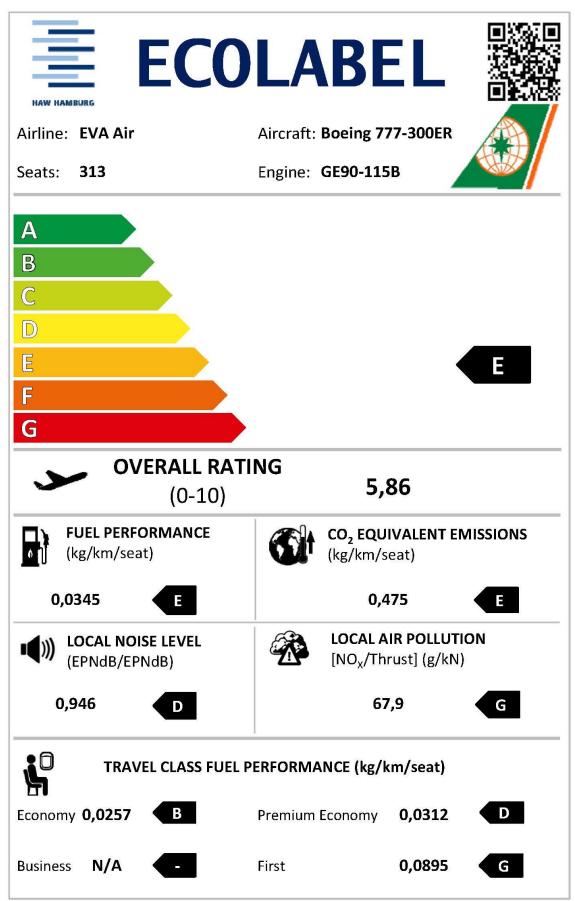




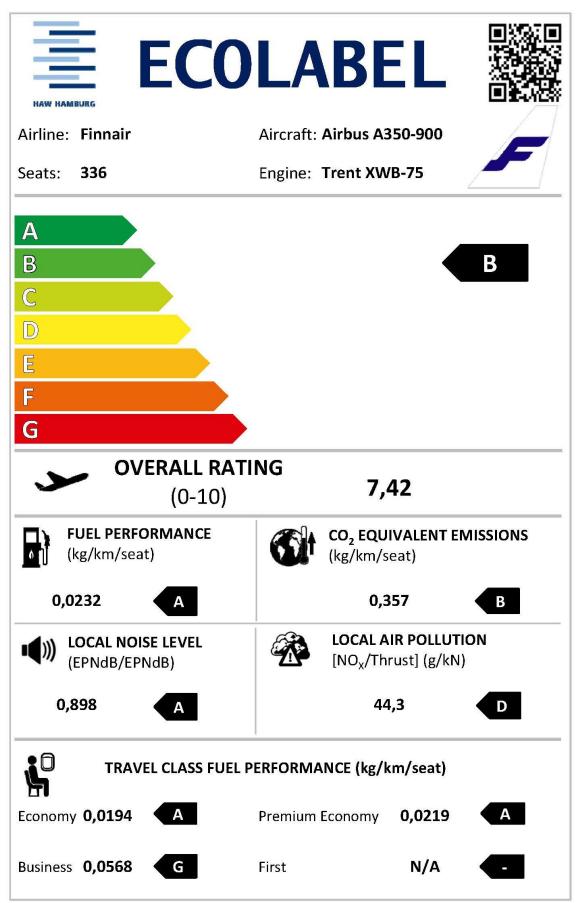


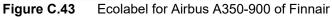


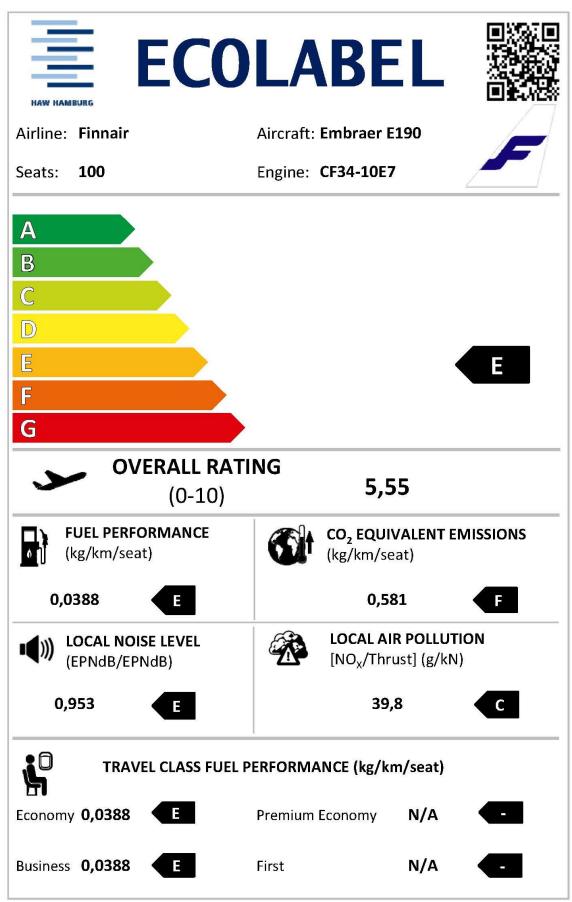


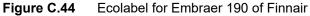


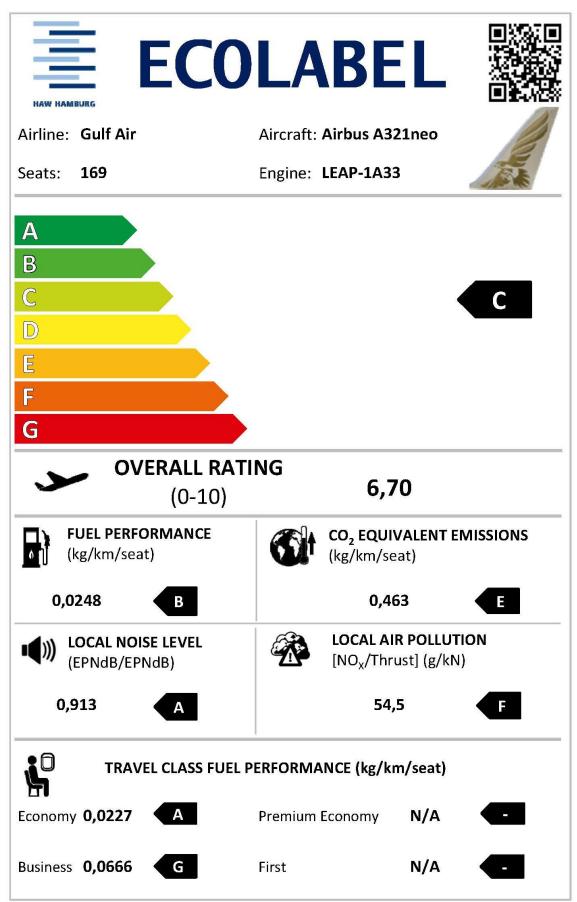


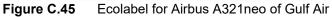


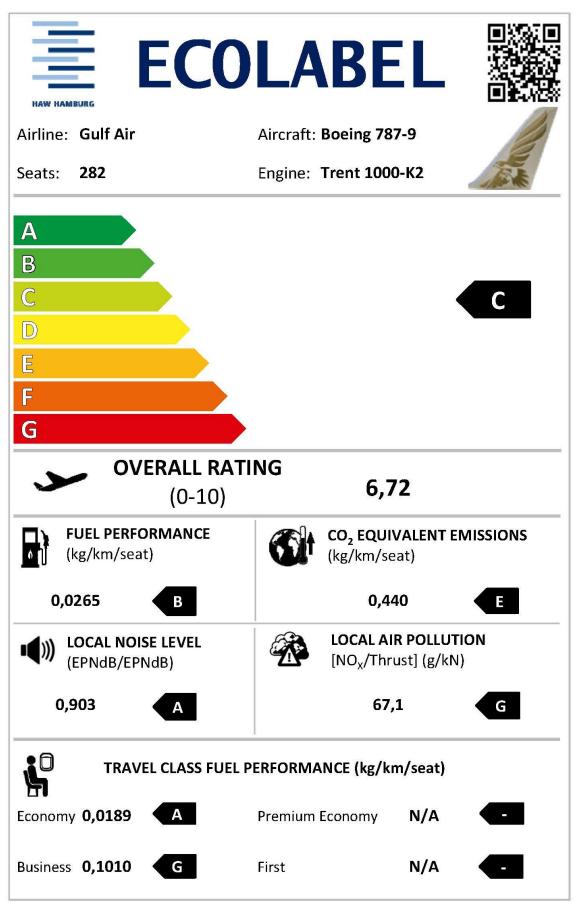


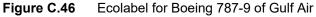


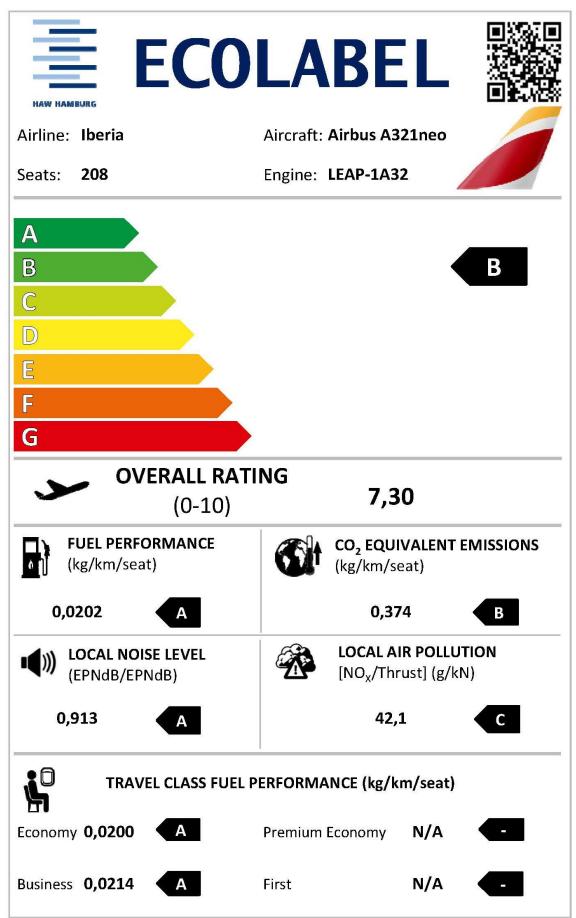


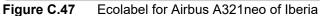


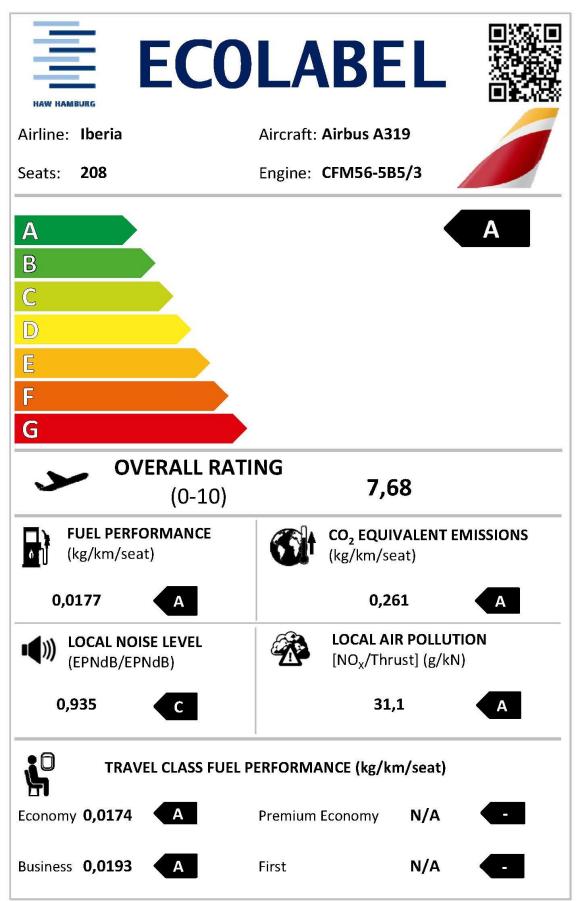


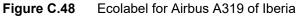


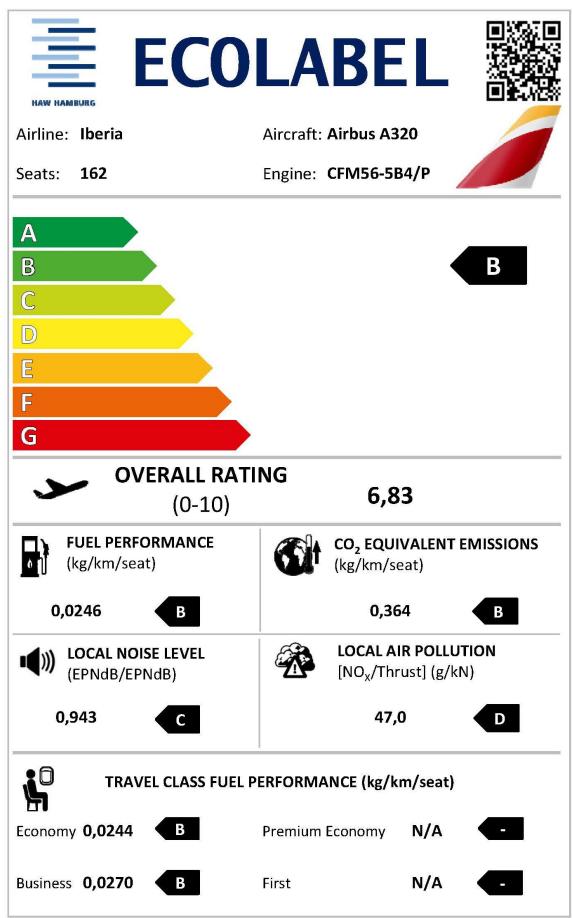


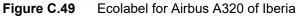


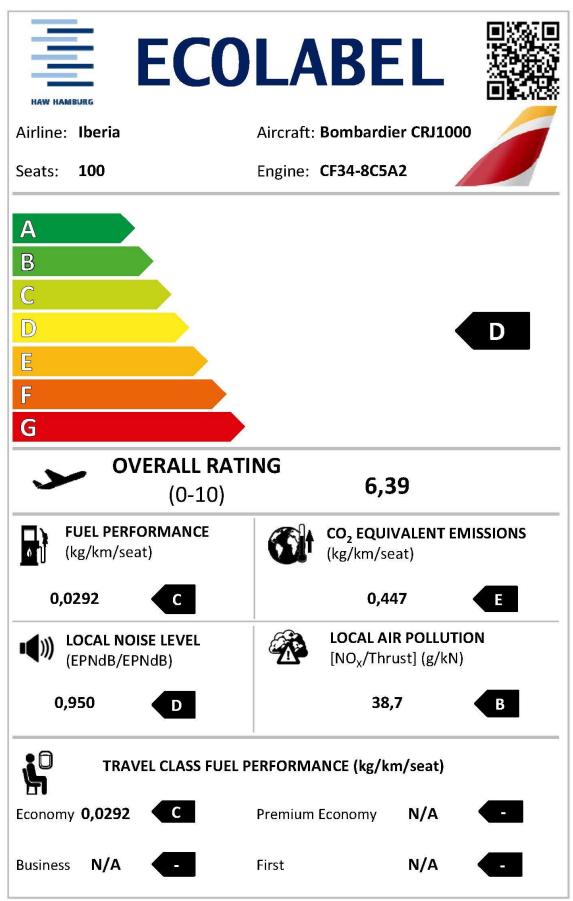




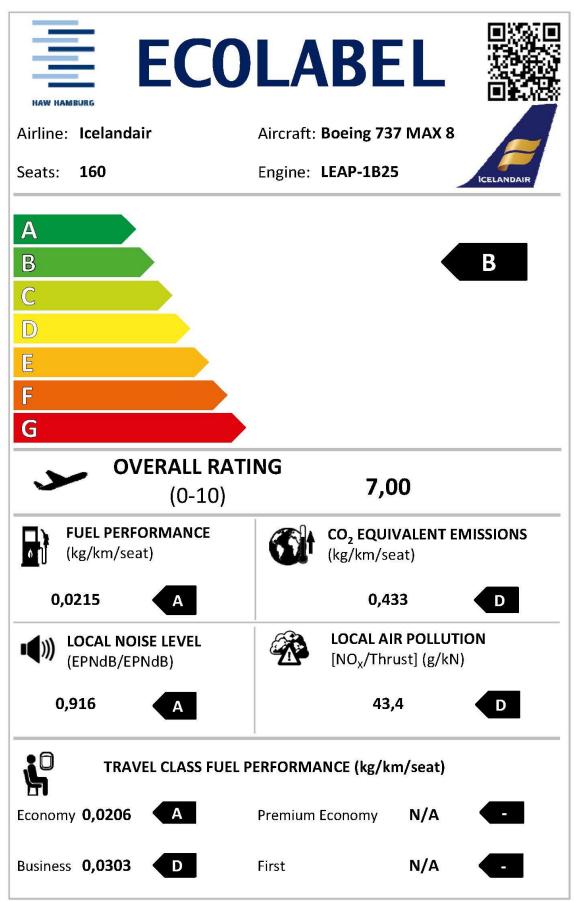




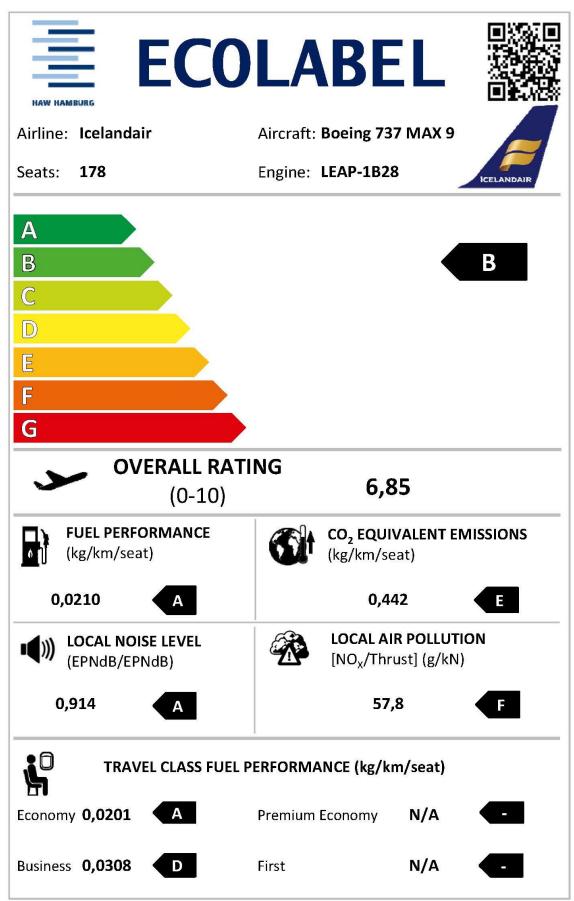




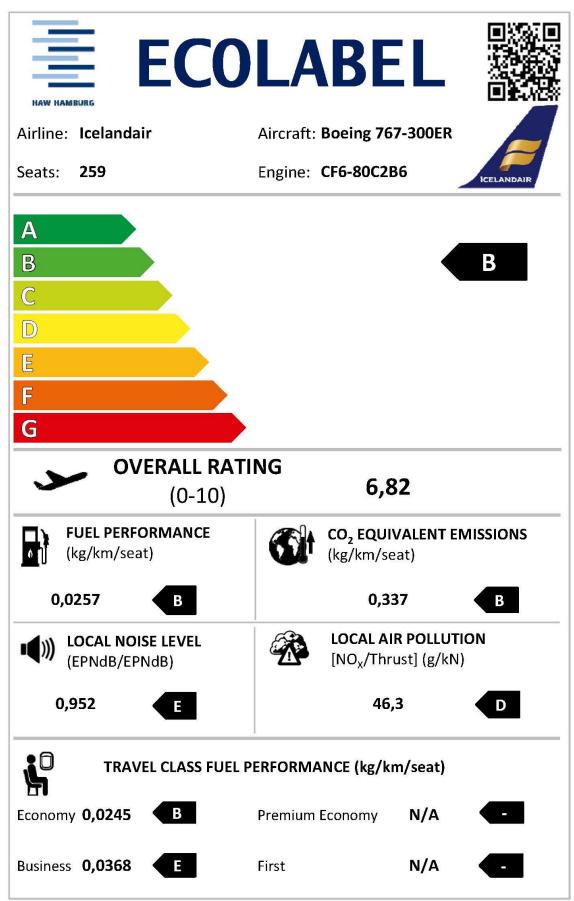




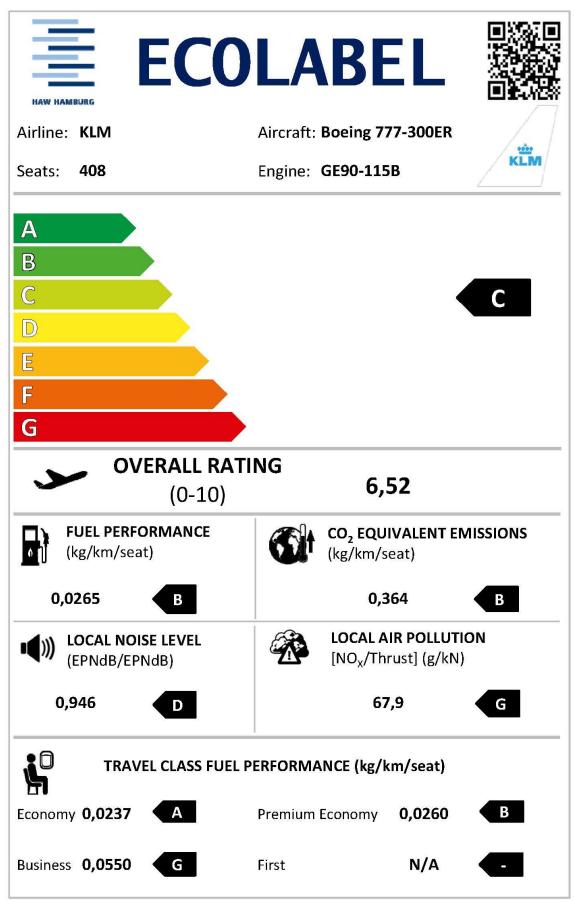


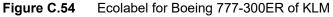


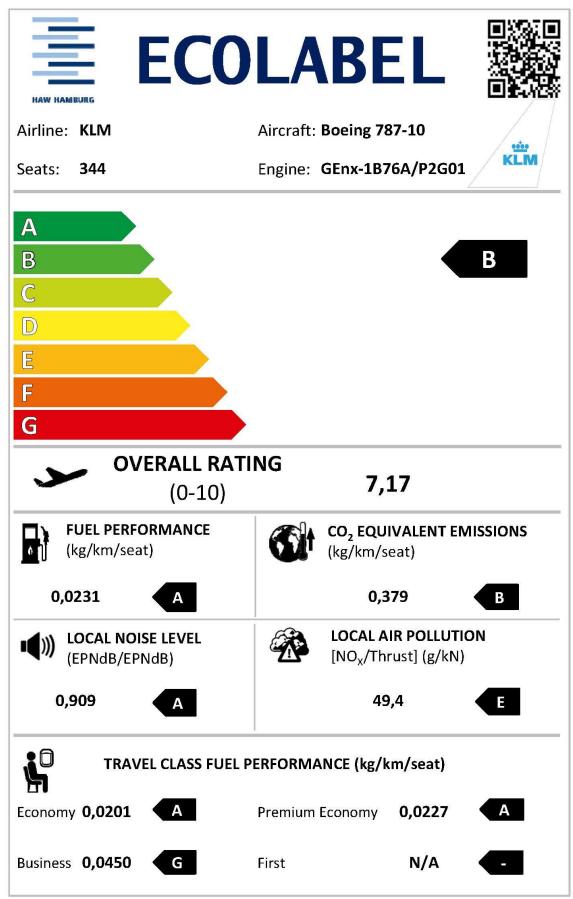


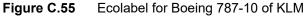


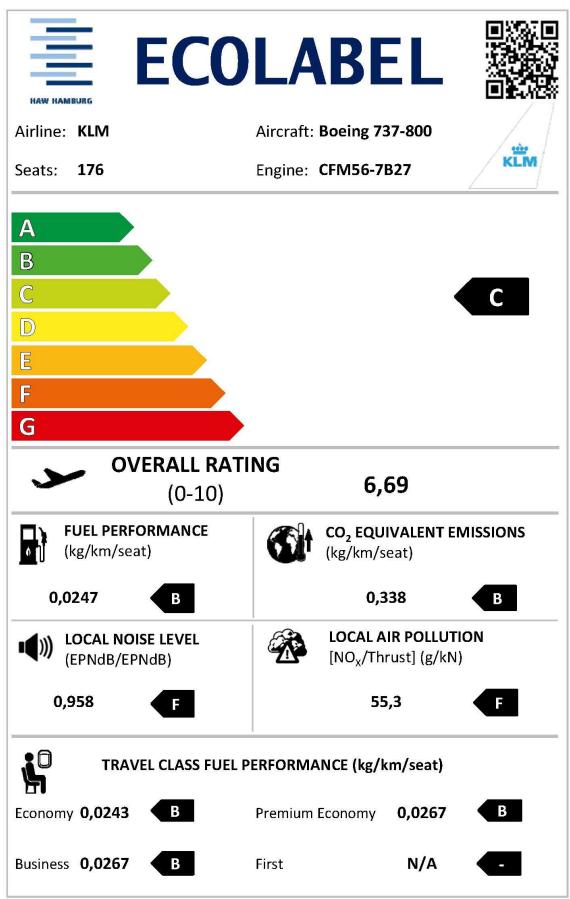


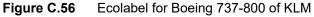


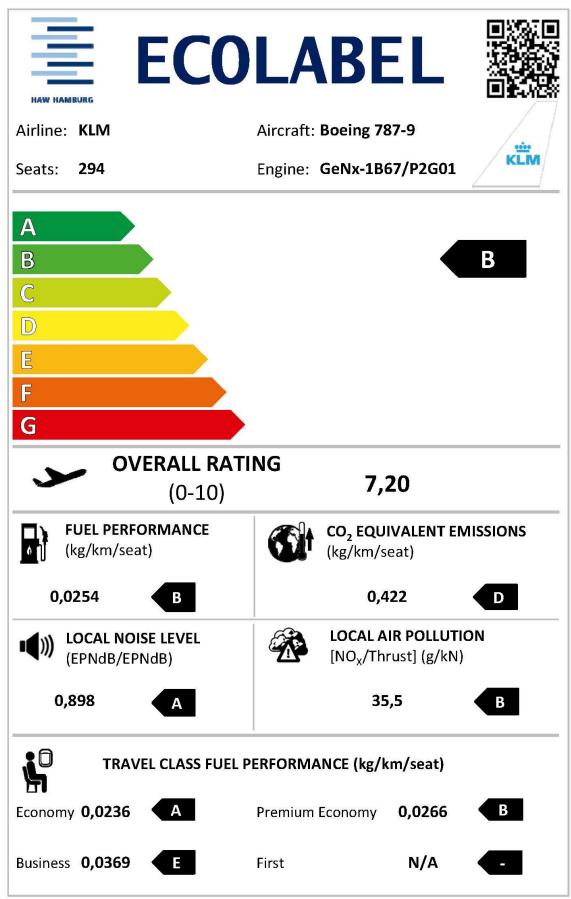


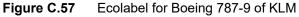


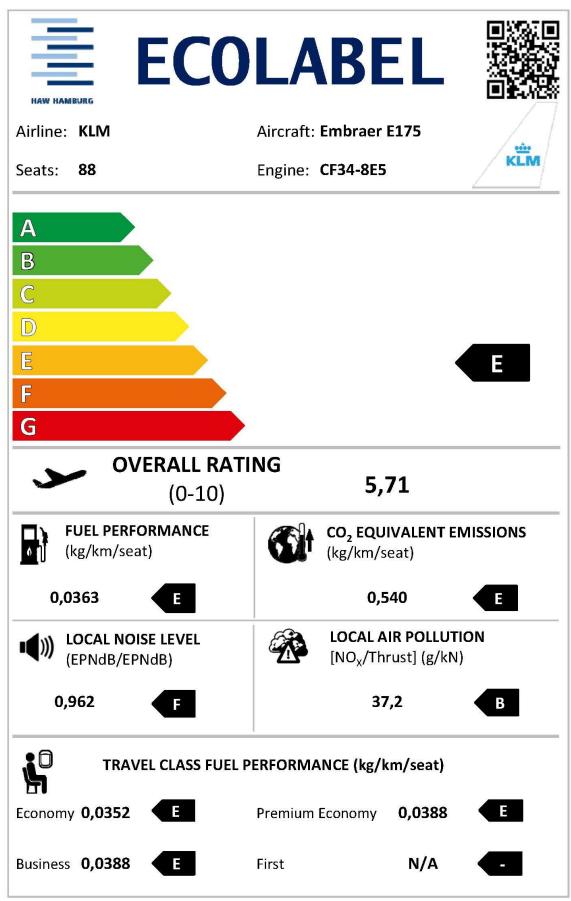


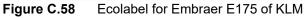


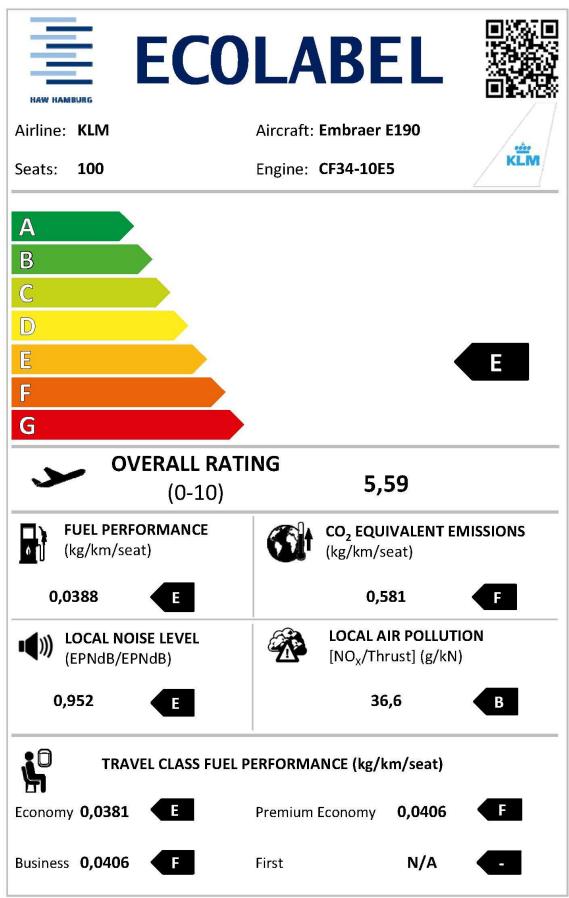


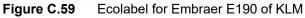


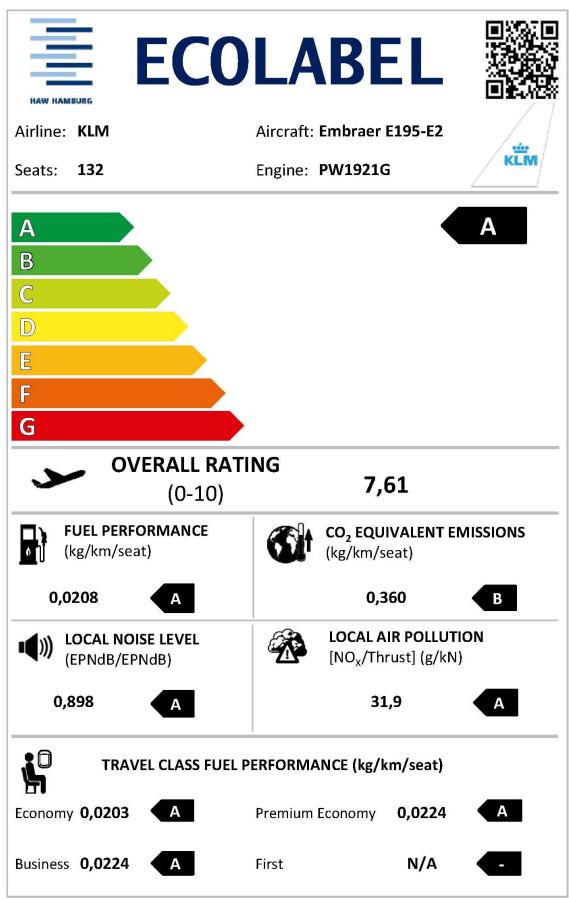


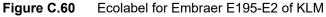


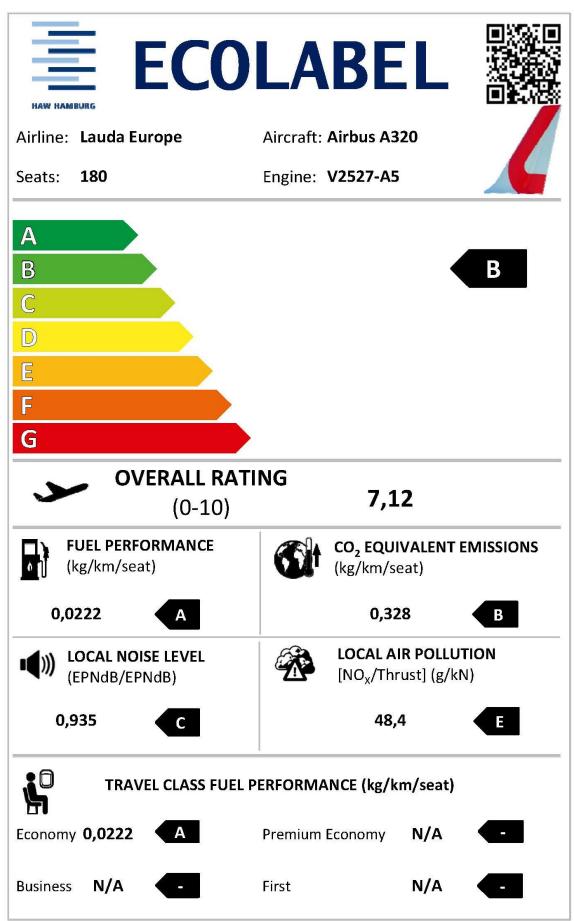




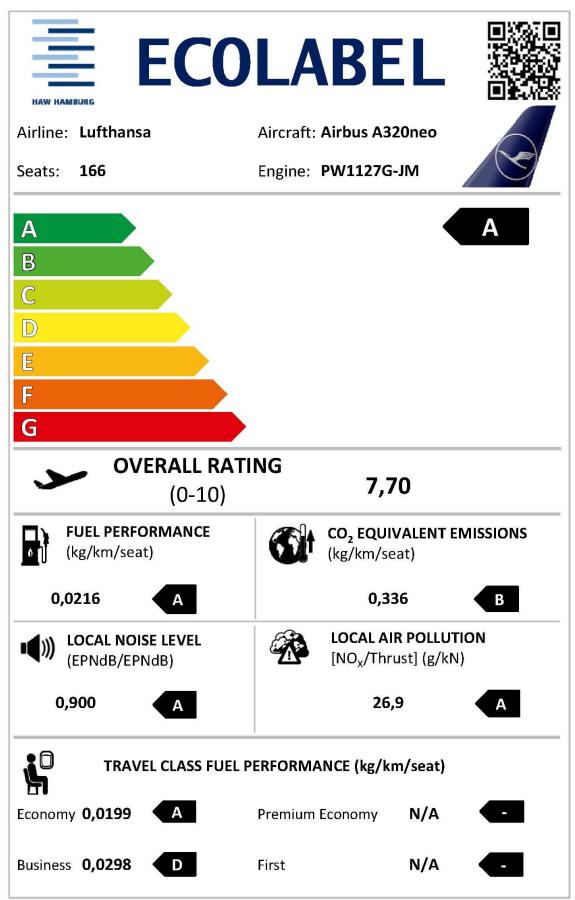




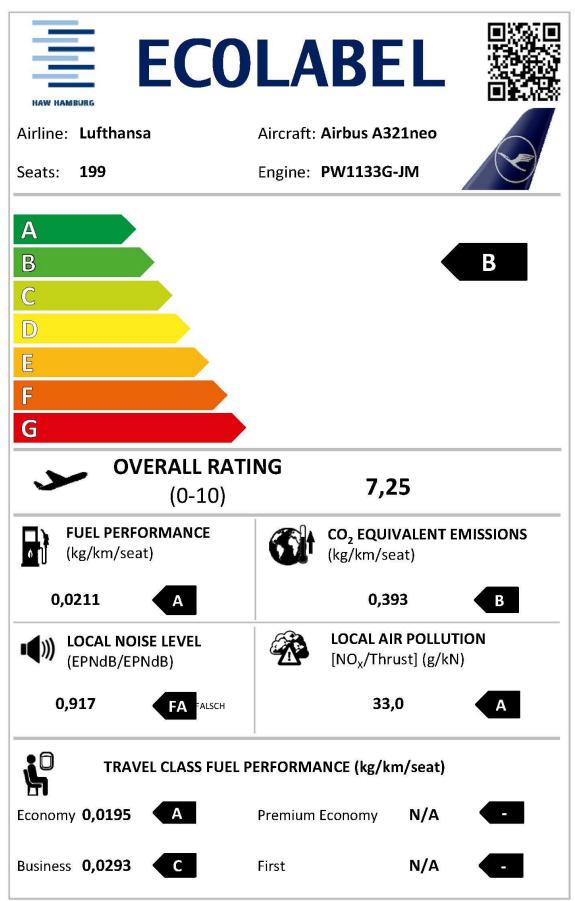




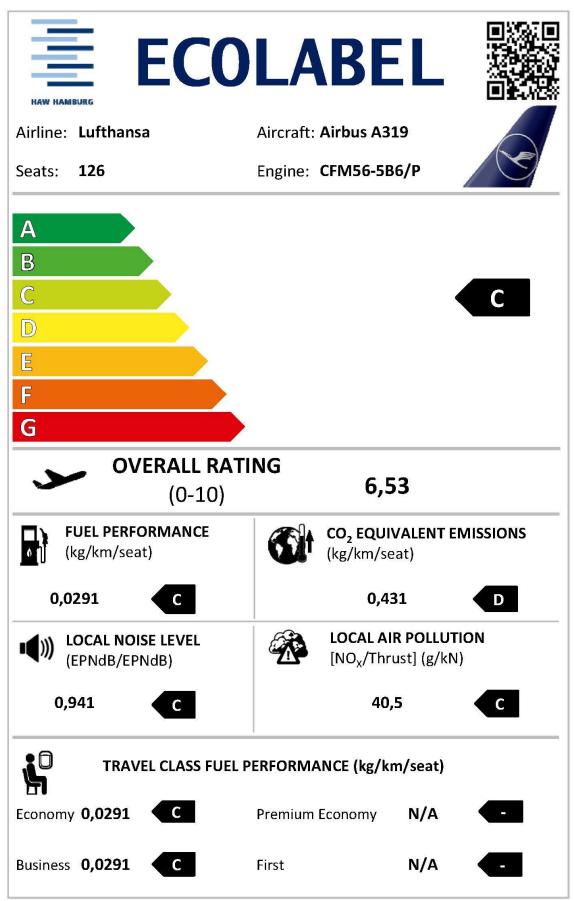


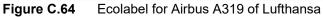


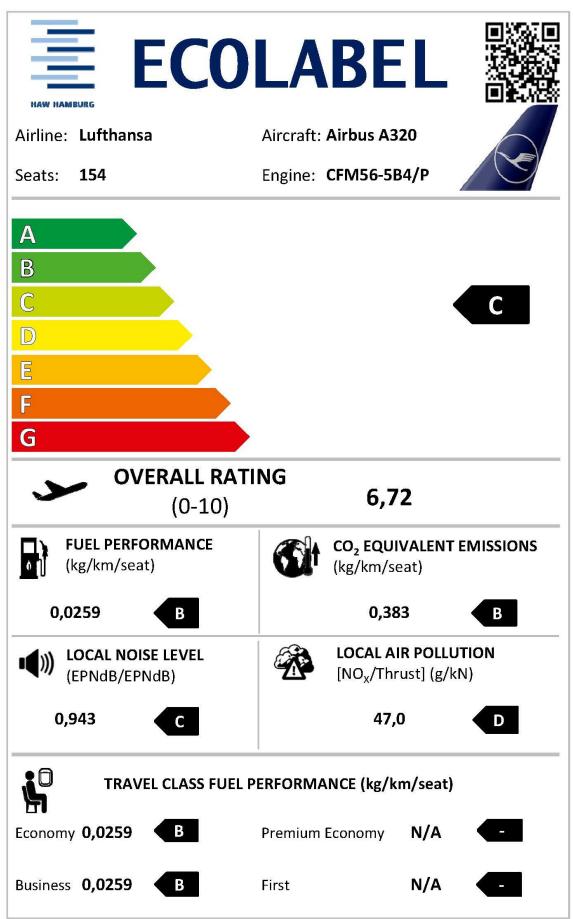


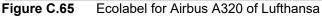


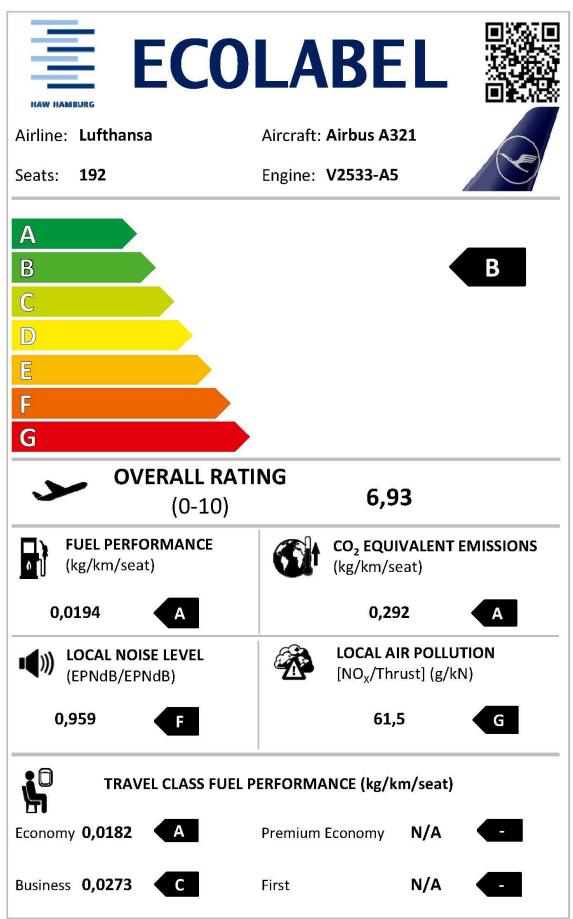


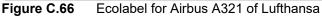


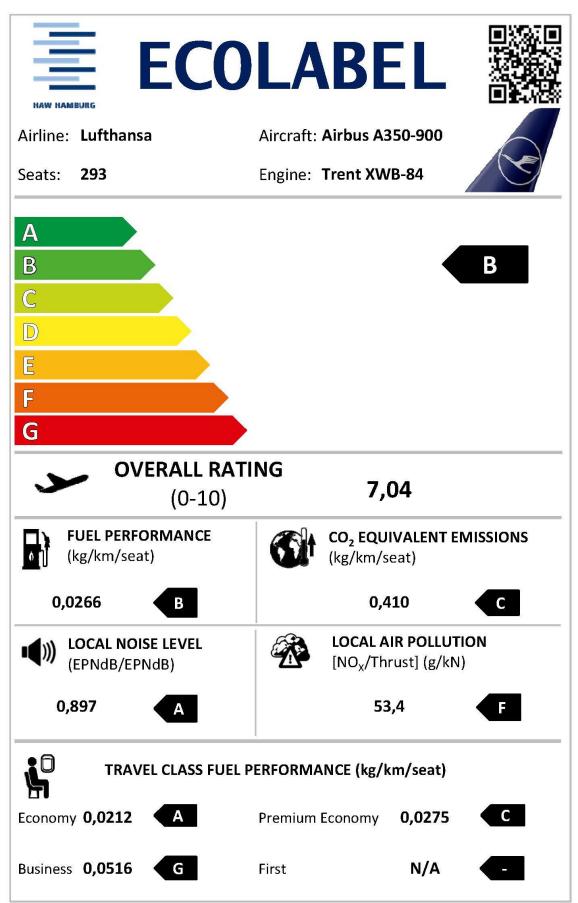




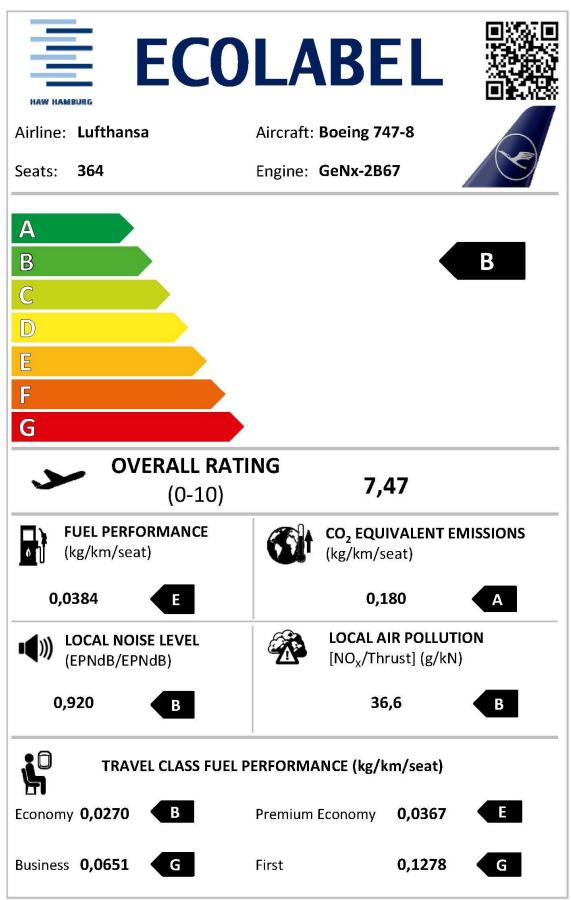


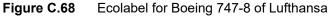




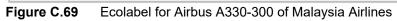








HAW HAMEURG ECO	
Airline: Malaysia Airlines	Aircraft: Airbus A330-300
Seats: 290	Engine: PW4168A
A B	
C	
D	
F	
G	
OVERALL RATI (0-10)	NG 6,45
(0-10)	6,45
(0-10) FUEL PERFORMANCE (kg/km/seat)	6,45 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0299 D LOCAL NOISE LEVEL	6,45 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,380 B LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0299 D (kg/km/seat) 0,0299 D (kg/km/seat) 0,0299 D (kg/km/seat) 0,0299 D (kg/km/seat) D (kg/km/seat) (kg/km/seat)	6,45 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,380 B COCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0299 D 0,0299 D LOCAL NOISE LEVEL (EPNdB/EPNdB) 0,959 F	6,45Image: Co_z EQUIVALENT EMISSIONS (kg/km/seat)0,380B0,380BImage: Colspan="2">LOCAL AIR POLLUTION [NOx/Thrust] (g/kN)46,1D

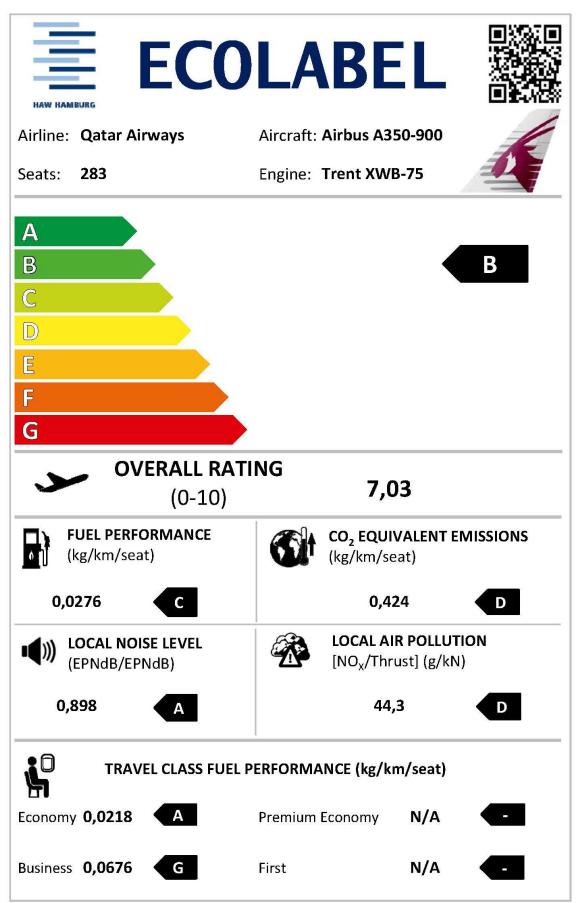


HAW HAMBURG ECO	
Airline: Pegasus Airlines	Aircraft: Airbus A320neo
Seats: 186	Engine: LEAP-1A26
A B C D E F G	A
(0-10)	NG 8,05
(0-10)	8,05
(0-10) FUEL PERFORMANCE (kg/km/seat)	8,05 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0192 A LOCAL NOISE LEVEL	8,05 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,300 A LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0192 A (DOCAL NOISE LEVEL (EPNdB/EPNdB) 0,891 A	8,05 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,300 A COCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0192 A (DOCAL NOISE LEVEL (EPNdB/EPNdB) 0,891 A	8,05Image: Signed stressImage: Signed stress

Figure C.70 Ecolabel for Airbus A320neo of Pegasus Airlines

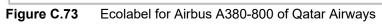
HAW HAMEURG ECO	
Airline: Pegasus Airlines	Aircraft: Boeing 737-800
Seats: 189	Engine: CFM56-7B26
A B C D E F G	В
OVERALL RATI	NG
OVERALL RATI (0-10)	NG 6,87
(0-10)	6,87 CO ₂ EQUIVALENT EMISSIONS
(0-10) FUEL PERFORMANCE (kg/km/seat)	6,87 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0230 A LOCAL NOISE LEVEL	6,87 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,314 B LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0230 A (c) A (6,87 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,314 B COCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0230 A (c) A (6,87 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,314 B COCAL AIR POLLUTION [NO _x /Thrust] (g/kN) 52,6 E

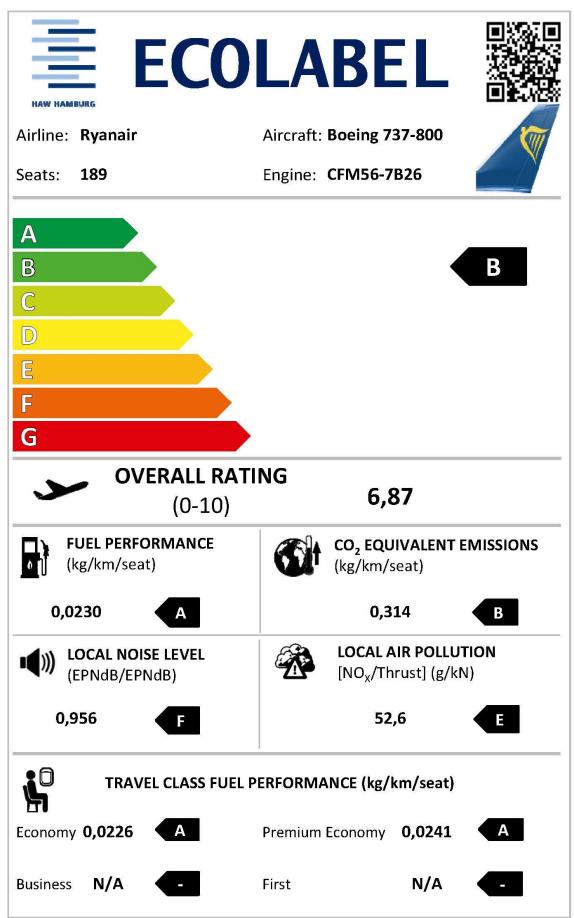
Figure C.71 Ecolabel for Boeing 737-800 of Pegasus Airlines

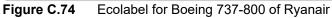


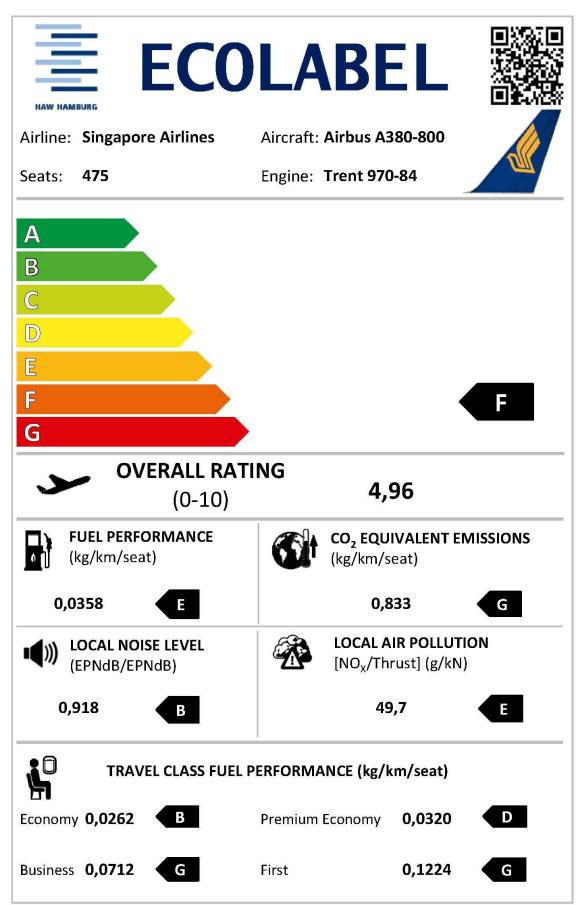


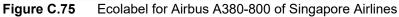
ECO	
Airline: Qatar Airways	Aircraft: Airbus A380-800
Seats: 517	Engine: GP7270
A B C D E F G	E
(0-10)	NG 5,29
(0-10)	5,29
(0-10) FUEL PERFORMANCE (kg/km/seat)	5,29 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0328 D LOCAL NOISE LEVEL	5,29 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,766 G LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0328 D (0,0328 D (kg/km/seat) 0,0328 D 0,0328 D 0,0328 D 0,0328 D 0,0328 D 0,0328 D 0,0328 D	5,29 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,766 G CO2 CO2 CO2 CO2 CO2 CO2 CO2 CO2
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0328 D (0,0328 D (kg/km/seat) 0,0328 D 0,0328 D 0,0328 D 0,0328 D 0,0328 D 0,0328 D 0,0328 D	5,29 CO2 EQUIVALENT EMISSIONS (kg/km/seat) 0,766 G 0,766 G Image: Colspan="2">CO2 EQUIVALENT EMISSIONS (kg/km/seat) 0,766 G Image: Colspan="2">CO2 EQUIVALENT EMISSIONS (kg/km/seat) 0,766 G Image: Colspan="2">CO2 EQUIVALENT EMISSIONS (kg/km/seat) Image: Colspan="2">O,766 Image: Colspan="2">G Image: Colspan="2">CO2 EQUIVALENT EMISSIONS (kg/km/seat) Image: Colspan="2">Colspan="2">CO2 EQUIVALENT EMISSIONS (kg/km/seat) Image: Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"Cols





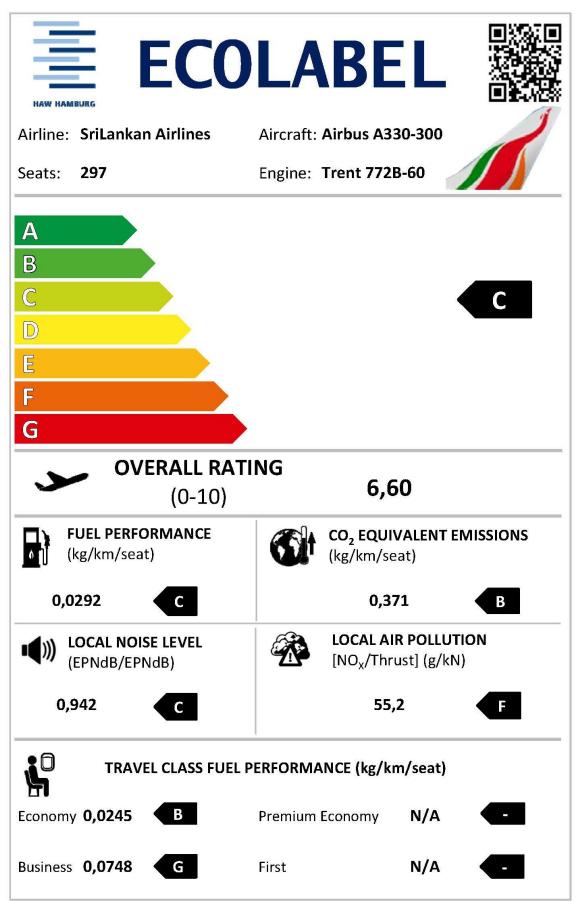


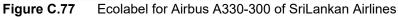


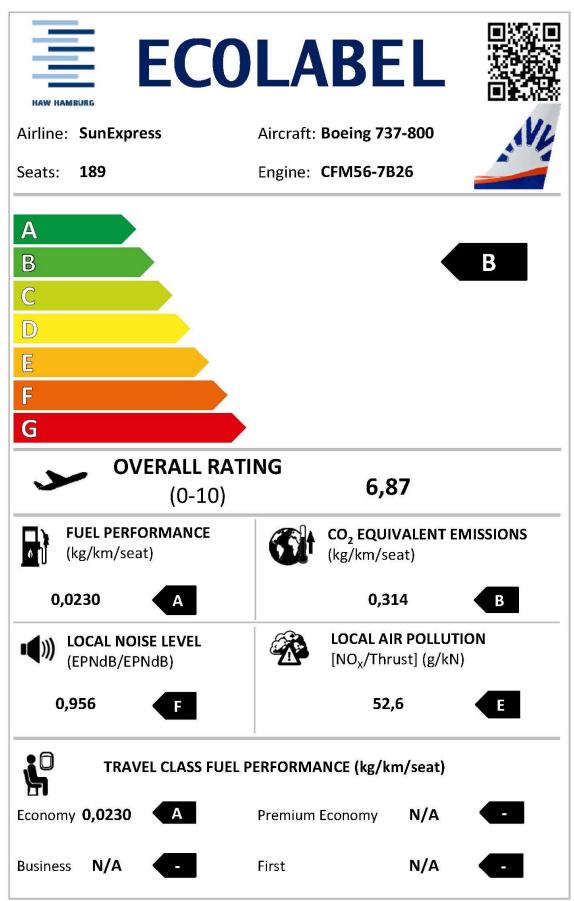


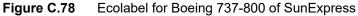
ECO	
Airline: SriLankan Airlines	Aircraft: Airbus A321
Seats: 181	Engine: V2533-A5
A B C D E F G	B
OVERALL RATI	NG
(0-10)	6,83
(0-10) FUEL PERFORMANCE (kg/km/seat)	
	6,83
FUEL PERFORMANCE (kg/km/seat)	6,83 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
FUEL PERFORMANCE (kg/km/seat) 0,0206 A LOCAL NOISE LEVEL	6,83 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,310 B LOCAL AIR POLLUTION
FUEL PERFORMANCE (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) (kg/km/seat)	6,83 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,310 B CO2 EQUIVALENT EMISSIONS (kg/km/seat) 0,310 B EXAMPLE IN
FUEL PERFORMANCE (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) 0,0206 (kg/km/seat) (kg/km/seat)	6,83 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,310 B COCAL AIR POLLUTION [NO _x /Thrust] (g/kN) 61,5 G

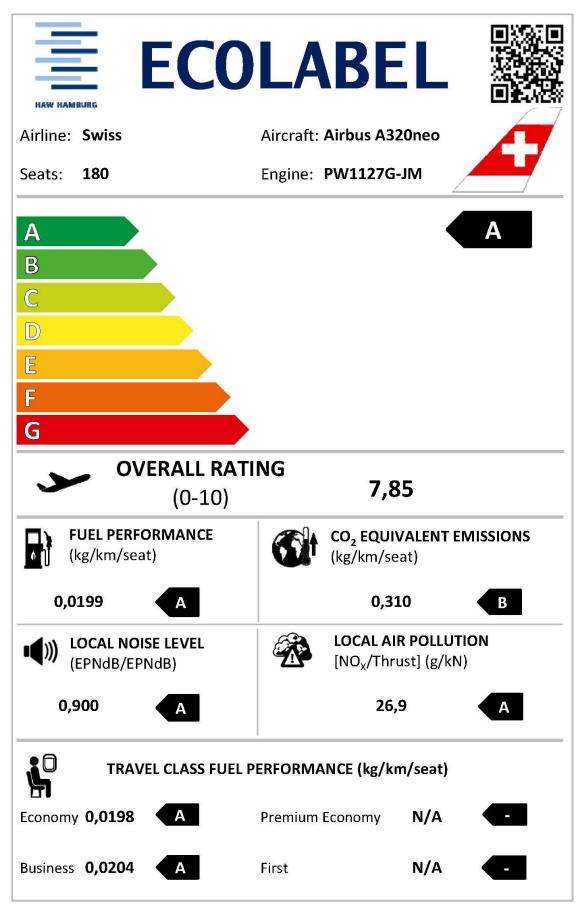
Figure C.76 Ecolabel for Airbus A321 of SriLankan Airlines

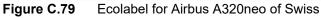


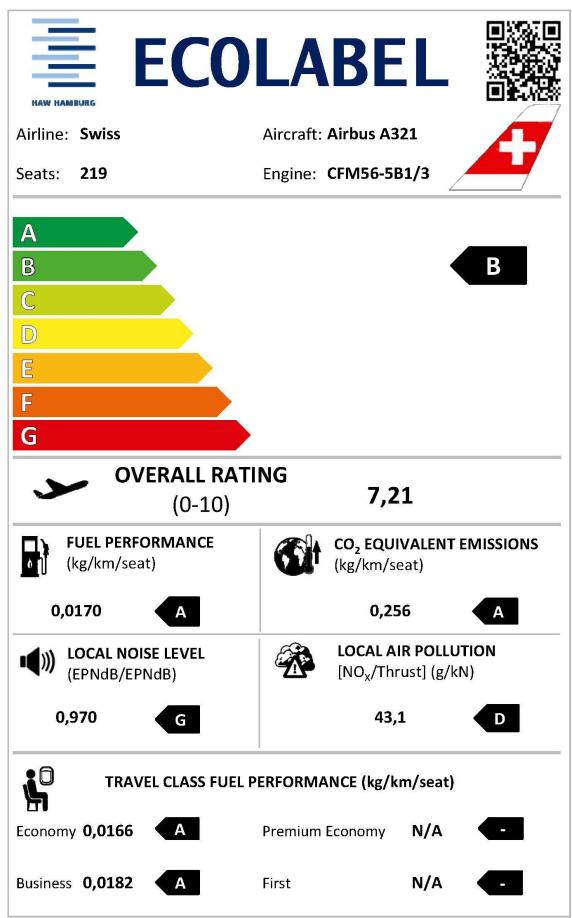


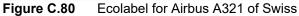






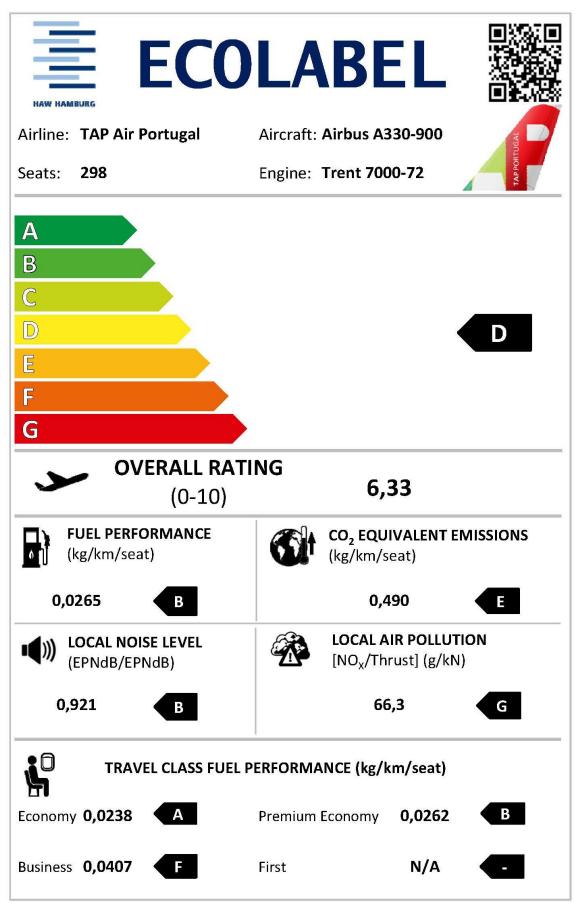






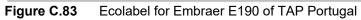
Airline: TAP Portugal	Aircraft: Airbus A320
Seats: 156	Engine: CFM56-5B4/P
A B C D E F G	C
OVERALL RATI (0-10)	NG 6,75
(0-10)	6,75
(0-10) FUEL PERFORMANCE (kg/km/seat)	6,75 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0256 B LOCAL NOISE LEVEL	6,75 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,378 B LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0256 B (c) 0,0256 C 0,0256 C 0	6,75 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,378 B LOCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0256 B (c) 0,0256 C 0,0256 C 0	6,75Image: Colspan="2">Colspan="2">EQUIVALENT EMISSIONS (kg/km/seat)0,378BImage: Olspan="2">Image: Olspan="2">O,378BImage: Olspan="2">Image: Olspan="2">Image: Olspan="2">Image: Olspan="2">Image: Olspan="2">Image: Olspan="2">Image: Olspan="2">Image: Olspan="2"Image: Olspan="2"Image: Olspan="2">Image: Olspan="2"Image: Olspan="2"<

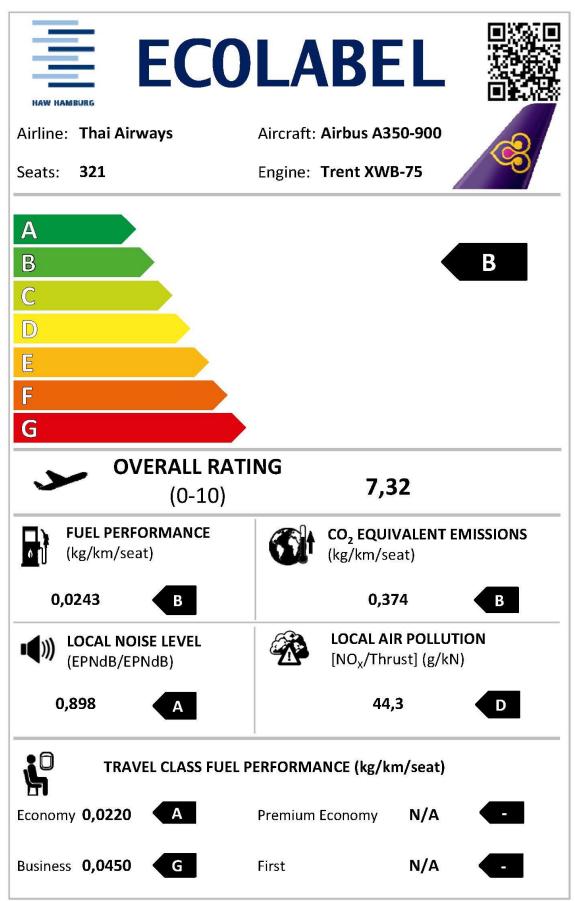






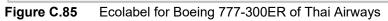
ECO	
Airline: TAP Air Portugal	Aircraft: Embraer E190
Seats: 106	Engine: CF34-10E7
A B C D E F G	E
OVERALL RATI (0-10)	NG 5,74
(0-10)	5,74
(0-10) FUEL PERFORMANCE (kg/km/seat)	5,74 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0366 E LOCAL NOISE LEVEL	5,74 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,548 E LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0366 E (kg/km/seat) 0,0366 (kg/km/seat) 0,0366 (kg/km/seat) 0,036 (kg/km/seat) 0,036 (kg/km/seat)	5,74 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,548 E CO2 EQUIVALENT EMISSIONS (kg/km/seat) E LOCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0366 E (kg/km/seat) 0,0366 (kg/km/seat) 0,0366 (kg/km/seat) 0,036 (kg/km/seat) 0,036 (kg/km/seat)	5,74 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,548 E COLLUTION [NO _x /Thrust] (g/kN) 39,8 C

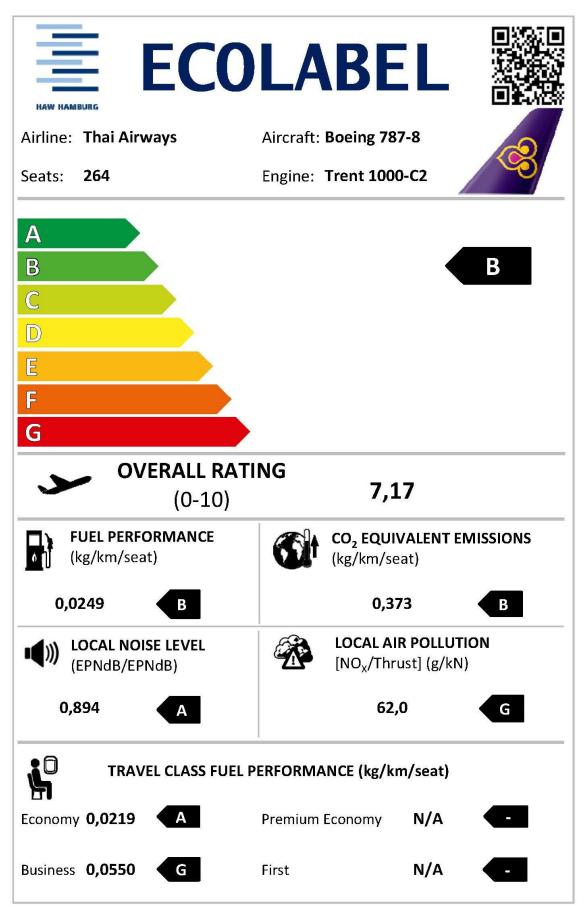






HAW HAMBURG ECO	
Airline: Thai Airways	Aircraft: Boeing 777-300ER
Seats: 348	Engine: GE90-115B
A B C D E F	E
G	
	NC
(0-10)	NG 6,15
(0-10)	6,15
(0-10) FUEL PERFORMANCE (kg/km/seat)	6,15 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0311 D LOCAL NOISE LEVEL	6,15 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,427 D LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0311 D (b) LOCAL NOISE LEVEL (EPNdB/EPNdB) 0,946 D	6,15 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,427 D COLCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0311 D (b) LOCAL NOISE LEVEL (EPNdB/EPNdB) 0,946 D	6,15Image: CO2 EQUIVALENT EMISSIONS (kg/km/seat)0,427D0,427DImage: CO2 EQUIVALENT EMISSIONS (kg/km/seat)DImage: CO2 EQUIVALENT [NO2/Thrust] (g/kN)DImage: CO2 EQUIVALENT [NO2/Thrust] (g/kN)G

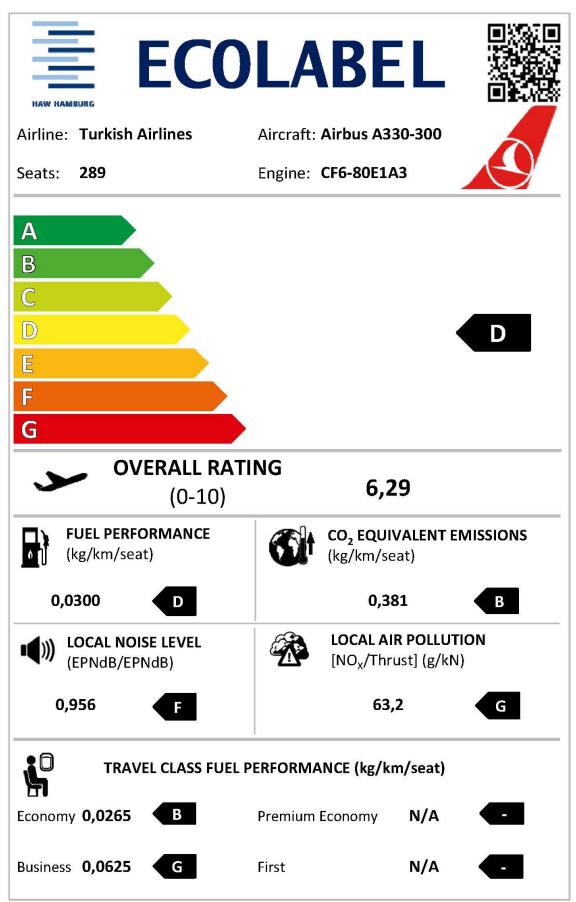


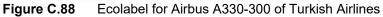




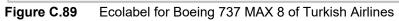
ECO	
Airline: Turkish Airlines	Aircraft: Airbus A321
Seats: 178	Engine: V2533-A5
A B C D E F G	C
OVERALL RATION (0-10)	NG 6,80
	-,
(U-IO) FUEL PERFORMANCE (kg/km/seat)	CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
FUEL PERFORMANCE (kg/km/seat)	CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
FUEL PERFORMANCE (kg/km/seat) 0,0209 A LOCAL NOISE LEVEL	CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,315 B LOCAL AIR POLLUTION
FUEL PERFORMANCE (kg/km/seat) 0,0209 (kg/km/seat) 0,0209 (kg/km/seat) 0,0209 (kg/km/seat) 0,0209 (kg/km/seat) 0,0209 (kg/km/seat) 0,0209 (kg/km/seat) 0,0209 (kg/km/seat) 0,0209 (kg/km/seat)	CO2 EQUIVALENT EMISSIONS (kg/km/seat) 0,315 DOCAL AIR POLLUTION [NOx/Thrust] (g/kN)
FUEL PERFORMANCE (kg/km/seat) 0,0209 A Image: Constraint of the second s	CO2 EQUIVALENT EMISSIONS (kg/km/seat)0,315B0,315BImage: Docal Air Pollution [NOx/Thrust] (g/kN)61,5G







ECO	
Airline: Turkish Airlines	Aircraft: Boeing 737 MAX 8
Seats: 151	Engine: LEAP-1B27
A B C D E F G	C
OVERALL RATI (0-10)	NG 6,81
(0-10)	6,81
(0-10) FUEL PERFORMANCE (kg/km/seat)	6,81 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0228 A LOCAL NOISE LEVEL	6,81 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,458 E LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0228 A (c) 0,0228 A (c) 0,024	6,81 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,458 E CO2 EQUIVALENT EMISSIONS (kg/km/seat) E LOCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0228 A (c) 0,0228 A (c) 0,024	6,81Image: CO2 EQUIVALENT EMISSIONS (kg/km/seat)0,458E0,458EImage: CO2 EQUIVALENT EMISSIONS (kg/km/seat)E0,458EImage: CO2 EQUIVALENT EMISSIONS (kg/km/seat)EImage: CO2 EQUIVALENT EMISSIONS (kg/km/seat)E



ECO	
Airline: Turkish Airlines	Aircraft: Boeing 777-300ER
Seats: 349	Engine: GE90-115B
A B C D E F G	E
OVERALL RATI (0-10)	NG 6,15
(0-10)	6,15
(0-10) FUEL PERFORMANCE (kg/km/seat)	6,15 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0310 D LOCAL NOISE LEVEL	6,15 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,426 D LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0310 D (kg/km/seat) 0,0310 D (kg/km/seat) 0,0310 D 0,0310 D 0,0310 D 0,0310 D 0,0310 D 0,0310 D 0,0310 D 0,0310 D	6,15 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,426 D COLCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0310 D (kg/km/seat) 0,0310 D (kg/km/seat) 0,0310 D 0,0310 D 0,0310 D 0,0310 D 0,0310 D 0,0310 D 0,0310 D 0,0310 D	6,15Image: Colspan="2">COlspan="2">EQUIVALENT EMISSIONS (kg/km/seat)0,426DImage: Olspan="2">Image: Olspan="2">O,426DImage: Olspan="2">Image: Olspan="2">Colspan="2">O,426DImage: Olspan="2">Image: Olspan="2">Colspan="2">Image: Olspan="2">O,426DImage: Olspan="2">Image: Olspan="2"Image: Olspan="2">Image: Olspan="2">Image: Olspan="2"Image: Olspan="2"Image: Olspan="2"Image: Olspan="2">Image: Olspan="2"Image: Olspan="2"Image: Olspan="2"Image: Olspan="2"Image: Olspan="2"Image: Olspan="2"Image: Olspan="2">Image: Olspan="2"Image: Olspan=

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

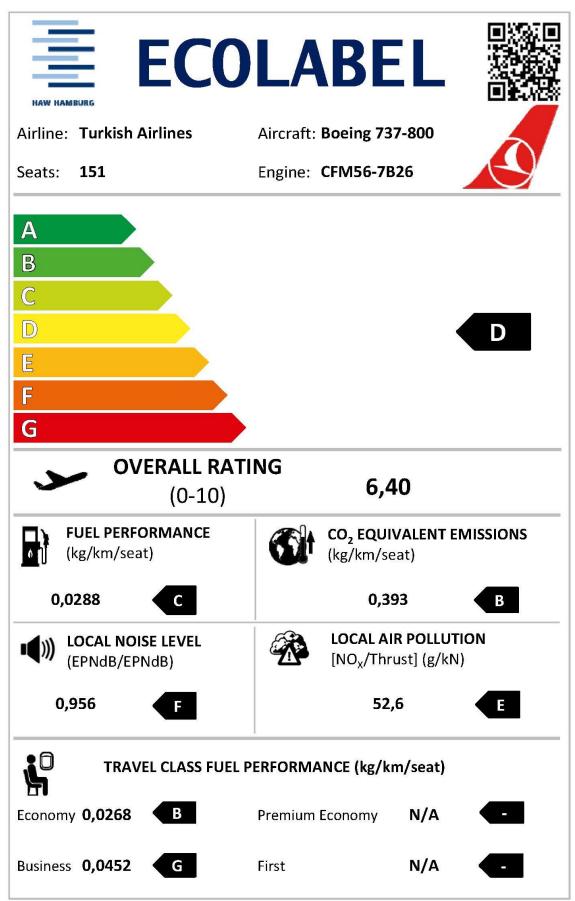
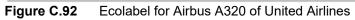


Figure C.91 Ecolabel for Boeing 737-800 of Turkish Airlines

Airline: United Airlines	Aircraft: Airbus A320
Seats: 150	Engine: V2527-A5
A B C D E F G	C
OVERALL RATI (0-10)	NG 6,74
(0-10)	6,74 CO ₂ EQUIVALENT EMISSIONS
(0-10) FUEL PERFORMANCE (kg/km/seat)	6,74 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0266 B LOCAL NOISE LEVEL	6,74 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,393 B LOCAL AIR POLLUTION
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0266 B (kg/km/seat) 0,0266 B (kg/km/seat) 0,0266 C (kg/km/seat) 0,0266 C (kg/km/seat) 0,026 C (kg/km/se	6,74 CO ₂ EQUIVALENT EMISSIONS (kg/km/seat) 0,393 B CO2 EQUIVALENT EMISSIONS (kg/km/seat) B LOCAL AIR POLLUTION [NO _x /Thrust] (g/kN)
(0-10) FUEL PERFORMANCE (kg/km/seat) 0,0266 B (kg/km/seat) 0,0266 B (kg/km/seat) 0,0266 C (kg/km/seat) 0,0266 C (kg/km/seat) 0,026 C (kg/km/se	6,74CO2 EQUIVALENT EMISSIONS (kg/km/seat)0,393B0,393BELOCAL AIR POLLUTION [NOx/Thrust] (g/kN)48,4E



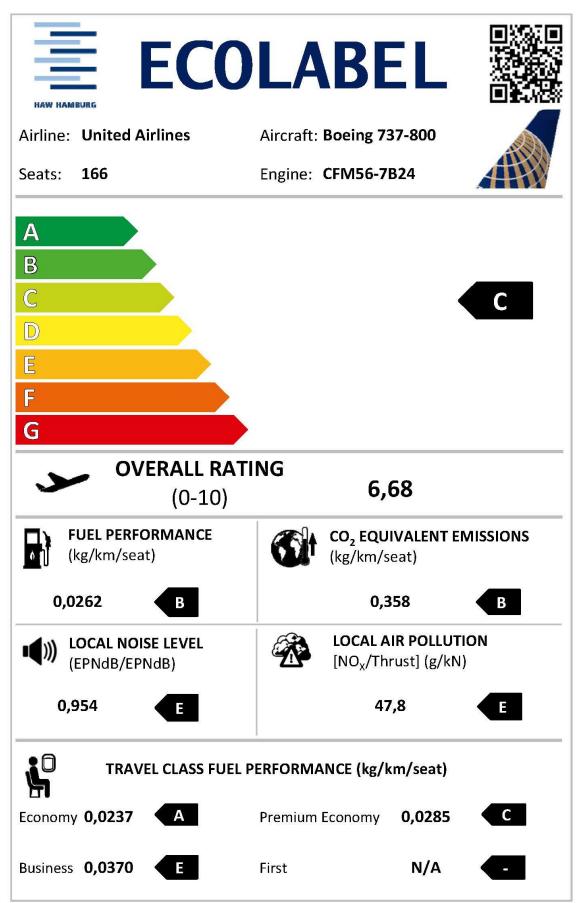


Figure C.93 Ecolabel for Boeing 737-800 of United Airlines

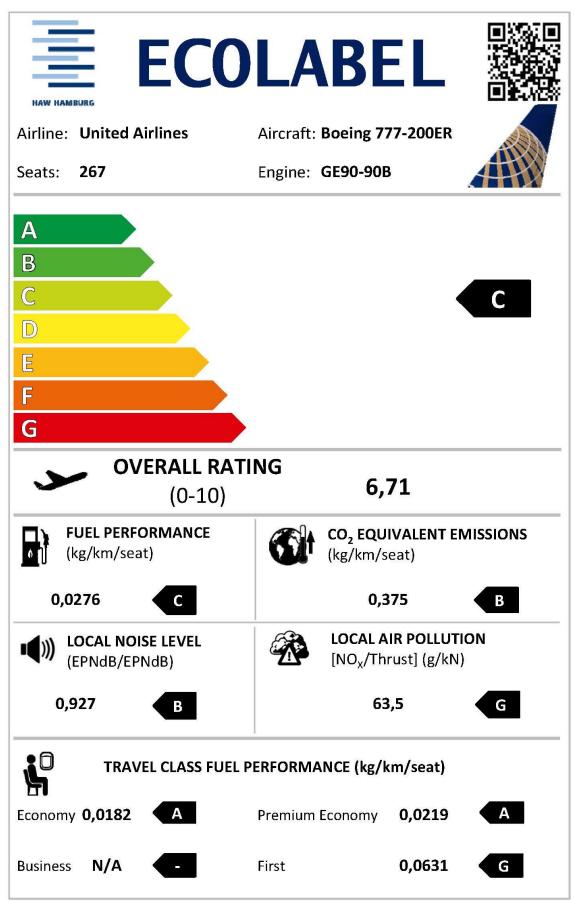
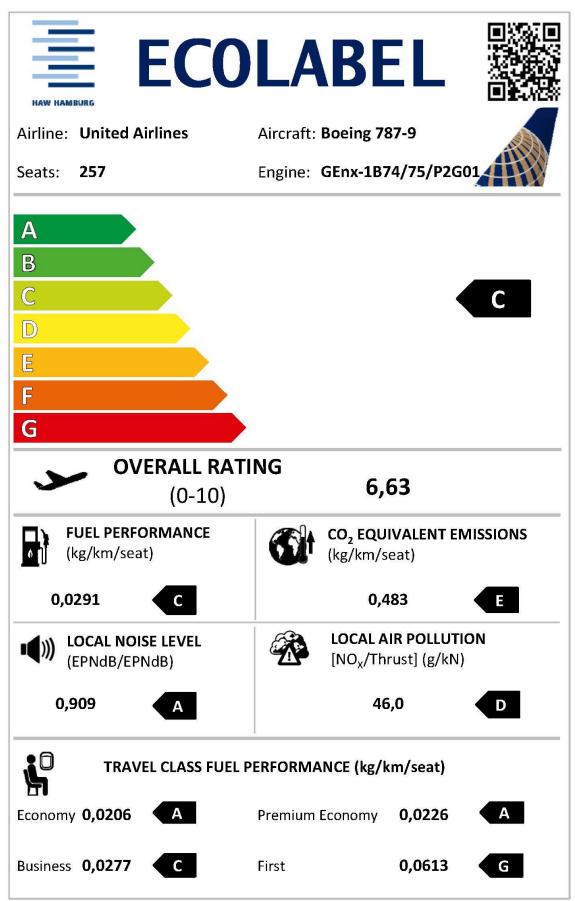
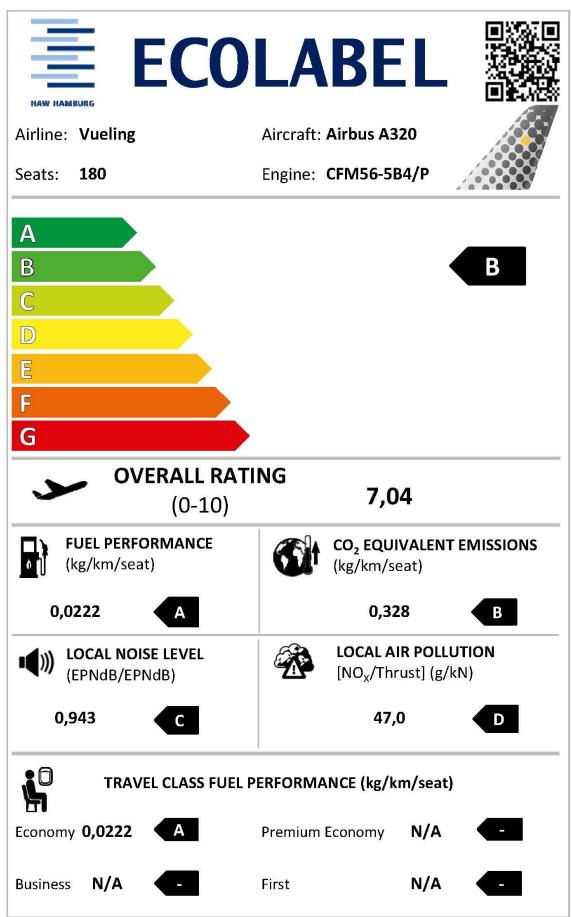
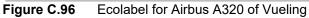


Figure C.94 Ecolabel for Boeing 777-200ER of United Airlines









Appendix D – Trip Emission Ecolabels

		COL /	ABEL		
	RG-ANTALYA 2456 km Boeing 737-800 189 CFM56-7B27 Corendon				
>	ENVIRONN	IENTAL RA	TING 1,0)1	
	FUEL PERFORMAN	ICE		ALENT EM	ISSIONS
57,6	kg/seat	(0,87)*	788	kg/seat	(0,87)*
	LOCAL NOISE LEV	EL			N
0,96	EPNdB/EPNdB	(1)*	71,1	g/seat	(1,42)*
j.	TRAVEL CLAS	S FUEL PERFOR	MANCE		
Economy	57,6	kg/seat	Premium Economy	N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference f	light of 2400 km, performe	d by a Boeing 737-800		

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

HAW HARED		OL	ABEL		
	RG-ANTALYA 2456 km Boeing 737-800 189 CFM56-7B26 SunExpress				
5	ENVIRONN	IENTAL R	ATING 0,9	8	
(م ال ه	FUEL PERFORMAN	ICE		ALENT EM	ISSIONS
57,6	kg/seat	(0,87)*	788	kg/seat	(0,87)*
•())	LOCAL NOISE LEVE	EL)N
0,96	EPNdB/EPNdB	(1)*	65,1	g/seat	(1,3)*
j0	TRAVEL CLAS	S FUEL PERFO	RMANCE		
Economy	57,6	kg/seat	Premium Economy	N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to t	the emissions of <u>one</u> reference fl Trin Emission F		rmed by a Boeing 737-800 urg to Antalya by SunExp	Tress	

HAW HAMED	and the second sec	OL	ABEL		
to the beaustions and	RG-ANTALYA e: 2456 km Boeing 737-800 151 CFM56-7B26 Turkish Airlines				
>	ENVIRONM	1ENTAL RA	ATING 1,1	.8	
	FUEL PERFORMAN	ICE		ALENT EM	ISSIONS
72,1	kg/seat	(1,09)*	986	kg/seat	(1,08)*
•••))	LOCAL NOISE LEVI	EL			N
0,96	EPNdB/EPNdB	(1)*	81,4	g/seat	(1,63)*
j.	TRAVEL CLAS	S FUEL PERFOR	MANCE		
Economy	67,2	kg/seat	Premium Economy	N/A	kg/seat
Business	113,3	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference f	light of 2400 km, perform	ed by a Boeing 737-800		

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

	EC	:0L/	ABEL		
	RG-ISTANBUL SABIH : 2023 km Boeing 737-800 Turkish Airlines	IA GÖKCEN Seats: 151	Engine: CF	M56-7B26	
Distance	JL SABIHA GÖKCEN- : 463 km Airbus A320neo Pegasus Airlines	ANTALYA Seats: 186	Engine: LE	AP-1A26	
5	ENVIRONN	IENTAL R	ATING 1,4	17	
	FUEL PERFORMAN	ICE		VALENT EI	MISSIONS
69,5	kg/seat	(1,05)*	969	kg/seat	(1,07)*
•••))	LOCAL NOISE LEV	EL		IR POLLUT	ION
1,85	EPNdB/EPNdB	(1,94)*	112,1	g/seat	(2,25)*
j,	TRAVEL CLAS	S FUEL PERFOI	RMANCE		
LI∎ Economy	65,4	kg/seat	Premium Economy	N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference f		ed by a Boeing 737-800		

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

	EC	ÖLA	BEL		
	RG-ISTANBUL SABIH	A GÖKCEN			
	: 2023 km	C			
Aircraft: Airline:	Boeing 737-800 Turkish Airlines	Seats: 151	Engine: CF	10120-7820	
ISTANBU	IL SABIHA GÖKCEN-/	ANTALYA			
Distance	: 463 km				
Aircraft:	Boeing 737-800	Seats: 151	Engine: CF	M56-7B26	
Airline:	Turkish Airlines				
> •	ENVIRONM		1,7	'3 VALENT EN	MISSIONS
U 74,4		(N.)	10 /8 ⁻		
ware ware diale	kg/seat	(1,12)*	1017	kg/seat	(1,12)*
	kg/seat			R POLLUTI	
				R POLLUTI	
•(*))	LOCAL NOISE LEVE	iL	LOCAL AI 162,9	R POLLUTI	ON
•(*))	LOCAL NOISE LEVE	:L (2)*	LOCAL AI 162,9	R POLLUTI g/seat	ON
■ 1,91	LOCAL NOISE LEVE EPNdB/EPNdB TRAVEL CLASS	EL (2)* S FUEL PERFORM	LOCAL AI 162,9 MANCE	R POLLUTI g/seat	ON (3,26)*

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

	EC	OL	\BEL		
HAMBUR Distance: Aircraft: Airline:	2151 km	Seats: 189	Engine: Cl	FM56-7B26	
IZMIR-AN Distance: Aircraft: Airline:	357 km	Seats: 189	Engine: Cl	FM56-7B26	
5	, ENVIRONIV	IENTAL RA	TING 1,4	46	
a li	FUEL PERFORMAN	ICE		VALENT EI	VISSIONS
59,9	kg/seat	(0,9)*	820	kg/seat	(0,9)*
	LOCAL NOISE LEVE	EL			ON
1,91	EPNdB/EPNdB	(2)*	130,1	g/seat	(2,61)*
j.	TRAVEL CLAS	S FUEL PERFOR	MANCE		
Economy	59,9	kg/seat	Premium Economy	N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to th	ne emissions of <u>one</u> reference fl		d by a Boeing 737-800		

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

		:0L/	ABEL		
Distance Aircraft:	RG-ISTANBUL ATAT : 1990 km Airbus A321 Turkish Airlines	ÜRK Seats: 178	Engine:	V2533-A5	
Distance	JL ATATÜRK-ANTAL' : 484 km Airbus A330-300 Turkish Airlines	YA Seats: 289	Engine:	CF6-80E1A3	
5	ENVIRONN	IENTAL RA		,87	
	FUEL PERFORMAN	ICE		JIVALENT EI	VISSIONS
58,7	kg/seat	(0,88)*	846	kg/seat	(0,93)*
•••))	LOCAL NOISE LEVI	ĒL		AIR POLLUTI	ON
1,92	EPNdB/EPNdB	(2,01)*	230,4	g/seat	(4,62)*
i.	TRAVEL CLASS	S FUEL PERFOR	RMANCE		
Economy	55,3	kg/seat	Premium Econon	ny N/A	kg/seat
Business	88,2	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference f	100 N. 10	ed by a Boeing 737-800		

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

	E EC	:0L/	ABEL		
Distance Aircraft:	RG-ISTANBUL ATAT : 1990 km Airbus A321 Turkish Airlines	Ü RK Seats: 178	Engine: V	/2533-A5	
Distance Aircraft:	JL ATATÜRK-ANTAL : 484 km Airbus A321 Turkish Airlines	/A Seats: 178	Engine: V	2533-A5	
>	ENVIRONN	IENTAL R	ATING 1,	70	
	FUEL PERFORMAN	ICE			VISSIONS
53,9	kg/seat	(0,81)*	810	kg/seat	(0,89)*
	LOCAL NOISE LEVE	εL		IR POLLUTI	ON
1,92	EPNdB/EPNdB	(2,01)*	194,3	g/seat	(3,89)*
j.	TRAVEL CLASS	5 FUEL PERFOF	RMANCE		
Economy	51,9	kg/seat	Premium Econom	y N/A	kg/seat
Business	69,2	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference fl	10°0 10	ed by a Boeing 737-800		

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

	EC	OLA	ABEL		
Distance Aircraft:	RG-ISTANBUL ATATÜ : 1990 km Airbus A330-300 Turkish Airlines	JRK Seats: 289	Engine: CF	6-80E1A3	
Distance Aircraft:	JL ATATÜRK-ANTALY :: 484 km Airbus A321 Turkish Airlines	7 A Seats: 178	Engine: V2	2533-A5	
5	ENVIRONM	ENTAL RA	TING 1,9	96	
\Box	FUEL PERFORMAN	CE		VALENT EN	VISSIONS
۱ (
• [] 72,4	kg/seat	(1,09)*	946	kg/seat	(1,04)*
▲]) 72,4 ■ ()))	kg/seat		946		(1,04)*
			946	kg/seat	(1,04)*
•())	LOCAL NOISE LEVE	L	946 EDCAL AI 230,4	kg/seat R POLLUTI	(1,04)* ON
•())	LOCAL NOISE LEVE	L (2,01)*	946 EDCAL AI 230,4	kg/seat R POLLUTI g/seat	(1,04)* ON

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

ECOLABEL HAW HAMBURG HAMBURG-MÜNCHEN Distance: 600 km Aircraft: Airbus A321 Seats: 192 Engine: V2533-A5 Airline: Lufthansa **MÜNCHEN-ANTALYA** Distance: 2003 km Aircraft: Boeing 737-800 Seats: 189 Engine: CFM56-7B26 Airline: **SunExpress ENVIRONMENTAL RATING** 1,57 **FUEL PERFORMANCE CO₂ EQUIVALENT EMISSIONS** 59,8 (0,9)* 835 (0,92)* kg/seat kg/seat LOCAL NOISE LEVEL LOCAL AIR POLLUTION 1,92 155,1 EPNdB/EPNdB (2,01)* g/seat (3,11)* 20 TRAVEL CLASS FUEL PERFORMANCE Economy 59,0 kg/seat **Premium Economy** N/A kg/seat **Business** N/A kg/seat N/A kg/seat First * Compared to the emissions of one reference flight of 2400 km, performed by a Boeing 737-800

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

		OLA	BEL		
	RG-HELSINKI e: 1172 km Embraer E190 Finnair	Seats: 100	Engine: CF	-34-10E7	
	KI-BANGKOK e: 7912 km Airbus A350-900 Finnair	Seats: 336	Engine: Tr	ent XWB-7	5
2	ENVIRONN	IENTAL RA	TING 3,2	27	
> ₽	FUEL PERFORMAN		3,2	27 VALENT EF	MISSIONS
232,4			3,2		
> 232,4 ■	FUEL PERFORMAN	ICE (3,5)*	3,2 CO2 EQUI 3554	VALENT EI	(3,91)*
Solution </td <td>FUEL PERFORMAN kg/seat</td> <td>ICE (3,5)*</td> <td>3,2 CO2 EQUI 3554</td> <td>VALENT EI kg/seat</td> <td>(3,91)*</td>	FUEL PERFORMAN kg/seat	ICE (3,5)*	3,2 CO2 EQUI 3554	VALENT EI kg/seat	(3,91)*
•••))	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	ICE (3,5)* EL	3,2 CO ₂ EQUI 3554 CO ₂ EQUI 3554 LOCAL AI 154,7	VALENT EN kg/seat	(3,91)* ON
•••))	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	ICE (3,5)* EL (1,94)*	3,2 CO ₂ EQUI 3554 CO ₂ EQUI 3554 LOCAL AI 154,7	VALENT ER kg/seat IR POLLUTI g/seat	(3,91)* ON

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

	EC	OL/	ABEL		
	RG-AMSTERDAM : 380 km Airbus A319 Eurowings	Seats: 138	Engine: C l	FM56-5B6/F	•
Distance	DAM-BANGKOK : 9217 km Boeing 777-300ER EVA Air	Seats: 313	Engine: G	E90-115B	
2	ENVIRONM	ENTAL RA	ATING 4,!	54	
4 U	FUEL PERFORMAN	CE		VALENT EN	AISSIONS
331,5	kg/seat	(4,99)*	4567	kg/seat	(5,02)*
•())	LOCAL NOISE LEVE	L	LOCAL A	IR POLLUTI	ON
1,89	EPNdB/EPNdB	(1,98)*	284,3	g/seat	(5,7)*
j.	TRAVEL CLASS	FUEL PERFOR	MANCE		
L I Economy	248,8	kg/seat	Premium Economy	305,23	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
	he emissions of <u>one</u> reference flig	ht of 2400 km, performe			

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

	E EC	OLA	BEL		
Distance Aircraft:	RG-FRANKFURT e: 412 km Airbus A321 Lufthansa	Seats: 192	Engine: V2	533-A5	
Distance	URT-BANGKOK 9009 km Boeing 777-300ER Thai Airways	Seats: 348	Engine: GE	90-115B	
	FNVIRONM	ENTAL RA	TING		
S			4,2	20	
	FUEL PERFORMANC			20 VALENT EN	VISSIONS
2 90,3					ИISSIONS (4,4)*
 290,3	FUEL PERFORMANC	CE (4,37)*		VALENT EN	(4,4)*
4.	FUEL PERFORMANC	CE (4,37)*	4002	VALENT EN kg/seat	(4,4)*
•())	FUEL PERFORMANC kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	CE (4,37)* L	4002 LOCAL AI 290,6	VALENT EN kg/seat R POLLUTI	(4,4)* ON
•())	FUEL PERFORMANC kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	CE (4,37)* L (2)*	4002 LOCAL AI 290,6	VALENT EN kg/seat R POLLUTI g/seat	(4,4)* ON

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

ISAW HAMBUR	EC	:0L	ABEL		
	RG-MÜNCHEN 600 km Airbus A320 Lufthansa	Seats: 1	. 54 Engine:	CFM56-5B4	1/P
Distance:	N-BANGKOK 8809 km Airbus A350-900 Thai Airways	Seats: 3	21 Engine:	Trent XWB	-75
>	, ENVIRONN	1ENTAL R	ATING 3,	,32	
1 A A A A A A A A A A A A A A A A A A A	ELIEL DEDEODMAN	ICE	~ 1.		
6 []	FUEL PERFORMAN	NCE		JIVALENT EM	IISSIONS
0 232,3	FUEL PERFORMAN	ICE (3,5)*	Solution CO ₂ EQU 3561	JIVALENT EM	(3,92)*
232,3		(3,5)*	3561		(3,92)*
232,3	kg/seat	(3,5)*	3561	kg/seat	(3,92)*
232,3	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(3,5)* EL	3561 (CAL) 165,5	kg/seat AIR POLLUTIC	(3,92)* ON
232,3 ••••)) 1,84	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(3,5)* EL (1,93)*	3561 (CAL) 165,5	kg/seat AIR POLLUTIC g/seat	(3,92)* DN
232,3 •())) 1,84	kg/seat LOCAL NOISE LEV EPNdB/EPNdB TRAVEL CLA	(3,5)* EL (1,93)* SS FUEL PERF(3561 CORMANCE	kg/seat AIR POLLUTIC g/seat	(3,92)* DN (3,32)*

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

		OL	AE	BEL		
	G-ZÜRICH					
Distance: Aircraft: Airline:	693 km Airbus A320neo Swiss	Seats:	180	Engine:	PW1127G	ML-
	BANGKOK					
Distance: Aircraft: Airline:	9064 km Boeing 787-8 Thai Airways	Seats:	264	Engine:	Trent 100	0-C2
				~		
	, ENVIRONM			3,4	48 IVALENT EF	VIISSIONS
241,5				3,4		MISSIONS (4)*
241,5	FUEL PERFORMAN	CE (3,64)*		3,4 €CO₂ EQU 3632	IVALENT EN	(4)*
241,5	FUEL PERFORMAN kg/seat	CE (3,64)*		3,4 €CO₂ EQU 3632	IVALENT EN kg/seat IR POLLUTI	(4)*
▲Ú 241,5 ■●)))	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE	CE (3,64)* EL (1,88)*	S .	3,4 CO2 EQU 3632 LOCAL A 193,1	IVALENT EN kg/seat IR POLLUTI	(4)* ON
241,5 ■●))) 1,79	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	CE (3,64)* EL (1,88)*	FORMAN	3,4 CO2 EQU 3632 LOCAL A 193,1	IVALENT EN kg/seat IR POLLUTI g/seat	(4)* ON

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

		OL	ABEL		
	G-DUBAI 4888 km Airbus A380-800 Emirates	Seats: 4	89 Engine:	GP7270	
DUBAI-B/ Distance: Aircraft: Airline:	4909 km	Seats: 3	54 Engine:	GE90-115	В
>	, ENVIRONM		5,	41 IVALENT EN	AISSIONS
<u>0</u>] 322,9	kg/seat	(4,86)*	6078	kg/seat	(6,69)*
	LOCAL NOISE LEVE	L		AIR POLLUTI	ON
1,86	EPNdB/EPNdB	(1,95)*	342,0	g/seat	(6,85)*
j0	TRAVEL CLAS	S FUEL PERF	DRMANCE		
Economy	277,5	kg/seat	Premium Econom	y N/A	kg/seat
Business	519,7	kg/seat	First	798,6	kg/seat
					0.

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

HAW HAMBUR		OL	ABEL		
HAMBUR Distance: Aircraft: Airline:	G-AMSTERDAM 380 km Boeing 737-800 KLM	Seats: 1	. 76 Engine:	CFM56-7B	27
	DAM-BANGKOK 9217 km Boeing 777-300EF KLM	R Seats: 4	1 08 Engine:	GE90-115	В
>	, ENVIRONM		3,	71 IVALENT EN	AISSIONS
256,1	kg/seat	(3,86)*	3519	kg/seat	(3,87)*
	LOCAL NOISE LEVE	iL		AIR POLLUTI	ON
1,90	EPNdB/EPNdB	(2)*	247,4	g/seat	(4,96)*
j0	TRAVEL CLAS	SS FUEL PERF	DRMANCE		
LI • Economy	229,7	kg/seat	Premium Econom	y 251,98	kg/seat
.	500.0	les (an ab	First	NI / A	I
Business	520,8	kg/seat	First	N/A	kg/seat

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

HAW HAMBUR		OL	A	BEL		
HAMBUR Distance: Aircraft: Airline:	769 km	Seats:	161	Engine:	CFM56-5E	34/P
WIEN-BA Distance: Aircraft: Airline:	8459 km	Seats:	308	Engine:	GE90-90B	
>	, ENVIRONM		RATIN	3,3		
<u>م</u> ال 223,9	kg/seat	(3,37)*	0	3063	IVALENT EI kg/seat	(3,37)*
•••))	LOCAL NOISE LEVE	iL	á	LOCAL A		ON
1,87	EPNdB/EPNdB	(1,96)*		243,1	g/seat	(4,87)*
j0	TRAVEL CLAS	S FUEL PER	FORMAN	ICE		
Economy	192,9	kg/seat	Prer	nium Economy	/ N/A	kg/seat
Business	397,1	kg/seat	First		N/A	kg/seat
		ght of 2400 km, per				

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

		C	OL		BE	L		
	G-FRANKFUR	г						
Distance: Aircraft: Airline:	Airbus A321		Seats:	1 92	Engiı	ie:	V2533-A	5
	IRT-COLOMBC)						
Distance: Aircraft: Airline:	8068 km Airbus A330- SriLankan Ai		Seats:	297	Engir	ne:	Trent 77	2B-60
	O-BANGKOK							
	2393 km Airbus A321 SriLankan Ai	rlines	Seats:	181	Engi	ie:	V2533-A	5
د	ENVI	RONI	MENT. NG	AL	4,43			
> •	ENVI	RATI	NG		4,43	/ALEN	IT EMISSI	ONS
296,4		RATI	NG E			/ALEN kg/set		ONS (4,3)*
 296,4 • ↓)))	FUEL PERFOI	RATI RMANC (4,46)	NG E *			kg/sea	at	
✓ 296,4 ↓ <td>FUEL PERFOI kg/seat</td> <td>RATI RMANC (4,46) E LEVEL</td> <td>NG E *</td> <td>39 39</td> <td>202 EQUIN</td> <td>kg/sea</td> <td>at LUTION</td> <td></td>	FUEL PERFOI kg/seat	RATI RMANC (4,46) E LEVEL	NG E *	39 39	202 EQUIN	kg/sea	at LUTION	
•••))	FUEL PERFOI kg/seat LOCAL NOIS EPNdB/EPNd	RATI RMANC (4,46) E LEVEL IB (3)*	NG E *	39 39	CO ₂ EQUIN 905 LOCAL AI 04,6	kg/sea R POLI	at LUTION	(4,3)*
■ ())) 2,86	FUEL PERFOI kg/seat LOCAL NOIS EPNdB/EPNd	RATI RMANC (4,46) E LEVEL IB (3)*	NG E *	Since a second s	CO ₂ EQUIN 905 LOCAL AI 04,6	kg/sea R POLI g/sea	at LUTION t	(4,3)*

and SriLankan Airlines

RANKFURT				121244	
2 km bus A321 thansa	Seats:	19 2	Engine:	V2533-A5	
BAHRAIN					
bus A321neo	Seats:	169	Engine:	LEAP-1A33	
NGKOK					
eing 787-9	Seats:	282	Engine:	Trent 1000-K2	
R	ATING		,81		
LPERFORM	ANCE	St tco		INT EMISSIONS	
/seat (3	3,99)*	461	1 kg/s	seat (5,0)/}*
(seat (S			1 kg/s CAL AIR PC	10 ISANJO • 1 1899)/)*
	VEL		CAL AIR PC	OLLUTION	
C AL NOISE LE NdB/EPNdB (2	VEL	لمن المن المن المن المن المن المن المن ا	CAL AIR PC	OLLUTION	
CAL NOISE LE NdB/EPNdB (; TRAVEL CL/	E VEL 2,91)*	لمن المن المن المن المن المن المن المن ا	CAL AIR PC ,2 g/se	p LLUTION eat (7)*	
	thansa BAHRAIN 44 km bus A321neo If Air NGKOK 92 km eing 787-9 If Air ENVIRC R/	rthansa BAHRAIN 14 km bus A321neo Seats: If Air NGKOK 92 km eing 787-9 Seats: If Air	Thansa BAHRAIN 44 km bus A321neo Seats: 169 If Air NGKOK 32 km eing 787-9 Seats: 282 If Air ENVIRONMENTAL RATING 4	Thansa BAHRAIN 14 km bus A321neo Seats: 169 Engine: If Air Seats: 282 Engine: If Air ENVIRONMENTAL RATING 4,81	Thansa BAHRAIN 44 km bus A321neo Seats: 169 Engine: LEAP-1A33 If Air NGKOK 92 km eing 787-9 Seats: 282 Engine: Trent 1000-K2 If Air ENVIRONMENTAL RATING 4,81

and Gulf Air

Victorico	G-AMSTERD	AM					
Aircraft: Airline:		.90	Seats:	100	Eng	gine: CF34-1	0E5
MSTER	DAM-ORANJE	STAD					
istance:	7883 km						
vircraft:	Boeing 777 KLM	-300ER	Seats:	408	Eng	gine: GE90-1	.15B
RANJES	TAD-BONAIR	E					
istance:	194 km						
ircraft:		-300ER	Seats:	408	Eng	gine: GE90-1	.15B
irline:	KLM						
. ``		IRONN	1ENT	AL	4.22		
У		RATIN	IG	AL	4,32		MISSIONIS
_> ₽	ENV	RATIN	IG	AL	- -	IIVALENT E	MISSIONS
2 33,3	ENV	RATIN	IG		- -	JIVALENT E kg/seat	MISSIONS (3,55)*
233,3	ENV	RATIN RMANCE (3,51)*	IG		CO ₂ EQU		(3,55)*
	ENV FUEL PERFO kg/seat	RATIN RMANCE (3,51)*	IG		CO ₂ EQU	kg/seat	(3,55)*
	ENV FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNO	RATIN RMANCE (3,51)*	IG		CO ₂ EQU 3227 LOCAL <i>4</i> 398,8	kg/seat	(3,55)* ION
233,3 •())) 2,85 •()) conomy	ENV FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNO	RATIN RMANCE (3,51)* SE LEVEL dB (2,98)*	JEL PE		CO ₂ EQU 3227 LOCAL <i>4</i> 398,8	kg/seat AIR POLLUT g/seat	(3,55)* ION

			LA	BE		
Distance: Aircraft:	RG-LONDON HE 748 km Airbus A320		ats: 174	Engine: C l	FM56-5B4/P	
Distance:	Eurowings HEATHROW-H 7779 km Boeing 787-9 United Airlin) Se	ats: 257	Engine: G	Enx-1B74/75	/P2G01
Distance:	N-BONAIRE 3422 km Boeing 737-8 United Airlin		ats: 166	Engine: Cl	FM56-7B24	
5		RONME RATING		4,93		
	FUEL PERFOR	MANCE	æ		JIVALENT EI	MISSIONS
0						
0 336,7	kg/seat	(5,07)*	Q	5294	kg/seat	(5,82)*
▲U 336,7 ■ ()))	kg/seat			5294		(5,82)*
▲Ŭ 336,7 ■ ())) 2,81		LEVEL		5294	kg/seat	(5,82)*
•••))	LOCAL NOISE	LEVEL	. PERFORM	5294 LOCAL / 249,1	kg/seat AIR POLLUT	(5,82)* ON
•••))	LOCAL NOISE	3 (2,94)*		5294 LOCAL / 249,1	kg/seat AIR POLLUT g/seat	(5,82)* ON
• ())) 2,81	LOCAL NOISE EPNdB/EPNdE TRAVEL 0 260,8	: LEVEL 3 (2,94)* CLASS FUEI		5294 LOCAL / 249,1 MANCE	kg/seat AIR POLLUT g/seat	(5,82)* ON (4,99)*

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

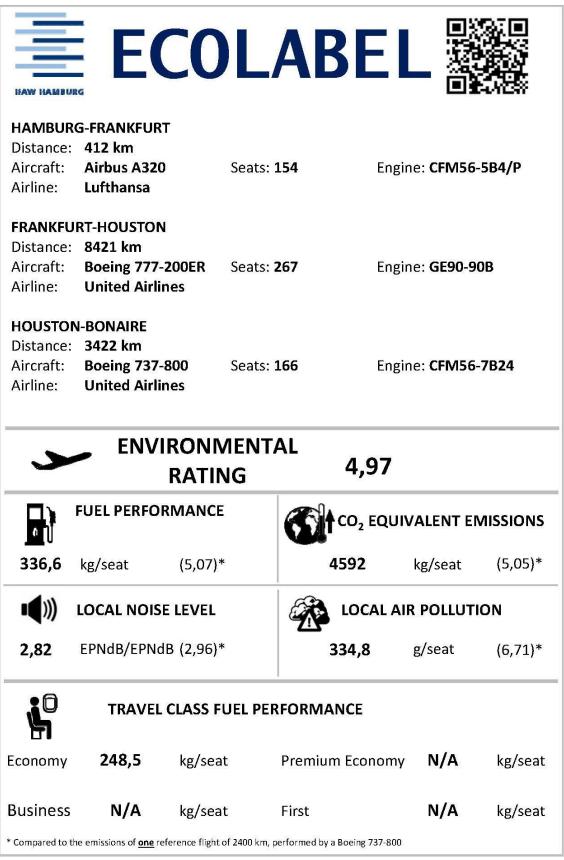


Figure D.23 Trip Emission Ecolabel Hamburg to Bonaire via Frankfurt and Houston by Lufthansa and United Airlines

HAW HAMEU		COL		BE		
HAMBUR	G-LONDON H	EATHROW				
Distance: Aircraft: Airline:	Airbus A320		ats: 171	Eng	gine: V2527E	E-A5
LONDON	HEATHROW-	MIAMI				
	7121 km			_		
	Boeing 777- American A		ats: 304	Eng	gine: GE90-1	.15B
MIAMI-B	ONAIRE					
Distance:	1970 km					
	Airbus A319 American A		ats: 128	Eng	gine: CFM56	-5B6/P
د	ENV		NTAL	5,07		
د	FUEL PERFO	RATING	NTAL	5,07		
		RATING	NTAL	0.	IVALENT E	MISSIONS
3 31,6		RATING	NTAL	0.	I VALENT E l kg/seat	MISSIONS (5,1)*
٥U	FUEL PERFO	RATING RMANCE (4,99)*	NTAL	CO₂ EQU 4636		(5,1)*
٥U	FUEL PERFO	RATING RMANCE (4,99)* E LEVEL	NTAL	CO₂ EQU 4636	kg/seat	(5,1)*
₀ 331,6 ■	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNc	RATING RMANCE (4,99)* E LEVEL		4636 LOCAL A 358,6	kg/seat	(5,1)* ION
₀ 331,6 ■	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNc	RATING RMANCE (4,99)* E LEVEL IB (2,96)*	PERFORM	4636 LOCAL A 358,6	kg/seat NR POLLUT g/seat	(5,1)* ION
331,6 ())) 2,82 ())	FUEL PERFOR kg/seat LOCAL NOIS EPNdB/EPNC TRAVEL	RATING RMANCE (4,99)* E LEVEL IB (2,96)* CLASS FUEL	PERFORM	4636 LOCAL A 358,6	kg/seat NR POLLUT g/seat	(5,1)* ION (7,19)*

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

		COL		BE		
HAMBUR	G-LONDON HE	ATHROW				
Distance:	748 km					
	Airbus A321r		ts: 210	Eng	ine: LEAP-1	A32
Airline:	British Airwa	ys				
LONDON	HEATHROW-M	IIAMI				
Distance:	7121 km					
Aircraft:	Airbus A380-	800 Sea	ts: 469	Eng	ine: Trent 9	70-84
Airline:	British Airwa	ys				
MIAMI-BO	ONAIRE					
Distance:	1970 km					
Aircraft:	Airbus A319	Sea	ts: 128	Eng	ine: CFM56	-5B6/P
Airline:	American Air	lines				
	ENIV/II	DONINAEN	ΙΤΛΙ			
<u>ک</u>		RONMEN RATING	ITAL	5,83		
		RATING	ITAL	0.	VALENT EI	MISSIONS
3 33,5		RATING	ITAL	0.	VALENT El kg/seat	MISSIONS (7,93)*
٥Ú	FUEL PERFOR	RATING MANCE (5,02)*	JTAL	7206		(7,93)*
٥Ú	FUEL PERFOR kg/seat	RATING MANCE (5,02)* LEVEL	ITAL	7206	kg/seat	(7,93)*
a 333,5 ■●)))	FUEL PERFOR kg/seat LOCAL NOISE EPNdB/EPNdE	RATING MANCE (5,02)* LEVEL		CO₂ EQUI 7206 LOCAL A 267,0	kg/seat IR POLLUT	(7,93)* ION
a 333,5 ■●)))	FUEL PERFOR kg/seat LOCAL NOISE EPNdB/EPNdE	RATING MANCE (5,02)* LEVEL 3 (2,91)*	PERFORM	CO₂ EQUI 7206 LOCAL A 267,0	kg/seat IR POLLUT g/seat	(7,93)* ION (5,35)*
a 333,5 ■●))) 2,77	FUEL PERFOR kg/seat LOCAL NOISE EPNdB/EPNdE TRAVEL (RATING MANCE (5,02)* LEVEL 3 (2,91)*	PERFORM	CO ₂ EQUI 7206 LOCAL A 267,0	kg/seat IR POLLUT g/seat	(7,93)* ION

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

		COI		BE		
HAMBUR Distance:	G-AMSTERD 380 km	AM				
Aircraft: Airline:		. 75 Se	ats: 88	Eng	ine: CF34-8 I	E5
	AM-ATLANT 7082 km	A				
	Airbus A33		ats: 293	Eng	ine: PW416	8A
	-BONAIRE					
Distance: Aircraft: Airline:	2893 km Boeing 737 Delta Air Li		ats: 160	Eng	ine: CFM56	-7B26
د	ENV	IRONME RATING		4,18		
۵ () ۱	FUEL PERFO	RMANCE	6	CO₂ EQU	IVALENT EI	MISSIONS
306,7	kg/seat	(4,62)*		4008	kg/seat	(4,41)*
•••))	LOCAL NOIS	E LEVEL	<i>A</i>		IR POLLUT	ION
2,88	EPNdB/EPN	dB (3,02)*		222,5	g/seat	(4,46)*
j.	TRAVEL	. CLASS FUEL	. PERFORM	IANCE		
Economy	260,0	kg/seat	Prem	ium Economy	/ 286,4	kg/seat
Business	N/A	kg/seat	First		N/A	kg/seat

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

		COI	_ A	BE		
HAMBUR Distance: Aircraft: Airline:	Embraer E1		ats: 88	Er	ngine: CF34-8I	5
Distance:	AM-ATLANT 7082 km Airbus A350 Delta Air Lin)-900 Se	ats: 306	Er	ngine: Trent X	WB-75
ATLANTA Distance: Aircraft: Airline:	2893 km		ats: 160	Er	ngine: CFM56 -	-7826
د	ENV	IRONME RATING		4,14		
	FUEL PERFO	RMANCE	6	CO2 EQ	UIVALENT EI	VISSIONS
277,5	kg/seat	(4,18)*		4122	kg/seat	(4,54)*
•••))	LOCAL NOIS	E LEVEL	E		AIR POLLUT	ION
2,82	EPNdB/EPNo	IB (2,95)*		224,1	g/seat	(4,49)*
j0	TRAVEL	CLASS FUEL	. PERFO	RMANCE		
Economy	233,8	kg/seat	Pre	mium Econor	my 275,8	kg/seat
Business	N/A	kg/seat	Firs	t	N/A	kg/seat
* Compared to th	ne emissions of <u>one</u> r	eference flight of 240	10 km, perforr	ned by a Boeing 737-8	300	

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

		COL	_A	BE		
Distance: Aircraft:	G-FRANKFUR 412 km Airbus A320 Lufthansa	-	ts: 154	Eng	;ine: CFM56	-5B4/P
FRANKFU Distance: Aircraft: Airline:			ts: 364	Eng	;ine: GeNx-2	B67
HOUSTON Distance: Aircraft: Airline:		- 800 Sea	ts: 160	Eng	;ine: CFM56	-7B26
د	ENV	IRONMEN RATING	NTAL	4,29		
	FUEL PERFO	RMANCE	6		IVALENT EI	MISSIONS
431,8	kg/seat	(6,5)*		2993	kg/seat	(3,29)*
	LOCAL NOIS	E LEVEL				ION
2,82	EPNdB/EPNd	IB (2,96)*		270,8	g/seat	(5,43)*
j0	TRAVEL	CLASS FUEL	PERFORM	MANCE		
Economy	328,9	kg/seat	Prem	ium Econom	y N/A	kg/seat
Business	N/A	kg/seat	First		N/A	kg/seat
* Compared to th	e emissions of <u>one</u> r	eference flight of 2400	km, performed	by a Boeing 737-80	0	

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

BAW HAMBUR		0 L/	4 B	EL		
HAMBUR Distance: Aircraft: Airline:	G-FRANKFURT 412 km Airbus A319 Lufthansa	Seats: 1	26	Engine:	CFM56-5E	6/P
	RT-HONG KONG 9169 km Boeing 777-300ER Cathay Pacific	Seats: 2	75	Engine:	GE90-115	В
> D	, ENVIRONM		ATING	5,0 co, equi)9 VALENT ER	AISSIONS
0 375,8	kg/seat	(5,66)*		5179	kg/seat	(5,7)*
•••))	LOCAL NOISE LEVE	L		LOCAL AI	R POLLUTI	ON
1,89	EPNdB/EPNdB	(1,98)*		320,9	g/seat	(6,43)*
j0	TRAVEL CLAS	S FUEL PERFC	DRMANCE			
LI • Economy	258,7	kg/seat	Premiu	m Economy	N/A	kg/seat
Business	718,0	kg/seat	First		N/A	kg/seat

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

		0L	AB	EL	■34×3■	
	RG-ISTANBUL ATATÜ 1990 km Airbus A321 Turkish Airlines		178	Engine:	V2533-A5	
Distance:	L ATATÜRK-HONG K 8022 km Boeing 777-300ER Turkish Airlines		349	Engine:	GE90-115E	3
5	, ENVIRONM	ENTAL R	ATING	4,2	27	
د ال 1	FUEL PERFORMAN	CE	6		VALENT EN	AISSIONS
292,7			the second second			
	kg/seat	(4,41)*		4078	kg/seat	(4,49)*
•())	kg/seat	n Crassica Science of		Energy 23 02-24	kg/seat R POLLUTI	
■ ●))) 1,91		n Crassica Science of		Energy 23 02-24		
	LOCAL NOISE LEVE	L (2)*		LOCAL AI 297,1		ON
1,91	LOCAL NOISE LEVE EPNdB/EPNdB	L (2)*	ORMANCE	LOCAL AI 297,1	R POLLUTI	ON
1,91	LOCAL NOISE LEVE EPNdB/EPNdB TRAVEL CLAS	L (2)* S FUEL PERF	ORMANCE	LOCAL AI 297,1	R POLLUTI	ON (5,95)*

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

gine: CF34-10E7
gine: Trent XWB-75
gine: Trent XWB-84
IVALENT EMISSIONS
kg/seat (4,73)*
kg/seat (4,73)*
AIR POLLUTION
AIR POLLUTION
22

and Cathay Pacific

	E	C (C		BE	L	
	4888 km Airbus A380	-800	Seats:	489	Engir	ie:	GP7270
	ANGKOK 4909 km Boeing 777- Emirates	300ER	Seats:	354	Engir	ne:	GE90-115B
Distance:	K-HONG KON 1689 km Boeing 777- Emirates		Seats:	354	Engir	ne:	GE90-115B
5	ENV	IRONN RATIN		AL	6,88		
> •	ENV	RATIN	IG			/ALENT	EMISSIONS
3 76,0		RATIN	IG			/ALENT kg/seat	
→ 376,0 • ()))	FUEL PERFO	RATIN RMANCE (5,66)*	IG		CO ₂ EQUIN	kg/seat	(7,49)*
→ 376,0 •••))) 2,81	FUEL PERFO kg/seat	RATIN RMANCE (5,66)* SE LEVEL	IG	Git G	202 EQUIN	kg/seat	(7,49)*
•(*))	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNd	RATIN RMANCE (5,66)* SE LEVEL	IG	6 6	CO ₂ EQUIN 808 LOCAL AII 39,1	kg/seat	: (7,49)* JTION
• ())) 2,81	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNd	RATIN RMANCE (5,66)* SE LEVEL dB (2,94)*	JG JEL PEF	G G G S FORMAN	CO ₂ EQUIN 808 LOCAL AII 39,1	kg/seat	: (7,49)* JTION
■●))) 2,81	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNo TRAVEL	RATIN RMANCE (5,66)* E LEVEL dB (2,94)*	JG JEL PEF	G G G S FORMAN	CO ₂ EQUIN 808 LOCAL AII 39,1 NCE	kg/seat R POLLU g/seat	: (7,49)* JTION (10,8)*

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

HAW HAMEU		C	OL		BE	L		
	G-MÜNCHEN							
Distance:			-					
Aircraft: Airline:	Airbus A320 Lufthansa		Seats:	154	Engi	ne:	CFM56-5	B4/P
	N-BANGKOK 8809 km							
Aircraft:		900	Seats:	371	Engi	ne.	Trent XW	R-75
Airline:	Thai Airways		56415.	JEI	-11 <u>8</u> 11	iic.	THEIR AND	0-75
BANGKO	K-HONG KONG	9						
	1689 km	-						
Aircraft:		OOER	Seats:	348	Engi	ne:	GE90-115	в
Airline:	Thai Airways	ie.						
	- ENVI	RONI	MENT	AL				
.		RATI	NG	AL	4,81			
> •	ENVI	RATI	NG	AL	•	VALEN	IT EMISSIC	DNS
> 286,3		RATI	NG		•	VALEN kg/set		DNS (4,73)*
 286,3	FUEL PERFOR	RATI RMANC	NG		CO ₂ EQUI	kg/se	at	
→ 286,3 •••))) 2,79	FUEL PERFOR	RATI RMANC (4,31) E LEVEL	NG E *	4 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	CO ₂ EQUIV	kg/se	at LUTION	
•())	FUEL PERFOR kg/seat LOCAL NOISI EPNdB/EPNd	RATI RMANC (4,31) E LEVEL B (2,92)	NG E *	4 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	CO ₂ EQUIV 304 LOCAL AI 66,0	kg/sea	at LUTION	(4,73)*
• ())) 2,79	FUEL PERFOR kg/seat LOCAL NOISI EPNdB/EPNd	RATI RMANC (4,31) E LEVEL B (2,92)	NG E * * UEL PEF	4 A A A A A A A A A A A A A A A A A A A	CO ₂ EQUIV 304 LOCAL AI 66,0	kg/sea R POL	at LUTION t	(4,73)*
■●))) 2,79	FUEL PERFOF kg/seat LOCAL NOISI EPNdB/EPNd TRAVEL	RATI RMANC (4,31) E LEVEL B (2,92) CLASS F	NG E * * •UEL PEF	4 A A A A A A A A A A A A A A A A A A A	CO2 EQUIN 304 LOCAL AI 66,0 NCE	kg/sea R POL	at LUTION t	(4,73)* (7,33)*

and Thai Airways

HAW HAMEU			UL	. A	BF		j Ka	
	G-FRANKFUR	т						
Distance: Aircraft: Airline:	Airbus A319		Seats:	1 2 6	En	gine:	CFM56-5	66/P
	JRT-BANGKOK	C						
Distance: Aircraft: Airline:	9009 km Boeing 777-3 Thai Airways		Seats:	348	En	gine:	GE90-11	5B
BANGKO	K-HONG KON	G						
Distance: Aircraft: Airline:	1689 km Boeing 777-3 Thai Airways		Seats:	348	En	gine:	GE90-11	5B
				۸١				
>		RATI		AL	5,64			
> •	FUEL PERFO	RATI	NG	AL		JIVALEN	NT EMISSI	ONS
> 348,9		RATI	NG E			JIVALEN kg/se		ONS (5,29)*
> 348,9	FUEL PERFO	RATI RMANC (5,25)	NG E		CO ₂ EQU	kg/se		
→ 348,9 •())) 2,83	FUEL PERFO	RATI RMANC (5,25) E LEVEL	NG E)*		CO ₂ EQU	kg/se	LUTION	
	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNc	RATI RMANC (5,25) E LEVEL	NG E)*		CO ₂ EQU 809 LOCAL /	kg/se	LUTION	(5,29)*
• ())) 2,83	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNc	RATI RMANC (5,25) E LEVEL	NG E)* FUEL PEF		CO ₂ EQU 809 LOCAL /	kg/se AIR POL g/sea	eat ILUTION at	(5,29)*
())) 2,83	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNC TRAVEL 283,1	RATI RMANC (5,25) E LEVEL IB (2,97) . CLASS	NG E)* FUEL PEF		CO ₂ EQU 809 LOCAL / 68,2 NCE	kg/se AIR POL g/sea	eat LUTION at	(5,29)* (9,38)*

Lufthansa and Thai Airways

HAW HAMEUR		OL	AB	EL		
HAMBUR Distance: Aircraft: Airline:	G-PARIS CHARLES I 729 km Airbus A319 Eurowings		.38	Engine:	CFM56-5B€	5/P
Distance:	ARLES DE GAULLE-I 9607 km Airbus A350-1000 Cathay Pacific		334	Engine:	Trent XWB	-97
		IFNTAL R	ATING			
>				4,(09	
٥Ú	FUEL PERFORMAN			CO₂ EQUI	09 valent em	
288,4					and and and	ISSIONS (5,91)*
288,4	FUEL PERFORMAN	ICE (4,34)*		CO ₂ EQUI	VALENT EM	(5,91)*
288,4	FUEL PERFORMAN kg/seat	ICE (4,34)*		CO ₂ EQUI	VALENT EM kg/seat	(5,91)*
● 1) 288,4 ■【)))	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	ICE (4,34)* EL		CO ₂ EQUI 5368 LOCAL AI	VALENT EM kg/seat R POLLUTIC	(5,91)* DN
288,4 ■())) 1,86	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	ICE (4,34)* EL (1,95)*		CO ₂ EQUI 5368 LOCAL AI	VALENT EM kg/seat R POLLUTIC g/seat	(5,91)* DN
288,4 •(1))) 1,86	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB TRAVEL CLAS	CE (4,34)* 5L (1,95)* 5S FUEL PERFO		CO ₂ EQUI 5368 LOCAL AI 117,3	VALENT EM kg/seat R POLLUTIC g/seat	(5,91)* DN (2,35)*

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

BAW HAMBUR		OL	ABE		
	G-LONDON HEATH 748 km Airbus A320 British Airways		71 En	gine: V2527E-A	5
States second products	HEATHROW-HONG 9648 km Airbus A350-1000 Cathay Pacific		34 En	gine: Trent XW	B-97
>	, ENVIRONM	ENTAL R	ATING	4,67	
۵ () ۱	FUEL PERFORMAN	CE		2 EQUIVALENT EI	VISSIONS
287,4	kg/seat	(4,33)*	535	8 kg/seat	(5,9)*
•())	LOCAL NOISE LEVE	L		CAL AIR POLLUT	ION
1,85	EPNdB/EPNdB	(1,94)*	263	,8 g/seat	(5,29)*
j0	TRAVEL CLAS	S FUEL PERFO	DRMANCE		
Economy	233,1	kg/seat	Premium Ec	onomy N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to th	ne emissions of <u>one</u> reference flig	ght of 2400 km, perform	med by a Boeing 737-80	0	

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

			C		BE	L		
HAMBUR Distance:	G-LONDON I	HEATHRO	w					
Aircraft:	Airbus A320 British Airw		Seats:	171	Engi	ne:	V2527E-A5	
	HEATHROW 5247 km	-DOHA						
	Airbus A380 Qatar Airwa		Seats:	517	Engi	ne:	GP7270	
	ONG KONG 6301 km							
	Airbus A350 Qatar Airwa		Seats:	283	Engi	ne:	Trent XWB	-75
		201101 25.47	10.10-10.00. Boo10	2021 500				
5	ENV	IRONN RATII		AL	6,00			
_> ₽	ENV	RATI	NG		•	/ALEN	T EMISSION	15
ی ۱۹۹۵ ۱۹۹۵ ۱۹۹۵ ۱۹۹۵ ۱۹۹۵ ۱۹۹۵ ۱۹۹۵ ۱۹۹		RATI	NG		•	/ALEN kg/sea		\S (7,73)*
→ 367,8	FUEL PERFO	RATIN DRMANCE (5,54)*	NG			kg/sea	at	
→ 367,8 • ())) 2,75	FUEL PERFO	RATIN PRMANCE (5,54)* SE LEVEL	NG *		20 ₂ EQUIV	kg/sea	at .UTION	
	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPN	RATII 0RMANCE (5,54)* SE LEVEL dB (2,88)*	NG *		20 ₂ EQUI 224 LOCAL AI 24,6	kg/sea R POLI	at .UTION	(7,73)*
	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPN	RATII 0RMANCE (5,54)* SE LEVEL dB (2,88)*	NG * * UEL PEI	TO TO SCORE	20 ₂ EQUI 224 LOCAL AI 24,6	kg/sea R POLI g/seat	ution	(7,73)*
• ())) 2,75	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPN TRAVE	RATIN PRMANCE (5,54)* SE LEVEL dB (2,88)* L CLASS F	NG * * UEL PEI	TO TO SCORE	CO ₂ EQUIN 024 LOCAL AI 04,6	kg/sea R POLI g/seat	at LUTION	(7,73)* (6,1)*

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

			OL	A	BE	EL	-	
Distance: Aircraft:	G-DUBAI 4888 km Airbus A380 Emirates	D-800	Seats:	489	En	gine:	GP727	70
	UALA LUMPU 5550 km Boeing 777 Emirates		Seats:	354	En	gine:	GE90-	115B
Distance:	UMPUR-HON 2535 km Airbus A330 Malaysia Ai	D-300	Seats:	290	En	gine:	PW41	68A
5	ENV	IRONI RATII		AL	6,84			
> B	FUEL PERFC	RATI	NG	-	-		NT EMIS	SIONS
> 419,8		RATI	NG		-			SSIONS (8,06)*
→ 419,8	FUEL PERFO	RATII DRMANCI (6,32)	NG		CO ₂ EQI 330	JIVALE kg/s		(8,06)*
→ 419,8 • ())) 2,82	FUEL PERFC	RATII ORMANCI (6,32) SE LEVEL	NG E *		CO ₂ EQI 330	JIVALE kg/s	eat LLUTION	(8,06)*
•())	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPN	RATII ORMANCI (6,32) SE LEVEL dB (2,96)	NG E *		CO ₂ EQ 330 LOCAL 38,1	JIVALE kg/s AIR PO	eat LLUTION	(8,06)* I
•())	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPN	RATII ORMANCI (6,32) SE LEVEL dB (2,96)	NG E * * EUEL PEF	7 7 2 4	CO2 EQI 330 LOCAL 38,1 NCE	JIVALE kg/s AIR PO g/se	eat LLUTION at	(8,06)* I
• ())) 2,82	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPN TRAVE 364,6	RATII ORMANCI (6,32) SE LEVEL dB (2,96) L CLASS F	NG E * * EUEL PEF	T T T T T T T T T T T T T T T T T T T	CO2 EQI 330 LOCAL 38,1 NCE	JIVALE kg/s AIR PO g/se	eat LLUTION at A	(8,06)* N (8,78)*

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

		OL	AB	EL		
	G-ISTANBUL SABIH 2023 km Airbus A320neo Pegasus Airlines		86 I	Engine:	LEAP-1A26	5
	L SABIHA GÖKCEN 1577 km Boeing 737-800 Pegasus Airlines		89 1	Engine:	CFM56-7B	26
、	, ENVIRONN	IENTAL R	ATING	1,!	50	
			×			2
• Ì	FUEL PERFORMAN	NCE			VALENT EN	IISSIONS
77,3	F UEL PERFORMAN kg/seat	NCE (1,16)*		02 EQUI	VALENT EN kg/seat	1 ISSIONS (1,25)*
77,3		(1,16)*		.33		(1,25)*
77,3	kg/seat	(1,16)*		.33	kg/seat	(1,25)*
∎ 77,3 ∎()))	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(1,16)* EL		L33 LOCAL AI	kg/seat R POLLUTI	(1,25)* ON
0 77,3 ■●))) 1,85	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(1,16)* EL (1,94)*		133 LOCAL AI 5,7	kg/seat R POLLUTIO g/seat	(1,25)* ON
77,3 •())) 1,85	kg/seat LOCAL NOISE LEV EPNdB/EPNdB TRAVEL CLA	(1,16)* EL (1,94)* SS FUEL PERFC	11 95 ORMANCE	133 LOCAL AI 5,7	kg/seat R POLLUTIO g/seat	(1,25)* ON (1,92)*

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

		OL	ABE		
HAMBUR Distance: Aircraft: Airline:	G-DÜSSELDORF 340 km Airbus A319 Eurowings	Seats: 1	38 Enj	gine: CFM56-5B	6/P
	ORF-HURGHADA 3511 km Airbus A320 Eurowings	Seats: 1	74 En;	gine: CFM56-5B	4/P
>	, ENVIRONN			1,78	
92,1	kg/seat	(1,39)*		2 EQUIVALENT EN	/IISSIONS (1,5)*
4.0	LOCAL NOISE LEV			CAL AIR POLLUTI	
1,88	EPNdB/EPNdB	(1,98)*	126,	2 g/seat	(2,53)*
j0	TRAVEL CLA	SS FUEL PERFO	DRMANCE		
Economy	88,4	kg/seat	Premium Ec	onomy N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat

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

HAW HAMBU		OL	ABEL		
	RG-HURGHADA : 3529 km Boeing 757-300 262 RB211-535E4B-37 Condor				
5	, ENVIRONN	IENTAL R	ATING 1,5	5	
a 1)	FUEL PERFORMAN	CE		ALENT EM	ISSIONS
87,6	kg/seat	(1,32)*	1457	kg/seat	(1,6)*
•••))	LOCAL NOISE LEVE	L			N
0,93	EPNdB/EPNdB	(0,98)*	112,9	g/seat	(2,26)*
j	TRAVEL CLAS	S FUEL PERFO	RMANCE		
Economy	87,6	kg/seat	Premium Economy	87,644	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to th	he emissions of <u>one</u> reference flig	ght of 2400 km, perform	ed by a Boeing 737-800		

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

NAW HAMBUR		OL	AB	EL		
Distance: Aircraft:	G-ISTANBUL ATAT 1990 km Airbus A321 Turkish Airlines		78	Engine:	V2533-A5	
	L ATATÜRK-HURGH 1598 km Boeing 737 MAX Turkish Airlines		51	Engine:	LEAP-1B27	
>	, ENVIRONN	IENTAL R	ATING	1,9	97	
	FUEL PERFORMAN	NCE	6	CO₂ EQUI	VALENT EM	ISSIONS
80,3	FUEL PERFORMAN	NCE (1,21)*		CO ₂ EQUI 1398	VALENT EM kg/seat	ISSIONS (1,54)*
80,3		(1,21)*		1398		(1,54)*
80,3	kg/seat	(1,21)*		1398	kg/seat	(1,54)*
▲1) 80,3 ■ ()))	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(1,21)* EL		1398 LOCAL A	kg/seat IR POLLUTIC	(1,54)* DN
▲ 80,3 ■ ■))) 1,87	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(1,21)* EL (1,96)*		1398 LOCAL A	kg/seat IR POLLUTIC g/seat	(1,54)* DN
80,3 •())) 1,87	kg/seat LOCAL NOISE LEV EPNdB/EPNdB TRAVEL CLA	(1,21)* EL (1,96)* SS FUEL PERFC		1398 LOCAL A 179,5	kg/seat IR POLLUTIC g/seat	(1,54)* ON (3,6)*

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

		OL	AB	EL		
HAMBUR Distance:	G-ZÜRICH					
Aircraft: Airline:	Airbus A320 Eurowings	Seats: 1	.74	Engine:	CFM56-5B	4/P
	IURGHADA 3147 km Airbus A320 Edelweiss Air	Seats: 1	74	Engine:	CFM56-5B	4/P
>	, ENVIRONN		ATING		78 VALENT EN	
<u>•</u>])			M	C		
90,4	kg/seat	(1,36)*		1335	kg/seat	(1,47)*
•••))	LOCAL NOISE LEV	EL		LOCAL A		ON
1,89	EPNdB/EPNdB	(1,98)*		129,7	g/seat	(2,6)*
,0	TRAVEL CLA	SS FUEL PERFO	ORMANCE	E		
			- ·		NI ŽA	
Economy	89,4	kg/seat	Premiu	m Economy	/ N/A	kg/seat
Economy Business	89,4 104,1	kg/seat kg/seat	Premiu First	m Economy	N/A	kg/seat kg/seat

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

HAW HAMBUR		COL	ABE		
HAMBUR Distance: Aircraft: Airline:	G-ZÜRICH 693 km Airbus A321 Swiss	Seats: 2	19 Eng	ine: CFM56-5B	1/3
	lURGHADA 3147 km Airbus A320 Edelweiss Air	Seats: 1	74 Eng	ine: CFM56-5B	34/P
5	, ENVIRONN	IENTAL R	ATING	1.00	
	FUEL PERFORMAN	NCE	co ₂	1,69 EQUIVALENT EN	AISSIONS
86,0	FUEL PERFORMAN	NCE (1,3)*	1273	EQUIVALENT EN	/IISSIONS (1,4)*
86,0		(1,3)*	1273	EQUIVALENT EN	(1,4)*
86,0	kg/seat	(1,3)*	1273	EQUIVALENT EN kg/seat	(1,4)*
▲Ŭ 86,0 ■ ()))	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(1,3)* EL	1273 1273 LOC 117,	EQUIVALENT EN kg/seat	(1,4)* ON
▲Ŭ 86,0 ■ ()))	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(1,3)* EL (2,01)*	1273 1273 LOC 117,	EQUIVALENT EN kg/seat CAL AIR POLLUTI 3 g/seat	(1,4)* ON
■ 86,0 • 1,91	kg/seat LOCAL NOISE LEV EPNdB/EPNdB TRAVEL CLA	(1,3)* EL (2,01)* SS FUEL PERFO	1273 1273 LOG 117,7	EQUIVALENT EN kg/seat CAL AIR POLLUTI 3 g/seat	(1,4)* ON (2,35)*

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

		OL	ABE						
HAMBUR Distance: Aircraft: Airline:	G-MÜNCHEN 600 km Airbus A320 Lufthansa	Seats: 1	. 54 Engine	:: CFM56-5B	4/P				
>	, ENVIRONN	IENTAL R		1,55					
	FUEL PERFORMAN	ICE							
م 76,0	FUEL PERFORMAN kg/seat	ICE (1,14)*	CO ₂ EC 1171	QUIVALENT EN kg/seat	1 ISSIONS (1,29)*				
0 76,0		(1,14)*	1171		(1,29)*				
0 76,0	kg/seat	(1,14)*	1171	kg/seat	(1,29)*				
6 1 76,0 ■ ()))	kg/seat LOCAL NOISE LEVI EPNdB/EPNdB	(1,14)* EL	1171 LOCAL 103,9	kg/seat	(1,29)* ON				
0 76,0 ■ 1,83	kg/seat LOCAL NOISE LEVI EPNdB/EPNdB	(1,14)* EL (1,92)*	1171 LOCAL 103,9	kg/seat L AIR POLLUTIC g/seat	(1,29)* ON				
0 76,0 ■●))) 1,83	kg/seat LOCAL NOISE LEVI EPNdB/EPNdB TRAVEL CLA	(1,14)* EL (1,92)* SS FUEL PERF(1171 LOCAL 103,9 ORMANCE	kg/seat L AIR POLLUTIC g/seat	(1,29)* DN (2,08)*				

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

	RG		C	_A	BE	L	
HAMBUR Distance:	G-FRANKFUR	т					
Aircraft:	Airbus A321 Lufthansa		Seats:	19 2	Engir	ne:	V2533-A5
Distance:	IRT-KAIRO 2922 km Airbus A321 Lufthansa	neo	Seats:	199	Engir	ne:	PW1133G-JM
KAIRO-HI Distance:	URGHADA 401 km						
Aircraft: Airline:	Boeing 737-8 EgyptAir	800	Seats:	154	Engir	ne:	CFM56-7B26
د	ENV	IRONIV RATIN		AL	2,38		
> •	ENV	RATIN		AL	-	/ALENT E	MISSIONS
8 4,3		RATIN			-	/ALENT E kg/seat	MISSIONS (1,63)*
► 84,3	FUEL PERFO	RATIN RMANCE (1,27)*				kg/seat	(1,63)*
► 84,3 •••••••• 2,83	FUEL PERFO kg/seat	RATIN RMANCE (1,27)* E LEVEL			200 ₂ EQUIN	kg/seat	(1,63)*
	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNo	RATIN RMANCE (1,27)* E LEVEL	IG		CO2 EQUIN 1478 LOCAL AII 218,8	kg/seat R POLLUT	(1,63)* TION
■ ())) 2,83	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNo	RATIN RMANCE (1,27)* E LEVEL IB (2,97)*	IG JEL PEF	Control of the second s	CO2 EQUIN 1478 LOCAL AII 218,8	kg/seat R POLLUT	(1,63)* TION
• ())) 2,83	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNo TRAVEL	RATIN RMANCE (1,27)* E LEVEL B (2,97)* CLASS FU	IG JEL PEF	Control of the second s	CO2 EQUIN 1478 LOCAL AII 218,8 NCE	kg/seat R POLLUT g/seat	(1,63)* TION (4,38)*

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

HAW HAMPUR		OL	AB	EL					
HAMBUR Distance: Aircraft: Airline:	G-FRANKFURT 412 km Airbus A320 Lufthansa	Seats:	154	Engine:	CFM56-5B	4/P			
Distance:									
>	, ENVIRONM		ATING	1,	80				
89,4	FUEL PERFORMAN	NCE (1,35)*	G	CO₂ EQU	IVALENT EN	1ISSIONS (1,45)*			
	LOCAL NOISE LEV	EL		LOCAL A		ON			
1,89	EPNdB/EPNdB	(1,98)*		138,1	g/seat	(2,77)*			
j	TRAVEL CLASS FUEL PERFORMANCE								
Economy	89,0	kg/seat	Premiu	m Econom	y N/A	kg/seat			
Business	94,2	kg/seat	First		N/A	kg/seat			
			rmed by a Boeing						

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

	EC	OL/	ABEL							
Distance Aircraft:	RG-FRANKFURT : 412 km Airbus A320neo Lufthansa	Seats: 166	Engine: PV	V1127G-JN	1					
Distance	FRANKFURT-NEW YORK JFKDistance:6206 kmAircraft:Boeing 767-300ERSeats:257Engine:PW4060Airline:Condor									
>	ENVIRONM	ENTAL RA	TING 2,5	51						
	FUEL PERFORMANC)E		VALENT EI	VISSIONS					
172,0	kg/seat	(2,59)*	2278	kg/seat	(2,51)*					
	LOCAL NOISE LEVEL	-			ON					
1,86	EPNdB/EPNdB	(1,95)*	148,8	g/seat	(2,98)*					
j.	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 t	he emissions of <u>one</u> reference flig	nt of 2400 km, performed	d by a Boeing 737-800							

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

	EC	OLA	BEL						
	RG-KEFLAVIK : 2173 km Boeing 737 MAX 9 Icelandair	Seats: 178	Engine: LE	AP-1B28					
Distance	KEFLAVIK-NEW YORK JFKDistance:4172 kmAircraft:Boeing 767-300ERSeats:259Engine:CF6-80C2B6								
5	ENVIRONM	ENTAL RA	TING 2,6	64					
	FUEL PERFORMANC	E		VALENT EN	VISSIONS				
155,3	kg/seat	(2,34)*	2404	kg/seat	(2,64)*				
	LOCAL NOISE LEVEL			R POLLUTI	ON				
1,87	EPNdB/EPNdB	(1,96)*	180,1	g/seat	(3,61)*				
j0	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 t	the emissions of <u>one</u> reference fligh	nt of 2400 km, performed	by a Boeing 737-800						

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

	EC	0L/	ABEL						
Distance Aircraft:	RG-PARIS CDG : 729 km Airbus A220-300 Air France	Seats: 135	Engine: P	W1521G-3					
Distance	PARIS CDG-NEW YORK JFKDistance:5849 kmAircraft:Boeing 777-200ERSeats:280Engine:GE90-90BAirline:Air France								
>	, ENVIRONM	ENTAL RA	TING 2,9	€2					
	FUEL PERFORMAN	CE		VALENT EI	VISSIONS				
173,6	kg/seat	(2,62)*	2417	kg/seat	(2,66)*				
	LOCAL NOISE LEVE	L			ON				
1,84	EPNdB/EPNdB	(1,93)*	236,8	g/seat	(4,75)*				
j.	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 t	he emissions of <u>one</u> reference fli	ght of 2400 km, performe	ed by a Boeing 737-800						

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

HAW HANDUR	EC	OLA	BEL						
	G-AMSTERDAM SCH 380 km Embraer E175 KLM	HPHOL Seats: 88	Engine: CF	34-8E5					
	AMSTERDAM SCHIPHOL-NEW YORK JFKDistance:5863 kmAircraft:Boeing 787-9Seats:294Engine:GeNx-1B67/P2G01								
5	, ENVIRONM	ENTAL RA	TING 2,5	59					
	FUEL PERFORMAN	CE		VALENT EN	AISSIONS				
165,9	kg/seat	(2,5)*	2728	kg/seat	(3)*				
•••))		L		R POLLUTI	ON				
1,86	EPNdB/EPNdB	(1,95)*	125,0	g/seat	(2,5)*				
j0	TRAVEL CLASS FUEL PERFORMANCE								
Economy	154,4	kg/seat	Premium Economy	173,91	kg/seat				
Business	235,0	kg/seat	First	N/A	kg/seat				
* Compared to th	e emissions of <u>one</u> reference flig	ht of 2400 km, performed	by a Boeing 737-800						

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

	E EC	:0L/	ABEL							
	RG-DUBLIN : 1076 km Airbus A320 Aer Lingus	Seats: 174	Engine: C	FM56-5B4/I	5					
Distance	DUBLIN-NEW YORK NEWARK Distance: 5138 km Aircraft: Airbus A321neo Seats: 184 Engine: LEAP-1A33									
5	ENVIRONN	IENTAL R		56						
	FUEL PERFORMAN	ICE	CO2 EQU	IVALENT EI	MISSIONS					
144,1	kg/seat	(2,17)*	2588	kg/seat	(2,85)*					
	LOCAL NOISE LEVE	EL			ON					
1,86	EPNdB/EPNdB	(1,95)*	149,6	g/seat	(3)*					
j,	TRAVEL CLASS FUEL PERFORMANCE									
Economy	138,0	kg/seat	Premium Econom	y N/A	kg/seat					
Business	N/A	kg/seat	First	N/A	kg/seat					
* Compared to t	he emissions of <u>one</u> reference fl	ight of 2400 km, perform	ned by a Boeing 737-800							

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

HAW HAMPU	EC	:0L/	ABEL						
Distance Aircraft:	RG-KEFLAVIK : 2173 km Boeing 737 MAX Icelandair	9 Seats: 178	Engine: LI	EAP-1B28					
Distance	K-NEW YORK NEWA : 4186 km Boeing 737 MAX Icelandair		Engine: LI	EAP-1B25					
5	ENVIRONM	IENTAL RA	ATING 2,0	64					
•	FUEL PERFORMAN	ICE		IVALENT EI	VISSIONS				
138,0	kg/seat	(2,08)*	2815	kg/seat	(3,1)*				
•(())	LOCAL NOISE LEV	EL			ION				
1,83	EPNdB/EPNdB	(1,92)*	149,3	g/seat	(2,99)*				
j.	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 t	he emissions of <u>one</u> reference f	light of 2400 km, perform	ed by a Boeing 737-800						

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

		CO		A	BE			
Distance: Aircraft:	G-AMSTERDA 380 km Embraer E19 KLM		Seats: :	100	Engine: (CF34-10E5		
AMSTERDAM-DETROITDistance:6341 kmAircraft:Airbus A350-900Seats: 306Engine: Trent XWB-75Airline:Delta								
	5							
ت	ENVI	RONN RATIN		AL	3,56			
	FUEL PERFOR	RMANCE		6		VALENT E	MISSIONS	
212,1	kg/seat	(3,19)*			3260	kg/seat	(3,59)*	
	LOCAL NOIS	E LEVEL			LOCAL AI	R POLLUT	ION	
2,78	EPNdB/EPNd	B (2,91)*			226,2	g/seat	(4,53)*	
TRAVEL CLASS FUEL PERFORMANCE								
H								
Economy	176,0	kg/seat	t	Premiu	m Economy	210,9	kg/seat	
Economy Business		kg/seat		Premiu First	m Economy	210,9 N/A	kg/seat kg/seat	

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

		OLA	ABEL							
and a second sec	RG-AMSTERDAM : 380 km Embraer E190 KLM	Seats: 100	Engine: CF	34-10E5						
Distance	AMSTERDAM-NEW YORK JFKDistance:5884 kmAircraft:Boeing 787-10Seats:344Engine:GEnx-1B76A/P2G01Airline:KLM									
د	ENVIRONN	IENTAL RA		58						
۵ T	FUEL PERFORMAN	NCE		IIVALENT EN	AISSIONS					
153,8	kg/seat	(2,32)*	2498	kg/seat	(2,75)*					
	LOCAL NOISE LEV	EL		AIR POLLUTI	ON					
1,86	EPNdB/EPNdB	(1,95)*	157,0	g/seat	(3,15)*					
j0	TRAVEL CLASS FUEL PERFORMANCE									
Economy	135,6	kg/seat	Premium Econom	y 152,04	kg/seat					
Business	284,4	kg/seat	First	N/A	kg/seat					
* Compared to t	the emissions of <u>one</u> reference t	flight of 2400 km, performe	d by a Boeing 737-800							

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

HAW HAMPU	Ε	OL	ABEL		
Distance Aircraft:	RG-FRANKFURT : 413 km Airbus A320 Lufthansa	Seats: 15 4	Engine: C	FM56-5B4/I	Þ
Distance Aircraft:	JRT-NEW YORK NE : 6228 km Boeing 747-8 Lufthansa	WARK Seats: 36 4	L Engine: G	eNx-2B67	
5	ENVIRON	/IENTAL R	ATING 2,	51	
	FUEL PERFORMA	NCE	CO2 EQU	IVALENT EI	VISSIONS
253,3	kg/seat	(3,81)*	1308	kg/seat	(1,44)*
	LOCAL NOISE LEV	ΈL		IR POLLUT	ION
1,86	EPNdB/EPNdB	(1,95)*	193,9	g/seat	(3,89)*
i	TRAVEL CLAS	S FUEL PERFO	RMANCE		
Economy	181,3	kg/seat	Premium Economy	/ N/A	kg/seat
Business	420,9	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference	flight of 2400 km, perfor	med by a Boeing 737-800		

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

	E EC	OL/	\BEL		
122	RG-LISBON : 2200 km Airbus A320 TAP Portugal	Seats: 156	Engine: CF	M56-5B4/I	Þ
Distance	NEW YORK JFK : 5418 km Airbus A330-900 TAP Portugal	Seats: 298	Engine: Tr	ent 7000-7	2
>	ENVIRONN	IENTAL RA	TING 3,4	13	
	FUEL PERFORMAN	ICE		VALENT EI	VISSIONS
202,5	kg/seat	(3,05)*	3531	kg/seat	(3,88)*
	LOCAL NOISE LEVE	ΞL		R POLLUT	ION
1,86	EPNdB/EPNdB	(1,95)*	218,2	g/seat	(4,37)*
i,	TRAVEL CLASS	5 FUEL PERFOR	MANCE		
Economy	183,6	kg/seat	Premium Economy	N/A	kg/seat
Business	291,7	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference fl	ight of 2400 km, performe	d by a Boeing 737-800		

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

		:0L/	ABEL		
Distance Aircraft:	RG-MÜNCHEN : 600 km Airbus A320 Lufthansa	Seats: 154	Engine: C	FM56-5B4/I	2
Distance Aircraft:	EN-NEW YORK NEW : 6498 km Airbus A350-900 Lufthansa		Engine: Ti	rent XWB-8	4
3	ENVIRONN	IENTAL RA	ATING 3,:	10	
	FUEL PERFORMAN	ICE		IVALENT EI	VISSIONS
191,3	kg/seat	(2,88)*	2931	kg/seat	(3,22)*
	LOCAL NOISE LEVI	EL			ON
1,84	EPNdB/EPNdB	(1,93)*	211,4	g/seat	(4,24)*
j,	TRAVEL CLAS	S FUEL PERFOR	MANCE		
Economy	155,8	kg/seat	Premium Economy	/ N/A	kg/seat
Business	354,4	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference f	light of 2400 km, perform	ed by a Boeing 737-800		

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

	EC	OLA	ABEL		
Distance: Aircraft:	RG-FRANKFURT 412 km Airbus A320 Lufthansa	Seats: 154	Engine: CF	M56-5B4/I	2
Distance:	JRT-LAS PALMAS D 3185 km Airbus A320 Eurowings Discov	Seats: 174		M56-5B4/I	5
5	, ENVIRONN	IENTAL RA	TING 1,7	77	
۵ ()	FUEL PERFORMAN	NCE		VALENT EI	VISSIONS
86,2	kg/seat	(1,3)*	1273	kg/seat	(1,4)*
•())	LOCAL NOISE LEV	EL			ON
1,89	EPNdB/EPNdB	(1,98)*	138,1	g/seat	(2,77)*
j,	TRAVEL CLAS	S FUEL PERFOR	MANCE		
Economy	85,9	kg/seat	Premium Economy	N/A	kg/seat
Business	90,8	kg/seat	First	N/A	kg/seat
	·····	light of 2400 km, performe	d hu a Booing 727 800		

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

	EC	:0L/	ABEL		
101000000000000000000000000000000000000	RG-MADRID : 1782 km Airbus A320 Iberia	Seats: 162	Engine: CF	M56-5B6/3	3
Distance	-LAS PALMAS DE G : 1763 km Airbus A321neo Iberia	RAN CANARIA Seats: 208	Engine: LE	AP-1A32	
5	ENVIRONM	IENTAL RA	ATING 1,6	53	
	FUEL PERFORMAN	ICE		VALENT EI	VISSIONS
81,7	kg/seat	(1,23)*	1349	kg/seat	(1,48)*
	LOCAL NOISE LEV	EL	LOCAL AI	R POLLUT	ION
1,85	EPNdB/EPNdB	(1,94)*	99,4	g/seat	(1,99)*
j0	TRAVEL CLAS	S FUEL PERFOF	RMANCE		
Economy	80,9	kg/seat	Premium Economy	N/A	kg/seat
Business	88,2	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference f	light of 2400 km, perform	ned by a Boeing 737-800		

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

		OL	ABEL		
Distance	RG-BARCELONA : 1493 km Airbus A320 Vueling	Seats: 180	Engine: CF I	M56-5B4/	P
Distance Aircraft:	DNA-LAS PALMAS D : 2175 km Airbus A320 Vueling	E GRAN CANAR Seats: 180		M56-5B4/	p
5	ENVIRONN	IENTAL R	ATING 1,6	9	
	FUEL PERFORMAN	NCE		ALENT E	MISSIONS
83,6	kg/seat	(1,26)*	1234	kg/seat	(1,36)*
•())	LOCAL NOISE LEV	EL		R POLLUT	ION
1,89	EPNdB/EPNdB	(1,98)*	125,4	g/seat	(2,51)*
j0	TRAVEL CLAS	S FUEL PERFO	RMANCE		
Economy	83,6	kg/seat	Premium Economy	N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to t	the emissions of <u>one</u> reference t	flight of 2400 km, perforr	ned by a Boeing 737-800		

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

		:0L/	ABEL		
121022230000000000000000000000000000000	RG-FUERTEVENTUR/ : 3406 km Boeing 757-300 Condor	A Seats: 262	Engine: R l	B 2 11-535E4	B-37
Distance Aircraft:	/ENTURA-LAS PALM : 160 km ATR 72 Binter Canarias	AS DE GRAN CA	ANARIA Engine: P	W127M	
>	ENVIRONN	IENTAL R/	ATING 1,3	75	
	FUEL PERFORMAN	ICE		IVALENT EI	VISSIONS
90,9	kg/seat	(1,37)*	1431	kg/seat	(1,57)*
	LOCAL NOISE LEVE	EL		IR POLLUT	ION
1,83	EPNdB/EPNdB	(1,92)*	116,3	g/seat	(2,33)*
j0	TRAVEL CLAS	S FUEL PERFOF	RMANCE		
Economy	90,9	kg/seat	Premium Economy	/ N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to t	the emissions of <u>one</u> reference fl	ight of 2400 km, perform	ed by a Boeing 737-800		

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

ECOLABEL HAW HAMBURG 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 **Edelweiss Air** Airline: **ENVIRONMENTAL RATING** 1,66 **FUEL PERFORMANCE CO2 EQUIVALENT EMISSIONS** 82,7 1224 (1,35)* kg/seat (1,25)*kg/seat LOCAL NOISE LEVEL LOCAL AIR POLLUTION 1,91 EPNdB/EPNdB (2,01)* 117,3 g/seat (2,35)* 20 TRAVEL CLASS FUEL PERFORMANCE Economy 82,1 kg/seat **Premium Economy** N/A kg/seat **Business** 87,9 kg/seat N/A kg/seat First * 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

ECOLABEL HAW HAMBURG HAMBURG-AMSTERDAM Distance: 380 km Aircraft: Embraer E195-E2 Seats: 132 Engine: PW1921G Airline: KLM AMSTERDAM-MADRID Distance: 1461 km Aircraft: Boeing 787-9 Seats: 335 Engine: Trent 1000-K3 Airline: Air Europa MADRID-LAS PALMAS DE GRAN CANARIA Distance: 1763 km Aircraft: **Boeing 787-9** Seats: 335 Engine: Trent 1000-K3 Airline: Air Europa **ENVIRONMENTAL** 4,50 RATING FUEL PERFORMANCE **CO₂ EQUIVALENT EMISSIONS** 83,1 kg/seat 1386 kg/seat (1,53)* $(1,25)^*$ LOCAL NOISE LEVEL LOCAL AIR POLLUTION 2.72 EPNdB/EPNdB (2,85)* 330,2 g/seat (6,62)* D TRAVEL CLASS FUEL PERFORMANCE Economy 76,8 kg/seat Premium Economy N/A kg/seat **Business** 141,3 N/A kg/seat First kg/seat

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

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

		OLA	ABEL		
Distance Aircraft:	RG-LISBON : 2200 km Embraer E190 TAP Air Portugal	Seats: 106	Engine: CF	34-10E7	
Distance Aircraft:	LAS PALMAS DE GR. : 1336 km Airbus A320 TAP Air Portugal	AN CANARIA Seats: 156	Engine: CF	M56-5B4/I	5
5	ENVIRONN	1ENTAL RA	TING 2,0)7	
۵ () ا	FUEL PERFORMAN	ICE		VALENT EI	MISSIONS
117,9	kg/seat	(1,78)*	1757	kg/seat	(1,93)*
	LOCAL NOISE LEVI	EL		R POLLUT	ON
1,90	EPNdB/EPNdB	(1,99)*	135,1	g/seat	(2,71)*
j.	TRAVEL CLAS	S FUEL PERFORI	MANCE		
Economy	114,9	kg/seat	Premium Economy	N/A	kg/seat
Business	130,3	kg/seat	First	N/A	kg/seat
* Compared to t	the emissions of <u>one</u> reference f	light of 2400 km, performe	d by a Boeing 737-800		

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

	Carton Carton	OL	ABEL		
	RG-ZÜRICH : 693 km Airbus A319 Eurowings	Seats: 138	Engine: CF	M56-5B6/	Þ
Distance Aircraft:	LAS PALMAS DE GR : 3002 km Airbus A320 Edelweiss Air	XAN CANARIA Seats: 174	Engine: CF	M56-5B4/	Þ
5	ENVIRONN	/IENTAL R	ATING 1,7	′5	
	FUEL PERFORMA	NCE		VALENT E	VISSIONS
89,8	kg/seat	(1,35)*	1326	kg/seat	(1,46)*
•())	LOCAL NOISE LEV	ΈL	LOCAL AI	R POLLUT	ION
1,88	EPNdB/EPNdB	(1,98)*	126,2	g/seat	(2,53)*
j0	TRAVEL CLAS	S FUEL PERFO	RMANCE		
Economy	88,7	kg/seat	Premium Economy	N/A	kg/seat
Business	N/A	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference	flight of 2400 km, perforn	ned by a Boeing 737-800		

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

	E EC	:0L/	ABEL		
Distance Aircraft:	RG-WIEN : 769 km Airbus A320 Austrian Airlines	Seats: 161	Engine: CF	M56-5B4/	р
Distance Aircraft:	S PALMAS DE GRAM : 3547 km Airbus A320 Austrian Airlines	N CANARIA Seats: 161	Engine: CF	M56-5B4/	P
5	ENVIRONN	IENTAL RA	ATING 2,0	0	
a 1	FUEL PERFORMAN	ICE		VALENT E	MISSIONS
109,5	kg/seat	(1,65)*	1617	kg/seat	(1,78)*
	LOCAL NOISE LEVE	EL	LOCAL AI	R POLLUT	ION
1,89	EPNdB/EPNdB	(1,98)*	140,1	g/seat	(2,81)*
j0	TRAVEL CLASS	S FUEL PERFOR	RMANCE		
Economy	107,6	kg/seat	Premium Economy	N/A	kg/seat
Business	118,7	kg/seat	First	N/A	kg/seat
* Compared to t	he emissions of <u>one</u> reference fl	ight of 2400 km, perform	ned by a Boeing 737-800		

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

ECOLABEL HAW HAMBURG HAMBURG-MADRID Distance: 1782 km Airbus A320 Aircraft: 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** 4,50 RATING **FUEL PERFORMANCE CO₂ EQUIVALENT EMISSIONS** 105,4 1584 kg/seat (1,59)*kg/seat (1,74)* LOCAL NOISE LEVEL LOCAL AIR POLLUTION 2,83 EPNdB/EPNdB (2,96)* g/seat 119,2 $(2,39)^*$ k0 TRAVEL CLASS FUEL PERFORMANCE Economy 104,8 kg/seat Premium Economy N/A kg/seat **Business** N/A N/A kg/seat First 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

	EC	OL	AB	BEL	- I	
Distance: Aircraft:	G-ISTANBUL ATATÜ 1990 km Airbus A321 Turkish Airlines		178	Engine:	V2533-A5	
	L ATATÜRK-MEXICO 11432 km Boeing 777-300EF Turkish Airlines		349	Engine:	GE90-1158	3
	, ENVIRONM	IENTAL R	ATING			
	FUEL PERFORMAN	ICE	E		22 IVALENT EN	AISSIONS
398,3	FUEL PERFORMAN kg/seat	I CE (6)*	6		22 IVALENT EN kg/seat	/IISSIONS (6,08)*
398,3		(6)*		CO₂ EQU	IVALENT EN	(6,08)*
398,3	kg/seat	(6)*		CO₂ EQU	IVALENT EN kg/seat	(6,08)*
▲Ŭ 398,3 ■ ●))	kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	(6)* EL	ORMANC	CO2 EQU 5530 LOCAL A 297,1	IVALENT EN kg/seat IR POLLUTI	(6,08)* ON
398,3 ■●))) 1,91	kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	(6)* EL (2)*		CO2 EQU 5530 LOCAL A 297,1	IVALENT EN kg/seat IR POLLUTI g/seat	(6,08)* ON (5,95)*
▲Ú 398,3 ■●))) 1,91	kg/seat LOCAL NOISE LEVE EPNdB/EPNdB TRAVEL CLAS	(6)* EL (2)* SS FUEL PERF		CO ₂ EQU 5530 LOCAL A 297,1 E	IVALENT EN kg/seat IR POLLUTI g/seat	(6,08)* ON

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

	27	0L	AB	EL		
HAMBUR Distance: Aircraft: Airline:	G-AMSTERDAM 380 km Embraer E190 KLM	Seats: 1	DO	Engine:	CF34-10E5	
	AM-MEXICO CITY 9220 km Boeing 787-9 KLM	Seats: 2	94	Engine:	GeNx-1B67	/P2G01
5	, ENVIRONM	ENTAL R	ATING	3,5	51	
	UEL PERFORMANC	ĈE			VALENT EM	ISSIONS
252,3	kg/seat	(3,8)*		4163	kg/seat	(4,58)*
■ ())) I	LOCAL NOISE LEVEI	L		LOCAL AI		DN
1,85	EPNdB/EPNdB	(1,94)*		131,2	g/seat	(2,63)*
j0	TRAVEL CLAS	S FUEL PERFC	DRMANCE			
Economy	234,7	kg/seat	Premiu	m Economy	263,97	kg/seat
Economy Business	234,7 359,7	kg/seat kg/seat	Premiu First	m Economy	263,97 N/A	kg/seat kg/seat

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

		OL	AE	BEL		
	RG-PARIS CHALES DI	E GAULLE			_	
Distance Aircraft:	: 729 km		178	Engine:	CFM56-5B	4/P
	HALES DE GAULLE-M : 9213 km Boeing 777-300EF Air France		381	Engine:	GE90-115	3
>	ENVIRONM	IENTAL F	RATING		93	
> B	ENVIRONM			3,	.93 IVALENT EN	AISSIONS
280,3				3,		ЛІSSIONS (4,26)*
 280,3 ■●)))	FUEL PERFORMAN	ICE (4,22)*		3, ↑ CO₂ EQU 3870	IVALENT EN	(4,26)*
	FUEL PERFORMAN	ICE (4,22)*		3, ↑ CO₂ EQU 3870	IVALENT EN kg/seat	(4,26)*
•••))	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	ICE (4,22)* EL		3, CO ₂ EQU 3870 LOCAL A 246,5	IVALENT EN kg/seat	(4,26)* ON
■ ())) 1,89	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	ICE (4,22)* EL (1,98)*		3, CO ₂ EQU 3870 LOCAL A 246,5	IVALENT EN kg/seat	(4,26)* ON

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

	RG		OL	_A	BE	L	
	G-PARIS CHA	LES DE G	AULLE				
Distance: Aircraft: Airline:	Airbus A319		Seats:	142	Engi	ne:	CFM56-5B5/3
PARIS CH	ALES DE GAU	LLE-ATLA	NTA				
	7072 km Boeing 777-2 Air France	200ER	Seats:	280	Engi	ne:	GE90-90B
	-MEXICO CIT	Y					
	2141 km Boeing 737-8 Delta Air Lin		Seats:	160	Engi	ne:	CFM56-7B26
			4				
د		IRONN RATII	NG	AL	4,25		
> •	ENV FUEL PERFO	RATII	NG	AL	-	VALENT E	MISSIONS
267,1		RATII	NG E		-	VALENT E kg/seat	MISSIONS {4,02}*
 267,1 • ↓)))	FUEL PERFO	RATII RMANCE (4,02)	NG E		CO ₂ EQUI		(4,02)*
	FUEL PERFO	RATII RMANCE (4,02) E LEVEL	NG E		CO ₂ EQUI	kg/seat	(4,02)*
•())	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNc	RATII RMANCE (4,02) [*] E LEVEL IB (2,95) [*]	NG = *		CO2 EQUI 8655 LOCAL AI 810,1	kg/seat	(4,02)*
•())	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNc	RATII RMANCE (4,02) [*] E LEVEL IB (2,95) [*]	NG = * * UEL PEI	SFORMA	CO2 EQUI 8655 LOCAL AI 810,1	kg/seat I R POLLUT g/seat	(4,02)*

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

HAW HAMEUR		OL	AB	EL		
HAMBUR Distance: Aircraft: Airline:	G-AMSTERDAM 380 km Boeing 737-800 KLM	Seats: 1	.76	Engine:	CFM56-7B2	27
	OAM-MEXICO CITY 9220 km Boeing 787-9 Aeromexico	Seats: 2	274	Engine:	GEnx-1B74	/75/P2G01
>	, ENVIRONN		ATING	3,8		
٥ 263,4	kg/seat	(3,97)*	GI	T ^{CO₂ EQUI 4344}	VALENT EM kg/seat	(4,78)*
•())	LOCAL NOISE LEV	EL		LOCAL AI		DN
1,87	EPNdB/EPNdB	(1,96)*		191,0	g/seat	(3,83)*
i,	TRAVEL CLA	SS FUEL PERF	ORMANCE	<u>.</u>		
Economy	224,9	kg/seat	Premiu	m Economy	257,09	kg/seat
Business	494,2	kg/seat	First		N/A	kg/seat
* Compared to the	e emissions of <u>one</u> reference f	light of 2400 km, perfor	med by a Boeing	737-800		

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

HAW HAMBUR		OL	AE	BEL		
Distance: Aircraft:	G-PARIS CHALES D 729 km Airbus A319 Air France		142	Engine:	CFM56-5B	5/3
	ALES DE GAULLE-N 9213 km Boeing 787-9 Aeromexico		274	Engine:	GEnx-1B74	¥/75/P2G01
、	, ENVIRONN	1ENTAL R	ATING		82	
_			Ĩ			
٥ U	FUEL PERFORMAN		C	CO₂ EQU	IVALENT EN	
272,7	FUEL PERFORMAN kg/seat LOCAL NOISE LEV	(4,11)*	6	CO₂ EQU 4493		(4,94)*
272,7	kg/seat	(4,11)*	S .	CO₂ EQU 4493	IVALENT EN kg/seat	(4,94)*
▲1 272,7 ■ ()))	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(4,11)* EL	ORMAN	CO₂ EQU 4493 LOCAL A 157,6	IVALENT EN kg/seat IR POLLUTIO	(4,94)* ON
272,7 ••••))) 1,84	kg/seat LOCAL NOISE LEV EPNdB/EPNdB	(4,11)* EL (1,93)*		CO₂ EQU 4493 LOCAL A 157,6	IVALENT EN kg/seat IR POLLUTIO	(4,94)* ON
272,7 • ())) 1,84	kg/seat LOCAL NOISE LEV EPNdB/EPNdB TRAVEL CLA	(4,11)* EL (1,93)* SS FUEL PERF(4493 LOCAL A 157,6	IVALENT EN kg/seat IR POLLUTIO g/seat	(4,94)* ON (3,16)*

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

HAW HAMBU		ECO	LA	BE	
	G-FRANKFURT				
Distance:		c .		- ·	
Aircraft: Airline:	Airbus A321 Lufthansa	Seats:	192	Engine:	V2533-A5
	JRT-NEW YORK J	EV			
	6206 km				
	Airbus A380-80	0 Seats:	475	Engine:	Trent 970-84
Airline:	Singapore Airli			0	
NEW YO	RK JFK-MEXICO C	TITY			
Distance:	3364 km				
Aircraft:	Boeing 787-9	Seats:	274	Engine:	GEnx-1B74/75/P2G03
Airline:	Aeromexico			00.62	16671 521
5	ENVIR	ONMENT	ΔΙ		
	R	ATING		,99	
د ا ا	R FUEL PERFORM		5	-	NT EMISSIONS
325,7	FUEL PERFORM		5		
● 325,7	FUEL PERFORM	IANCE (4,91)*	5		eat (7,59)*
 325,7 ▲)) 2,79 	FUEL PERFORM	IANCE (4,91)* EVEL	5	2 EQUIVALE 4 kg/se CAL AIR PO	eat (7,59)*
	FUEL PERFORM	IANCE (4,91)* EVEL	5 (())) (689) ()) ()) ()) ()) ()) ()) ()) ()) ()) (2 EQUIVALE 4 kg/se CAL AIR PO 4 g/se	eat (7,59)*
())) 2,79	FUEL PERFORM	IANCE (4,91)* EVEL (2,92)*	5 (())) (689) ()) ()) ()) ()) ()) ()) ()) ()) ()) (2 EQUIVALE 4 kg/so CAL AIR PO 4 g/se	eat (7,59)* LLUTION at (6,94)*
• ())) 2,79	FUEL PERFORM kg/seat (LOCAL NOISE L EPNdB/EPNdB (TRAVEL CL 251,5	IANCE (4,91)* EVEL (2,92)* ASS FUEL PEI	5 (())) (689) (689) (0) (689) (0) (689) (0) (689) (0) (689) (0) (689) (0) (689) (0) (689) (0) (689) (0) (689) (0) (0) (0) (0) (0) (0) (0) (0) (0) (0	2 EQUIVALE 4 kg/so CAL AIR PO 4 g/se	eat (7,59)* LLUTION (6,94)* A kg/seat
الله) 2,79 Economy Business	FUEL PERFORM kg/seat (LOCAL NOISE L EPNdB/EPNdB (TRAVEL CL 251,5	IANCE (4,91)* EVEL (2,92)* ASS FUEL PEI kg/seat	5 6894 6894 6894 CO 346, 346, RFORMANCE Premium Ec First	EQUIVALE 4 kg/si CAL AIR PO 4 g/se 5 onomy N/A N/A	eat (7,59)* LLUTION (6,94)* A kg/seat

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

HAW HAMBUR		OL	ABE		
HAMBUR Distance: Aircraft: Airline:	G-FRANKFURT 412 km Airbus A321 Lufthansa	Seats: 1	92 Engin	ie: V2533-A5	
	IRT-MEXICO CITY 9567 km Boeing 747-8 Lufthansa	Seats: 3	64 Engin	ie: GeNx-2B6	7
<u>></u>	, ENVIRONN		ATING	3,20	
	, ENVIRONIV			3,20 QUIVALENT EN	1ISSIONS
378,6					1ISSIONS (2,06)*
378,6	FUEL PERFORMAN	I CE (5,7)*	1868	QUIVALENT EN	(2,06)*
٥) 378,6	FUEL PERFORMAN kg/seat	I CE (5,7)*	1868	QUIVALENT EN kg/seat	(2,06)*
378,6 ■ ()))	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	ICE (5,7)* EL	1868 1868 LOCA 210,7	QUIVALENT EN kg/seat	(2,06)* ON
378,6 ■ ()))	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB	ICE (5,7)* EL (1,97)*	1868 1868 LOCA 210,7	QUIVALENT EN kg/seat AL AIR POLLUTIO g/seat	(2,06)* ON
378,6 ■●))) 1,88	FUEL PERFORMAN kg/seat LOCAL NOISE LEVE EPNdB/EPNdB TRAVEL CLAS	NCE (5,7)* EL (1,97)* SS FUEL PERFO	CO2 E 1868 LOCA 210,7	QUIVALENT EN kg/seat AL AIR POLLUTIO g/seat	(2,06)* ON (4,22)*

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

HAW HAMEU			JL	-A	DE		回新花
	G-FRANKFUR	T					
	412 km Airbus A321		Seats:	192	Engi	ne:	V2533-A5
Airline:							
RANKFU	JRT-WASHING	STON D.C.					
	6568 km	_					
Aircraft: Airline:	Boeing 747-8 Lufthansa	8	Seats:	364	Engiı	ie:	GeNx-2B67
WASHIN	GTON D.CM	EXICO CIT	Ŷ				
	3000 km		-				
Aircraft:	Airbus A320		Seats:	150	Engiı	ne:	V2527-A5
Airline:	United Airlin	ıes					
	ENV	IRONN	1ENT	AL			
.		RATIN		AL	3,87		
> •	ENV	RATIN		AL	•	/ALENT E	EMISSIONS
> 344,5		RATIN			•	/ALENT F kg/seat	EMISSIONS (2,78)*
> 344,5	FUEL PERFO	RATIN RMANCE (5,19)*				kg/seat	(2,78)*
100 NO NO	FUEL PERFO kg/seat	RATIN RMANCE (5,19)*		Sit 2 2	CO ₂ EQUIN	kg/seat	(2,78)*
•())	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNd	RATIN RMANCE (5,19)*	IG	2 2 2 2	CO ₂ EQUIN 526 LOCAL AI	kg/seat R POLLU	(2,78)* TION
■))) 2,81	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNd	RATIN RMANCE (5,19)* SE LEVEL dB (2,95)*	IG JEL PEI	2 2 RFORMA	CO ₂ EQUIN 526 LOCAL AI	kg/seat R POLLU	(2,78)* TION

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

HAW HAMEU							Elsave
Distance:	G-LONDON H 748 km Airbus A320 British Airwa		N Seats:	171	Engi	ne:	V2527E-A5
Distance:	HEATHROW- 7645 km Boeing 777-3 American Ai	300ER	Seats:	304	Engi	ne:	GE90-115B
Distance:	MEXICO CITY 1505 km Boeing 737-a American Ai		Seats:	1 72	Engi	ne:	CFM56-7B24
Annie.							
	ENV	IRONIV RATIN		AL	5,02		
	ENV FUEL PERFO	RATIN	IG			VALENT E	MISSIONS
331,5		RATIN	IG			VALENT E kg/seat	: MISSIONS (5,03)*
> •	FUEL PERFO	RATIN RMANCE (4,99)*	IG			kg/seat	(5,03)*
> 331,5	FUEL PERFO kg/seat	RATIN RMANCE (4,99)* E LEVEL	IG		573	kg/seat	(5,03)*
→ 331,5	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNc	RATIN RMANCE (4,99)* E LEVEL IB (2,97)*	IG		573 LOCAL AI	kg/seat R POLLUT	(5,03)* FION
→ 331,5	FUEL PERFO kg/seat LOCAL NOIS EPNdB/EPNc	RATIN RMANCE (4,99)* E LEVEL IB (2,97)*	JG JEL PEF	49 49 39 RFORMAN	573 LOCAL AI	kg/seat R POLLUT	(5,03)* FION

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

KAW HAMBUR		OL	A	BEL		
HAMBUR Distance: Aircraft: Airline:	G-LONDON HEATH 748 km Airbus A319 British Airways		143	Engine:	V2522-A5	
	HEATHROW-MEXI 8917 km Boeing 787-9 British Airways		216	Engine:	Trent 1000)-AE3
>	ENVIRONN		RATIN	4,	70	
330,6	kg/seat	(4,98)*	6	CO₂ EQU 5455	IVALENT EN	(6)*
	LOCAL NOISE LEV	EL	á			ON
1,84	EPNdB/EPNdB	(1,93)*		228,2	g/seat	(4,57)*
j.	TRAVEL CLA	SS FUEL PERF	ORMAN	ICE		
Economy	2247	kg/seat	Pren	nium Economy	/ N/A	kg/seat
Economy	234,7					
Business	234,7 N/A	kg/seat	First		N/A	kg/seat

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

	ECOLABEL							
Distance	Engine: CFM56-5B4/P							
2	ENVIRONI	MENTAL RA	ATING 0,6	60				
	FUEL PERFORMA	NCE		ALENT EM	ISSIONS			
14,9	kg/seat	(0,22)*	220	kg/seat	(0,24)*			
•••))	LOCAL NOISE LEV	/EL			N			
0,94	EPNdB/EPNdB	(0,99)*	64,8	g/seat	(1,3)*			
j	TRAVEL CLA	SS FUEL PERFOR	MANCE					
Economy	14,3	kg/seat	Premium Economy	N/A	kg/seat			
Business	22,9	kg/seat	First	N/A	kg/seat			
* Compared to t	he emissions of <u>one</u> reference	flight of 2400 km, perform	ed by a Boeing 737-800					

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

HAW HAMPU		COL	ABEL					
1: 111 1: 124, 124, 150, 100 - 101	Seats: 154 Engine: CFM56-5B4/P							
>	ENVIRON	MENTAL RA	ATING 0,6	5				
	FUEL PERFORMA	NCE		ALENT EM	ISSIONS			
16,9	kg/seat	(0,25)*	249	kg/seat	(0,27)*			
	LOCAL NOISE LEV	/EL)N			
0,94	EPNdB/EPNdB	(0,99)*	73,3	g/seat	(1,47)*			
j.	TRAVEL CLAS	SS FUEL PERFOR	MANCE					
Economy	16,9	kg/seat	Premium Economy	N/A	kg/seat			
Business	16,9	kg/seat	First	N/A	kg/seat			
* Compared to t	he emissions of <u>one</u> reference	flight of 2400 km, perform	ed by a Boeing 737-800					

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

		COL	ABEL					
Distance	Engine: V2533-A5							
3	ENVIRON	MENTAL R	ATING 0,6	8				
	FUEL PERFORMA	NCE		ALENT EM	ISSIONS			
12,6	kg/seat	(0,19)*	190	kg/seat	(0,21)*			
•())	LOCAL NOISE LEV	/EL			DN			
0,96	EPNdB/EPNdB	(1,01)*	90,1	g/seat	(1,8)*			
j	TRAVEL CLAS	SS FUEL PERFO	RMANCE					
Economy	11,8	kg/seat	Premium Economy	N/A	kg/seat			
Business	17,7	kg/seat	First	N/A	kg/seat			
* Compared to t	he emissions of <u>one</u> reference	flight of 2400 km, perforr	ned by a Boeing 737-800					

Figure D.82 Trip Emission Ecolabel Hamburg to Munich by Lufthansa

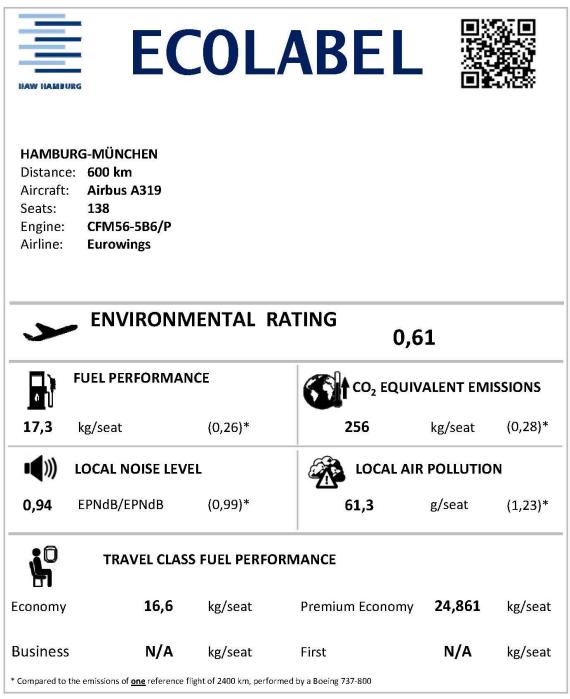


Figure D.83 Trip Emission Ecolabel Hamburg to Munich by Eurowings

		OL	ABEL			
Distance	RG-DÜSSELDORF : 340 km Airbus A319 Eurowings	Seats: 138	Engine: CFN	/156-5B6/P		
Distance Aircraft:	DORF - MÜNCHEN : 487 km Airbus A320 Lufthansa	Seats: 192	Engine: CFN	И56-5B4/Р		
Servironmental rating 1,17						
	FUEL PERFORMAN	ICE		ALENT EM	ISSIONS	
24,3	kg/seat	(0,37)*	359	kg/seat	(0,39)*	
•(*))	LOCAL NOISE LEV	EL			N	
1,88	EPNdB/EPNdB	(1,98)*	134,6	g/seat	(2,7)*	
TRAVEL CLASS FUEL PERFORMANCE						
Economy	23,9	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.84 Trip Emission Ecolabel Hamburg to Munich via Düsseldorf by Eurowings and Lufthansa

HAW HAMPU	EC	0L/	ABEL			
Aircraft:	RG-RIGA : 959 km Airbus A220-300 Air Baltic	Seats: 145	Engine: P\	W1524G-3		
Aircraft:	ÜNCHEN : 1257 km Airbus A220-300 Air Baltic	Seats: 145	Engine: P\	W1524G-3		
5	, ENVIRONM	ENTAL RA	TING 1,3	34		
	FUEL PERFORMAN	CE		VALENT EI	VISSIONS	
50,9	kg/seat	(0,77)*	858	kg/seat	(0,94)*	
•((())	LOCAL NOISE LEVE	L			ON	
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

		:0 L/	ABEL			
HAMBUI Distance Aircraft: Airline:	: 364 km	Seats: 174	Engine: C	FM56-5B4/I	5	
Aircraft:	ÜNCHEN : 437 km Airbus A320 Lufthansa	Seats: 154	Engine: C	FM56-5B4/I	5	
5	ENVIRONN	/IENTAL R	ATING 1,	16		
	FUEL PERFORMA	NCE	CO2 EQU	IVALENT EI	VISSIONS	
22,1	kg/seat	(0,33)*	327	kg/seat	(0,36)*	
	LOCAL NOISE LEV	EL			ON	
1,89	EPNdB/EPNdB	(1,98)*	138,1	g/seat	(2,77)*	
TRAVEL CLASS FUEL PERFORMANCE						
Economy	21,7	kg/seat	Premium Econom	y N/A	kg/seat	
Business	27,2	kg/seat	First	N/A	kg/seat	
* Compared to t	he emissions of <u>one</u> reference	flight of 2400 km, perforn	ned by a Boeing 737-800			

Figure D.86 Trip Emission Ecolabel Hamburg to Munich via Cologne by Eurowings and Lufthansa

	EC	OLA	\BEL				
2010	RG-DÜSSELDORF 340 km Airbus A319 Eurowings	Seats: 138	Engine: CF	M56-5B6/I	5		
Distance:	DÜSSELDORF-MÜNCHEN Distance: 487 km Aircraft: Airbus A320neo Seats: 174 Engine: LEAP-1A26 Airline: Eurowings						
Servironmental rating 0,97							
	FUEL PERFORMAN	CE		VALENT EF	VISSIONS		
21,4	kg/seat	(0,32)*	325	kg/seat	(0,36)*		
•••))	LOCAL NOISE LEVE	L		R POLLUTI	ON		
1,83	EPNdB/EPNdB	(1,92)*	94,1	g/seat	(1,89)*		
TRAVEL CLASS FUEL PERFORMANCE							
Economy	20,9	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.87 Trip Emission Ecolabel Hamburg to Munich via Düsseldorf by Eurowings

HAW HAMPU	EC	:0L/	ABEL				
Distance Aircraft:	RG-FRANKFURT : 412 km Airbus A321 Lufthansa	Seats: 192	Engine: V2	2533-A5			
Distance Aircraft:	FRANKFURT-MÜNCHENDistance:300 kmAircraft:Airbus A320Seats:154Engine:Lufthansa						
5	ENVIRONN	/IENTAL R	ATING 1,2	23			
۵ () ا	FUEL PERFORMA	NCE		VALENT EI	MISSIONS		
18,0	kg/seat	(0,27)*	269	kg/seat	(0,3)*		
	LOCAL NOISE LEV	EL	LOCAL AI	R POLLUT	ION		
1,90	EPNdB/EPNdB	(1,99)*	163,3	g/seat	(3,27)*		
TRAVEL CLASS FUEL PERFORMANCE							
Economy	17,5	kg/seat	Premium Economy	N/A	kg/seat		
Business	21,7	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.88 Trip Emission Ecolabel Hamburg to Munich via Frankfurt by Lufthansa

ECOLABEL							
10 NOL NOLDONS-13 042	Seats: 189 Engine: CFM56-7B26						
>	Servironmental rating 0,82						
	FUEL PERFORMA	NCE		ALENT EMI	SSIONS		
39,3	kg/seat	(0,59)*	537	kg/seat	(0,59)*		
	LOCAL NOISE LEV	'EL			N		
0,96	EPNdB/EPNdB	(1)*	65,1	g/seat	(1,3)*		
TRAVEL CLASS FUEL PERFORMANCE							
Economy	38,6	kg/seat	Premium Economy	41,143	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.89 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Ryanair

ECOLABEL							
	Seats: 174 Engine: CFM56-5B4/P						
5	Servironmental rating 0,83						
	FUEL PERFORMA	NCE		ALENT EM	ISSIONS		
39,2	kg/seat	(0,59)*	579	kg/seat	(0,64)*		
	LOCAL NOISE LEV	/EL			DN		
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 <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800							

Figure D.90 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Eurowings

ECOLABEL							
HAMBURG-PALMA DE MALLORCADistance:1,659 kmAircraft:Boeing 757-300Seats:262Engine:RB211-535E4B-37Airline:Condor							
5	Servironmental rating 1,08						
	FUEL PERFORMAN	NCE		ALENT EMI	SSIONS		
41,9	kg/seat	(0,63)*	695	kg/seat	(0,76)*		
•••))	LOCAL NOISE LEV	EL			N		
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 <u>one</u> reference flight of 2400 km, performed by a Boeing 737-800							

Figure D.91 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Condor

		COL	ABEL						
HAMBURG-PALMA DE MALLORCADistance:1,659 kmAircraft:Airbus A320Seats:180Engine:V2527-A5Airline:Ryanair (Aircraft: Lauda Europe)									
>	Servironmental rating 0,80								
	FUEL PERFORMAN	NCE		ALENT EM	ISSIONS				
37,9	kg/seat	(0,57)*	560	kg/seat	(0,62)*				
•())	LOCAL NOISE LEV	EL			N				
0,93	EPNdB/EPNdB	(0,98)*	59,8	g/seat	(1,2)*				
j0	TRAVEL CLAS	S FUEL PERFO	RMANCE						
Economy	37,9	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 t	flight of 2400 km, perfor	rmed by a Boeing 737-800						

Figure D.92 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Ryanair (Aircraft from Lauda Europe)

		OL/	\BEL							
1000 C C C C C C C C C C C C C C C C C C	RG-VALENCIA :: 1,761 km Airbus A319 Eurowings	Seats: 138	Engine: CF	M56-5B6/I	2					
Distance	VALENCIA-PALMA DE MALLORCADistance:277 kmAircraft:Boeing 737-800Seats: 180Airline:Air Europa									
د	Senvironmental rating 1,45									
	FUEL PERFORMAN	CE		VALENT ER	VISSIONS					
56,1	kg/seat	(0,84)*	820	kg/seat	(0,9)*					
•••))	LOCAL NOISE LEVE	iL		R POLLUTI	ON					
1,90	EPNdB/EPNdB	(1,99)*	129,7	g/seat	(2,6)*					
j0	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					
Business	,	0		-	0,					

Figure D.93 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Valencia by Eurowings and Air Europa

	EC	OL	ABEL							
1010	RG-MÜNCHEN 600 km Airbus A320 Eurowings	Seats: 174	Engine: CF	-M56-5B4/I	Þ					
Distance:	MÜNCHEN-PALMA DE MALLORCADistance:1,216 kmAircraft:Airbus A320Seats:174Engine:Eurowings									
>	Senvironmental rating 1,33									
∧]]	FUEL PERFORMA	NCE	CO₂ EQUI	VALENT EI	VISSIONS					
44,0	kg/seat	(0,66)*	649	kg/seat	(0,71)*					
•••)))	LOCAL NOISE LEV	ΈL		IR POLLUT	ION					
1,89	EPNdB/EPNdB	(1,98)*	129,7	g/seat	(2,6)*					
j0	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 th	ne emissions of <u>one</u> reference	flight of 2400 km, perfor	ned by a Boeing 737-800							

Figure D.94 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Munich by Eurowings

ISAW HAMEU		COL/	ABEL						
Distance	Engine: CFM56-5B6/P								
3	Servironmental rating 0,88								
	FUEL PERFORMA	NCE		ALENT EMI	SSIONS				
45,5	kg/seat	(0,68)*	672	kg/seat	(0,74)*				
•())	LOCAL NOISE LEV	/EL		POLLUTIO	N				
0,94	EPNdB/EPNdB	(0,99)*	61,3	g/seat	(1,23)*				
j0	TRAVEL CLAS	SS FUEL PERFORI	MANCE						
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 <u>one</u> reference	flight of 2400 km, performe	d by a Boeing 737-800						

Figure D.95 Trip Emission Ecolabel Hamburg to Palma de Mallorca by Eurowings

	EC	OL	ABEL							
12/01/20/01/20/02/20/01/20/02/20/01	RG-BARCELONA : 1,493 km Airbus A320 Eurowings	Seats: 174	Engine: CF	M56-5B4/	P					
Distance	BARCELONA-PALMA DE MALLORCADistance:202 kmAircraft:Boeing 737-800Seats: 180Airline:Air Europa									
5	Senvironmental rating 1,32									
	FUEL PERFORMAN	ICE		VALENT EI	VISSIONS					
41,5	kg/seat	(0,62)*	606	kg/seat	(0,67)*					
	LOCAL NOISE LEVI	EL		R POLLUT	ION					
1,90	EPNdB/EPNdB	(1,99)*	133,2	g/seat	(2,67)*					
j0	TRAVEL CLAS	S FUEL PERFO	RMANCE							
Economy	40,0	kg/seat	Premium Economy	N/A	kg/seat					
Business	62,2	kg/seat	First	N/A	kg/seat					
* Compared to t	he emissions of <u>one</u> reference f	light of 2400 km, perforr	ned by a Boeing 737-800							

Figure D.96 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Barcelona by Eurowings and Air Europa

		OL	ABEL							
101000000000000000000000000000000000000	RG-BARCELONA : 1,493 km Airbus A320 Vueling	Seats: 180	Engine: CF	M56-5B4/I	2					
Distance Aircraft:	BARCELONA-PALMA DE MALLORCADistance:202 kmAircraft:Airbus A320Seats: 180Airline:Vueling									
د	Servironmental rating 1,28									
	FUEL PERFORMAN	NCE		VALENT EI	VISSIONS					
39,8	kg/seat	(0,6)*	588	kg/seat	(0,65)*					
	LOCAL NOISE LEV	EL		R POLLUT	ON					
1,89	EPNdB/EPNdB	(1,98)*	125,4	g/seat	(2,51)*					
j,	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 t	he emissions of <u>one</u> reference t	flight of 2400 km, perforr	ned by a Boeing 737-800							

Figure D.97 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Barcelona by Vueling

		:0L/	ABEL							
	RG-KÖLN : 364 km Airbus A320 Eurowings	Seats: 174	Engine: Cl	-M56-5B4/I	5					
Distance	KÖLN-PALMA DE MALLORCADistance:1,304 kmAircraft:Airbus A319Seats: 138Engine:Eurowings									
Senvironmental rating 1,33										
	FUEL PERFORMAN	ICE		VALENT E	VISSIONS					
45,5	kg/seat	(0,69)*	673	kg/seat	(0,74)*					
	LOCAL NOISE LEVE	EL		IR POLLUTI	ON					
1,88	EPNdB/EPNdB	(1,98)*	126,2	g/seat	(2,53)*					
j0	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 t	he emissions of <u>one</u> reference fl	ight of 2400 km, perform	ed by a Boeing 737-800							

Figure D.98 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Cologne by Eurowings

ISAW HAMEUR	EC	OLA	BEL							
	G-MADRID 1,780 km Airbus A320 Iberia	Seats: 162	Engine: CF	M56-5B6/3	3					
5	Senvironmental rating 1,35									
ا	UEL PERFORMAN	CE		VALENT EI	VISSIONS					
	kg/seat	(0,86)*	890	kg/seat	(0,98)*					
•••))	LOCAL NOISE LEVE	L	LOCAL AI	R POLLUT	ION					
1,85	EPNdB/EPNdB	(1,94)*	99,4	g/seat	(1,99)*					
Š	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	e emissions of <u>one</u> reference flig	ht of 2400 km, performed	l by a Boeing 737-800							

Figure D.99 Trip Emission Ecolabel Hamburg to Palma de Mallorca via Madrid by Iberia

		:0L/	ABEL							
Distance	RG-ZÜRICH : 693 km Airbus A321 Swiss	Seats: 219	Engine: CFM56	-5B1/3						
Distance Aircraft:	ZÜRICH-PALMA DE MALLORCADistance:996 kmAircraft:Airbus A321Seats:219Engine:CFM56-5B1/3Airline:Swiss									
5	Servironmental rating 1,12									
	FUEL PERFORMA	NCE								
30,4	kg/seat	(0,46)*	458 kg/s	seat (0,5)*						
	LOCAL NOISE LEV	EL		ILUTION						
1,94	EPNdB/EPNdB	(2,03)*	105,0 g/se	eat (2,1)*						
j0	TRAVEL CLAS	S FUEL PERFOI	RMANCE							
Economy	29,7	kg/seat	Premium Economy N	I /A kg/seat						
Business	32,6	kg/seat	First N	I /A kg/seat						
* Compared to t	the emissions of <u>one</u> reference	flight of 2400 km, perforn	ed by a Boeing 737-800							

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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		Leg 1			Leg 2			Trip			
			A/C				A/C	Costs	Duration	Total Distance	Environmental
No.	Airline	Aircraft	Rating [-]	Stopover	Airline2	Aircraft2	Rating2 [-]	[€]	[hh:mm]	[km]	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.1
 Comparison of flight connections from Hamburg to Munich

 Table E.2
 Comparison of flight connections from Hamburg to Palma de Mallorca

		Leg 1				Trip					
No.	Airline	Aircraft	A/C Rating [-]	Stopover	Airline2	Aircraft2	A/C Rating2 [-]		Duration [hh:mm]	Total Distance [km]	Environmental Rating [-]
		Boeing 737-800		-	-	-	-	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

		Leg 1				Leg 2		
			A/C				A/C	
No.	Airline	Aircraft	Rating [-]	Stopover	Airline2	Aircraft2	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						
			A/C		Total Distance Environmen			
	Airline3	Aircraft3	Rating3 [-]	Costs [€]	Duration [hh:mm]	[km]	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	1
07	-	-	-	201	05:50	3.536	2,07	
08	-	-	-	207	05:50	3.695	1,75	

 Table E.3
 Comparison of flight connections from Hamburg to Gran Canaria

 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	•		Duration [hh:mm]		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		

		Leg 1				Leg 2	Trip				
			A/C				A/C	Costs	Duration	Total Distance	Environmental
No.	Airline	Aircraft	Rating [-]	Stopover	Airline2	Aircraft2	Rating2 [-]	[€]	[hh:mm]	[km]	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.5 Comparison of flight connections from Hamburg to New York

 Table E.6
 Comparison of flight connections from Hamburg to Bonaire

Boeing 737-800

Boeing 737-800

Delta Air Lines

08 Delta Air Lines

06 07

Stopover2
AUA
IAH
MIA
MIA
ATL
ATL

3.183

2.301

6,53

6,53

14:50

15:46

10.355

12.255

4,14

4,29

	Leg 1				Leg 2				Trip				
			A/C				A/C	Costs	Duration	Total Distance	Environmental		
No.	Airline	Aircraft	Rating [-]	Stopover	Airline2	Aircraft2	Rating2 [-]	[€]	[hh:mm]	[km]	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.7
 Comparison of flight connections from Hamburg to Bangkok

Table E.8 Comparison of flight connections from Hamburg to Hong Kong

		Leg 1						
			A/C				A/C	
No.	Airline	Aircraft	Rating [-]	Stopover	Airline2	Aircraft2	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						
			A/C		Duration	Total Distance	Environmental	
	Airline3	Aircraft3	Rating3 [-]	Costs [€]	[hh:mm]	[km]	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	

			A/C				A/C	Costs	Duration	Total Distance	Environmental
No.	Airline	Aircraft	Rating [-]	Stopover	Airline2	Aircraft2	Rating2 [-]	[€]	[hh:mm]	[km]	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.9
 Comparison of flight connections from Hamburg to Mexico City

 Table E.10
 Comparison of flight connections from Hamburg to Hurghada

			A/C				A/C	Costs	Duration	Total Distance	Environmental
No.	Airline	Aircraft	Rating [-]	Stopover	Airline2	Aircraft2	Rating2 [-]	[€]	[hh:mm]	[km]	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