Flight and Environment

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“Tiny changes within a complex system can lead to results that are impossible to predict.”
Flight and Environment

Aegean is transporting people, goods and materials by air. It connects Greece with other countries, societies and markets. It enhances trade and tourism. It creates business and employment opportunities. It promotes communication and culture. Without doubt through all these Aegean has an economic and social beneficial effect. At the same time, like all other operational activities, has an impact on the environment. Aegean is committed to mitigating its environmental impact.
Climate change

Global climate change has become today one of the major environmental concerns for most people. “Climate change” is a change in the statistical distribution of weather over periods of time that range from decades to thousands of years. The United Nations Convention on Climate Change defines this phenomenon as change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.1

The concept of “climate change” has acquired a number of different meanings. More often, denotes variations resulting from human interference. Sometimes designates variations longer than a certain period. Finally, is often taken to mean climate fluctuations of a global nature, including effects from human activities such as the enhanced greenhouse effect and from natural causes such as volcanic aerosols and ashes.2

The explanation of climate change mechanism is a difficult subject due to the interference of many factors and chain reactions. In addition, referring to air transport, aircraft contribution to the overall change is more difficult to assess because the aircraft effect is only a small part of anthropogenic effect as a whole.

The environmental impact caused by air transport is considered an important and complex issue. The expenses of additional measures have been increased the last years, but without doubt the benefits that result from the application of environmental regulations are definitely important, compensate the expenses for their achievement and satisfy the expectations of our society. Air transport has set a series of sustainable development objectives to meet the environmental challenges while at the same time will maintain the benefits of air travel promoting economic and social wellbeing. Aegean participates in this effort.
The Greenhouse effect

The majority of scientists agree today that our globe is undergoing a major climate change. They also agree that the level of carbon dioxide in the atmosphere is rising at a high rate that leads to the creation of the Greenhouse effect. This is considered to be the biggest environmental issue we face in the world today.

Here is what happens. Earth receives most of its energy from the sun, as electromagnetic radiation, which passes through gases of the atmosphere in order to reach the earth’s surface. This energy is then redistributed by atmospheric and oceanic circulations and radiated back to space.

More specifically the rays get absorbed in the surface and then generate new rays, called infrared rays. When part of these infrared rays try to go back into space, they get trapped in the atmosphere, and they come back down to earth again (most of them escape to outer space). The reason the rays return back is because our atmosphere is filled with greenhouse gasses. Today the most abundant radiative forcing greenhouse gases are six, including carbon dioxide, methane, and nitrous oxide.\(^3\)

Under normal circumstances, incoming solar energy is balanced by outgoing terrestrial radiation. This process, which tends to warm the lower atmosphere and the surface, has operated in the earth's atmosphere for hundred thousand of years as a result of naturally occurring greenhouse gases. The composition of the global atmosphere remained relatively stable till the beginning of industrial era. Since then, as a result of activities that cannot be explained by natural factors (human activities), increases in the concentrations of greenhouse gases in the atmosphere reduced gradually the efficiency with which the surface of the earth radiates heat to space. Thus the climate change started to occur.
We can now understand that, the increasing carbon dioxide, methane and nitrous oxide emissions that we have in the atmosphere because of the human activities, has caused a dangerous global warming process with all apparent consequences for the environment and human health.
Air transport impact on environment

Air transport’s main environmental issues are noise and pollution which are experienced by residents in the vicinity of airports and greenhouse gas emissions which occur in the high atmosphere.

Noise has been the focus of concern over the last 30 years of growth in air transport. Over the years advancements in airframe design and engine construction technologies have reduced airplane noise. To further reduce aircraft impact, specific regulations, procedures and restrictions have been established for arrival and departure flight paths.4

For many years air pollution from aircrafts has created a lot of concerns and has become a growing issue. The October 2006 report by Nicholas Stern states that the largest contributor to human-induced CO₂ is power generation at 24%, mostly produced in coal and gas fired stations. Next is land use change at 18%, then agriculture, industry and transport at 14% each, buildings (8%), other energy related activities (5%) and waste (3%) make up the rest.5

According to the United Nations Intergovernmental Panel on Climate Change (IPCC), aviation accounts for only 2% of man-made global CO₂ emissions from fossil fuel use and this could reach 3% by 2050. Of the total transport CO₂ emissions aviation accounts for 12% while road transport accounts for 74% and the rest 14% accounts to other form of transport.6

The exhausts from aircrafts engines have an impact on the atmosphere. Aircraft engines produce emissions that are similar to other emissions resulting from fuel combustion. However, aircraft emissions are different in that a significant part is emitted at high altitudes. This unusual situation gives rise to important environmental concerns regarding their global impact and their
effect on air quality at ground level. In the past 50 years major advances in aircraft turbine engines have been realized as a result of extensive efforts by engine manufacturers. Aircraft engines have very sophisticated electronic devices that measure fuel flow. If the computer detects higher than allowed fuel consumption, the problem is identified and rectified as soon as practicable. This is primarily for safety reasons but this practice also contributes to environmental efficiency.7

![Schematic of ideal combustion products and all existing combustion products](adapted from IPCC, 1999). UHC is unburned hydrocarbons.

Aircraft engine exhausts produce also condensation trails (contrails) in the atmosphere about 10 kilometres above the Earth's surface. At these high altitudes, contrails and cirrus clouds
form depending on the quantity of water vapour and atmospheric conditions. Exhausts may act in a way similar to the effects produced by greenhouse gases. Both reflect sunlight that would otherwise warm the Earth’s surface. At the same time, they absorb heat from the ground instead of allowing it to escape (infrared rays). Scientists are uncertain about the impact of contrails on global warming and climate change. More research is being done on this issue in defining the effect of contrails on climate change.
As early as 2007, the global air transport community adopted a four-pillar strategy, subsequently endorsed by the ICAO General Assembly which promotes and drives efforts in four key areas: improved technology, efficient operations, effective infrastructure and positive economic measures.  

Technology, out of the four pillars, has the best prospects for reducing air transport emissions with new aircraft designs, new lightweight materials, new engine advances and the development of sustainable alternative jet bio fuels from second generation sources. Modern jet aircraft are significantly more fuel efficient than 30 years ago and thus emit less CO₂. Research programs aim to achieve a further 50% reduction in CO₂ emissions and an 80% reduction in oxides of nitrogen (NOx) by 2020. Aircraft entering today’s fleet are 20 decibels (dB) quieter than comparable aircraft 40 years ago. This represents a reduction of 75% in noise. Research programmes aim to achieve a further 50% reduction in noise by 2020. Improved operational practices, including more efficient flight procedures, weight reduction measures, airlines timetables optimization, route networks and flight frequencies to increase load factors which minimize the number of empty seats, could achieve substantial emissions reductions. Improved infrastructure projects and systems, including more efficient air traffic management and airport facilities could also achieve substantial emissions reductions. The first three pillars will go a long way to achieving the goal of carbon neutral growth, thus some positive economic measures would be needed to close the gap. They are designed to achieve environmental objectives at a lower cost and give operators more flexibility. All interested sides are currently examining a number of measures to this direction, including emissions trading, as well as other voluntary and obligatory measures.

The ICAO has endorsed the adoption of an open Emission Trading
System to meet CO₂ emissions reduction objectives. Guidelines for the adoption and implementation of a global scheme were published on February 2007.¹⁰

In 2008, aviation industries, the airlines, airports, fuel suppliers and air navigation service providers came together in Geneva and signed a commitment to a pathway to carbon neutral growth. Carbon neutral growth means that net CO₂ emissions from aviation would peak up to 2020, then would stabilize and decline after that, despite increases in traffic growth. To achieve this carbon neutral growth from 2020 onward, a multifaceted approach is required with a strong commitment from all air transport stakeholders.¹¹

Within the European Union, the European Commission has resolved to incorporate aviation in the European Union Emissions Trading Scheme. A new directive has been adopted by the European Parliament and approved by the Council. It will enter into force on 1 January 2012.¹²
Aegean Environmental Policy

There are many ways to mitigate climate change some are very simple while others require more specific and complex actions. The first and most important is to alert and motivate population. Most persons do not act unless they are convinced that something important will happen. If enough persons present their concerns, communicate these concerns and encourage others to do likewise, then the rest of the world will be forced to act. There is no question for the right time; we need to change attitude now as the first step on course to a better future.

Aegean has undertaken a number of positive steps and improvements and has established an Environmental Management System that complies with the highest international standards. As a result in September 2008 has achieved the ISO 14001/2004 certification for passengers’ service and aircraft maintenance, confirming thus its strong decision and capability for a better confrontation of all environmental issues.

We implement our environmental management program aimed at achieving long term goals as well as at addressing current objectives and targets by controlling emissions, recycling solid waste and protecting the environment from hazardous materials. We operate according to all applicable legislative and regulatory requirements referring to air transport. Our environmental policy sets out our practices to continually improve the efficiency with which we operate:

- Provide appropriate environmental training and educate employees to be environmentally responsible.
- Minimize the amount and toxicity of waste generated and ensure the safe treatment and disposal of waste.
- Conserve natural resources by reusing and recycling materials, purchasing recycled materials, and using recyclable packaging and other materials.
• Ensure the responsible use of energy throughout our business.
• Consider environmental factors and full acquisition, use and disposal costs when making planning, purchasing and operating decisions.
• Minimize risk and protect our employees and the community in which we operate by employing safe technologies and operating procedures in both routine and emergency conditions.
• Communicate and reinforce our commitment to environmental quality to our employees, vendors, customers, other government entities and the community in which we operate.
• Work cooperatively with others to further common environmental objectives.
• Strive to continually improve Aegean Airlines’ Environmental Management System and performance, and periodically issue progress reports to the general public.
• Work cooperatively with others to further common environmental objectives.
• Conduct rigorous audits and self-assessments of Aegean Airlines’ compliance with this policy and measure progress of Aegean Airlines’ environmental affairs performance.
Aegean has ordered a total of 27 AIRBUS A320/321 aircraft. As of 2008 it gradually replaced all the older 737 aircrafts and as a result of this investment Aegean has the youngest fleet in the region of Balkans and South-Eastern Europe. The new A321s and A320s have been used for its expansion on both domestic and international routes. Aegean fleet presently consists of 4 AIRBUS A321, 18 AIRBUS A320, 6 AVRO RJ-100 and 2 wet leased ATR-72-500.

With safety as our number-one priority, we have invested heavily in state-of-the-art, brand-new planes, control systems, technical support and staff training. Every aircraft is equipped with the latest and most sophisticated safety systems, including the Airborne Collision Avoidance System (ACAS II), the Enhanced Ground Proximity Warning System (EGPWS) and the Digital Navigation System (DFGS).
The fuel consumption of our aircrafts is the main issue referring to emissions and this is the area where we concentrate most of our efforts. Having a young fleet and using it in the best possible way we believe that we follow the right path in terms of our fuel exploitation and efficiency.
Aegean aircraft maintenance

In January 2009, Aegean proudly unveiled the new Technical Base after an entire year of construction work. The magnitude of this ambitious multi-million investment project is staggering. It covers an area of more than 4,800 sq. meters that can fit up to two Airbus A-321s, the largest type of aircraft in Aegean’s fleet.

It is well known that in Aegean passenger safety comes first. That is why the new hangar is constructed in order to ease the demanding work of Aegean mechanics when performing everyday safety checks and repairs on the general upkeep of its fleet. Consequently, the new Base comprises of several sections, carefully designed to guarantee maximum efficiency. They are store rooms, engineering laboratories, administration offices, technical electronic library and computer labs for the employees.

In addition to that, the new Technical Base is equipped with an advanced technologically automated fire fighting system, capable of detecting and preventing a possible fire break out. A combined system is also used on aircraft under maintenance to provide electrical power, compressed air and water in case of fire. Finally, there is an Electrical Emergency Generator unit in the unlike event of outages.

Aegean operates in accordance with ISO 14001/2004 verification, with the implementation of an Environmental Management System for Passenger Services - Aircraft Services/Maintenance, regarding waste management control. In particular, in the new hangar a waste control system is in place, collecting all waste in specially designed tanks to keep the ground water levels clean and unpolluted. Our aircrafts undergo meticulous day-by-day maintenance by our airport technical team, consisting of engineers, aircraft construction specialists and mechanics. High engineering and safety standards, along with many reliability and
maintainability requirements, are continuously applied and impose constraints that do not necessarily exist to the same degree in other sectors of transport.

We strive to improve fuel efficiency and we achieve this by regularly washing the body and engines of our aircrafts. The eco wash system by Pratt & Whitney enables technical department to perform frequent engine washes without producing any polluted water. The water that is used for the engine wash is recycled automatically by the Eco-Wash equipment. By washing the engines, with the use of pure hot water, we extend their life due to cleaner compressors, vanes and turbines while we get good performance improvements and saves in fuel consumption. This has a real positive impact on environmental protection.

Aegean recognizes that the importance of protecting the environment and keeping up with those efforts is as vital as the constant improvement and evolution of our business. The new Technical Base makes us proud because not only it serves its functionality, but it is also environmentally friendly.
Aegean operational procedures

The only way to decrease CO₂ emissions is to increase fuel efficiency. In airports areas where landing and take-off cycle occur, CO₂ emissions have the most immediate impact. This is the stage where most fuels are consumed disproportionately with the distance covered. Efforts to increase aircraft operational efficiency are reducing fuel consumption and are therefore decreasing greenhouse gas emissions.

In Aegean since 2008 we have seen a small downward trend in CO₂ emissions due to reduction of fuel consumption. This largely depends on our pilots applying some good practices, in close cooperation with air traffic controllers, when it is operationally possible according to weather and traffic conditions and environmentally beneficial. The following practices can be used during flights and in airports areas to mitigate emissions:

- climbing continuously from the ground up to cruise altitude (CCD)
- following more direct routes
- using effective fuel optimised speeds and altitudes when circumstances change
- following continuous descent approaches (CDA)
- using low power and low drag techniques during approach for landing
- avoiding aircraft waiting on the ground with engines running
- avoiding unnecessary use of aircraft auxiliary power units

Lateral and vertical flight routes optimisation increases fuel efficiency and can be achieved by selecting optimum altitude, optimum speed and by following direct routes. Modern jet aircraft are designed to fly at specific optimum speeds and altitudes in order to maximise their performance, but because of congestion and other restrictions in the airspace system aircraft are often forced to fly far from the optimum cruise altitude and/or the cruise
speed. Continuous climbing up to the optimum cruise altitude eliminates the demand for additional thrust in the intermediate level flight segments. This means aircraft spend longer time at their optimal altitude which leads to a reduction in fuel burn and emissions. Continuous descent means an uninterrupted approach inbound to destination airport for landing without holdings and/or intermediate segments of level flight prior to intercepting the glide path. Finally a particular focus is given on minimising time spent during taxiing by improving operational procedures on the ground.

An internal Fuel Group made up of experts of all operational departments has been established aiming at fuel conservation. This group is striving to achieve its target by examining occasions and defining more fuel efficient processes and procedures. The key requirement for the successful implementation of fuel saving policy is to acquire full commitment and accountability of Aegean personnel. Training, awareness and inspiration are the core value towards to that end. Fuel conservation is a collective task and we consistently have been working on that the recent years. Using
accurate fuel measurement methods we are convinced that consistent teamwork activities can save more amount of fuel than each individual separately.

Additionally, weight and balance are critical factors that affect not only safety but also fuel economy. We continuously investigate ways to reduce operational aircraft weight which can significantly influence fuel consumption. Simple although clever solutions are used, like replacing flight crew library with laptops, reducing the number of magazines on board and the amount of potable water and replacing old catering items using lighter catering eco-recycled items. Last but not least, effective weight distribution permits the fuel consumption to be reduced considerably. All ground personnel is properly trained on aircraft loading so as to optimise center of gravity (CG) position to reduce trim drag to minimum.
At the same time we all can understand that, climate change in general and bad weather conditions more specifically, can seriously influence air transport operations affecting its capacity and efficiency. Thus extreme weather conditions, severe storms, restricted visibility or snowing at the airports, could result in long-lasting delays in flight or on the ground and even cause unexpected diversions to other destinations. All the above can significantly affect fuel management efforts. Consequently fuel consumption and emissions are unpredictably increased and may neutralize previous achievements.
Conclusion

Air transport move more people and produce less pollution per passenger than other forms of surface transport. The impact on the environment is much smaller than some people believe or claim. Taking into account the distances that aircrafts travel in order to move huge number of people in short time then the efficiency of air transport is indeed high. For decades has undertaken very important efforts to minimize its environmental impact.

Air transport partners have mainly set two targets: carbon-neutral growth from 2020 and a 50% reduction on its net emissions by 2050. Today’s aircrafts are 70% more fuel efficient than they were 40 years ago while research programs aim to achieve a further 50% fuel saving by 2020. In addition good traffic management and other operational improvements, have the potential to further reduce fuel consumption by 8-18%. The introduction of communications, navigations, surveillance and air traffic management systems and improved infrastructure will enable airlines to fly safer, quieter and shorter distances and thus reduce fuel consumption. 14

Aegean is very successful in its environmental efforts with the ISO 14001/2004 verification, the establishment of environmental department, stringent environmental audits and sound awareness program. Having a young and modern fleet, applying all required maintenance processes, training systematically our crews and applying essential operational practices, we are confident that we follow the right path. We do not have the perfect solution, but we can assure we do have a role to play in mitigating the environmental impact.

This booklet has explained the interaction of air transport and the environment. It has highlighted improvements that have been
made and procedures that have been established for reducing the impact on the environment. There are scientific, economic and political views which are expressed in several studies, some in agreement and some with different opinions on how climate change can be faced. Indubitably however, we will all agree that the time to act and take corrective measures has come.
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