

Mitigation of Carbon Oxides Emissions

Innovative measures and strategies to control emission in aircraft transportation and discuss various models in related to emission in Aviation.

Recommendation for future development

Introduction:

Mitigation of the environment is the key impact and a major challenge in the aviation innovative technology, with the focus on the noise reduction, carbon emission, global warming. Whenever a technology is invented the greater advantage or benefits have a greater disadvantage also. Aviation have contributed to the 2% of emission by manmade and will slowly rise to 3% by 2050. Hence control of this emission can save our environment and as well the life of all living creatures. The discussion here below is about the Effects, causes, Innovative measures and strategies to control emission in aircraft transportation and discuss various models in related to emission in Aviation. Recommendation for future development

Introduction to Carbon oxides gases:

Carbon oxides are the gases of atmosphere air and they are a part of the carbon cycle, the carbon forms two form of gases when its gets combined with oxygen namely **carbon dioxide and carbon mono oxide.**

Formation of the Carbon oxides:

Carbon di oxide (CO₂): This gas is generated by the metabolism of human bodies by breathing out the carbon dioxide and also generated by burning fuels in the industries as well burning of the plants and animal matter. These gases are consumed by plants by the process of photosynthesis.

Carbon Mono oxide (co): These gases are formed from incomplete burning of wood, coal, charcoal, oil, kerosene and other fuels. These gases are very toxic and affect the humans.

Sources of CO₂:

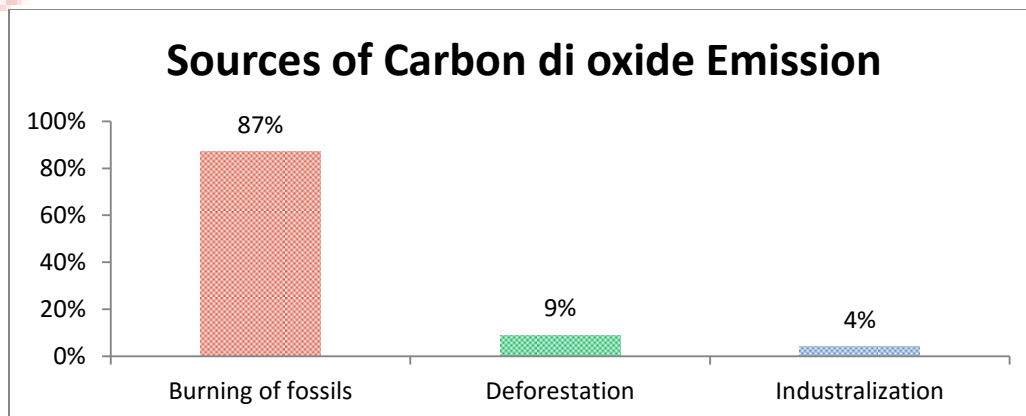
There is an increase in carbon dioxide emission high mainly in the recent days due to Industrialization and technology. There is a rapid emission of these gases in the atmosphere.

According to (Le Quéré, C. et al. (2013).) on global warming describes that most of the carbon di oxide emission is from.

- 87% are caused due to humans produced due to burning or heating of fossils, coal or oil.
- 9% is related to deforestation or burning the forest and turning all forest into land, therefore the carbon dioxide realized cannot be observed as a result it leads to global warning.
- 4% is due to industrial process (like the manufacture of cement).

These were the main causes or emission of carbon dioxide gases in the atmosphere and thus creates global warning for the environment.

Pic: 1 Chart shows the major sources of carbon dioxide emission



Sources of Carbon mono oxides:

Carbon mono oxide gases are due to the incomplete burning of wood, coal, charcoal, kerosene and any other fuels which is not completely burnt that leads to the emission of carbon mono oxide gases either at home or industries.

Major sectors of the Carbon dioxide gases:

There are three main areas where the carbon dioxide emission is higher

Electricity sector:

The largest man made carbon dioxide emission is by electricity and heat generation in the industries or economic sector, approximately 41% of this emission of gases are due to this sector

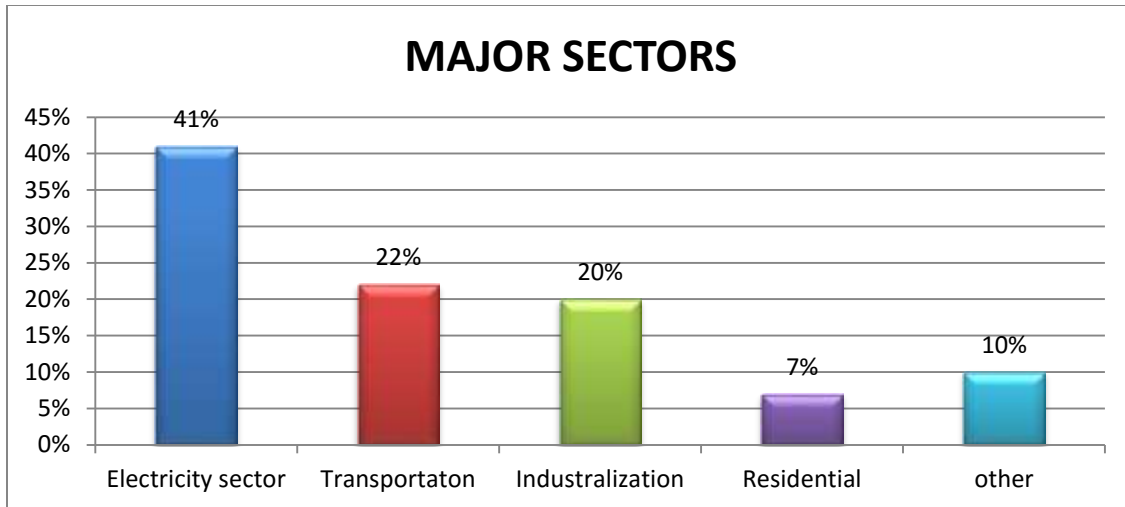
Transportation sector:

This the second largest sector in manmade emission of this carbon di oxide gases that is approximately around 21% of CO₂ emission is due to this sector. This is mainly due to the growing population the transportation sector have come into progress since 1990s.

Industrial sector:

This is the third largest sector that contributes to the manmade emission CO₂ ,this sector produces 20% of fossil fuel combustion.

Pic: 2 Chart shows the major Sectors of carbon dioxide emission

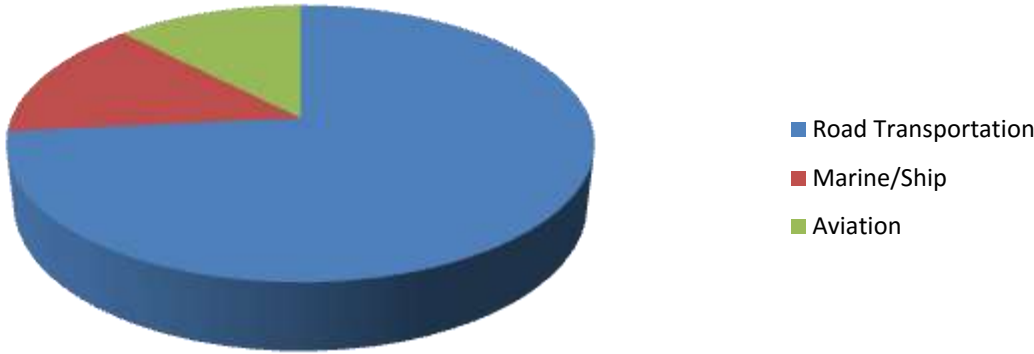


(Source from Emissions from Fuel Combustion (2012), International Energy Agency)

Strategies and operational technologies:

Transportation of any mode (either aircraft, automobiles etc.) are the second largest manmade emission of carbon dioxide gases, there has been increases in the transports from the year of 1990 to meet the global demand of the people and has been growing rapidly since then. It's been estimated that the road transportation accounts for 72% of carbon dioxide emissions, transportation by ship produces 14% carbon dioxide emissions and the aviation produces 12% of the co2 emission.

Emission of carbondioxide by Transportation



Carbon emission is a serious problem in the aviation that has caused severe impact on the environment, hence controlling the emission is done by various strategies to improve the environment

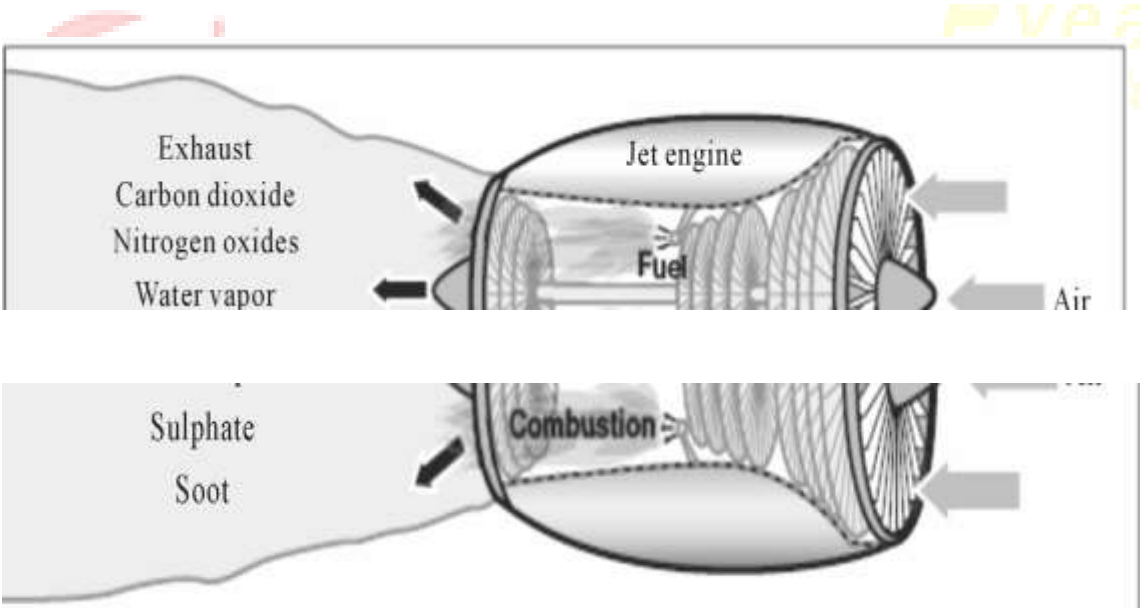


Figure 4. Carbon Emission from Aircraft.

Innovative technologies and operational strategies:

The airline industry have adopted various strategies to reduce the carbon emission by the following methods though the investment in creating a flight may be more but the emission of carbon can be controlled for a better.

These are some of the strategies to control carbon emission:

Fleet renewal:

Fleet renewal can reduce more amount carbon emission up to 21% and most of the aircrafts will be renewed by the year of 201.

Operations:

Improved operations procedures in APU (auxiliary power unit) usage and weight reduction measures will therefore reduce 3% of emission.

Infrastructure:

Implementation of Air traffic management and improvement of infrastructure of the airport can reduce around 4% of carbon emission.

Airframe and Engine Retro fits technology:

Modification of the aircraft fleet by current technologies (like drag reduction etc .) can also reduce the carbon emission up to 1%.

Bio-fuels:

The recent test of bio fuels usage in the aircraft which can reduce up to 80% of carbon emission.

Green Departures:

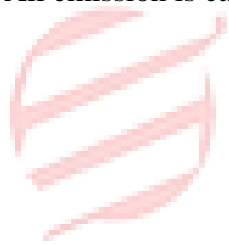
Maintain the environmental green and friendly is an advantage for takeoff thus keeping the environmental friendly thus to some extent carbon emission can be controlled.

There are some measures which can be controlled are summarized in short.

- Air Emission monitoring
- Change the fuels into bio fuels or any natural gases
- Minimize the ground work
- Keeping a regular schedule and avoid delays.
- Environmental friendly or green take off environment.
- Taxes on carbon emission vehicles.

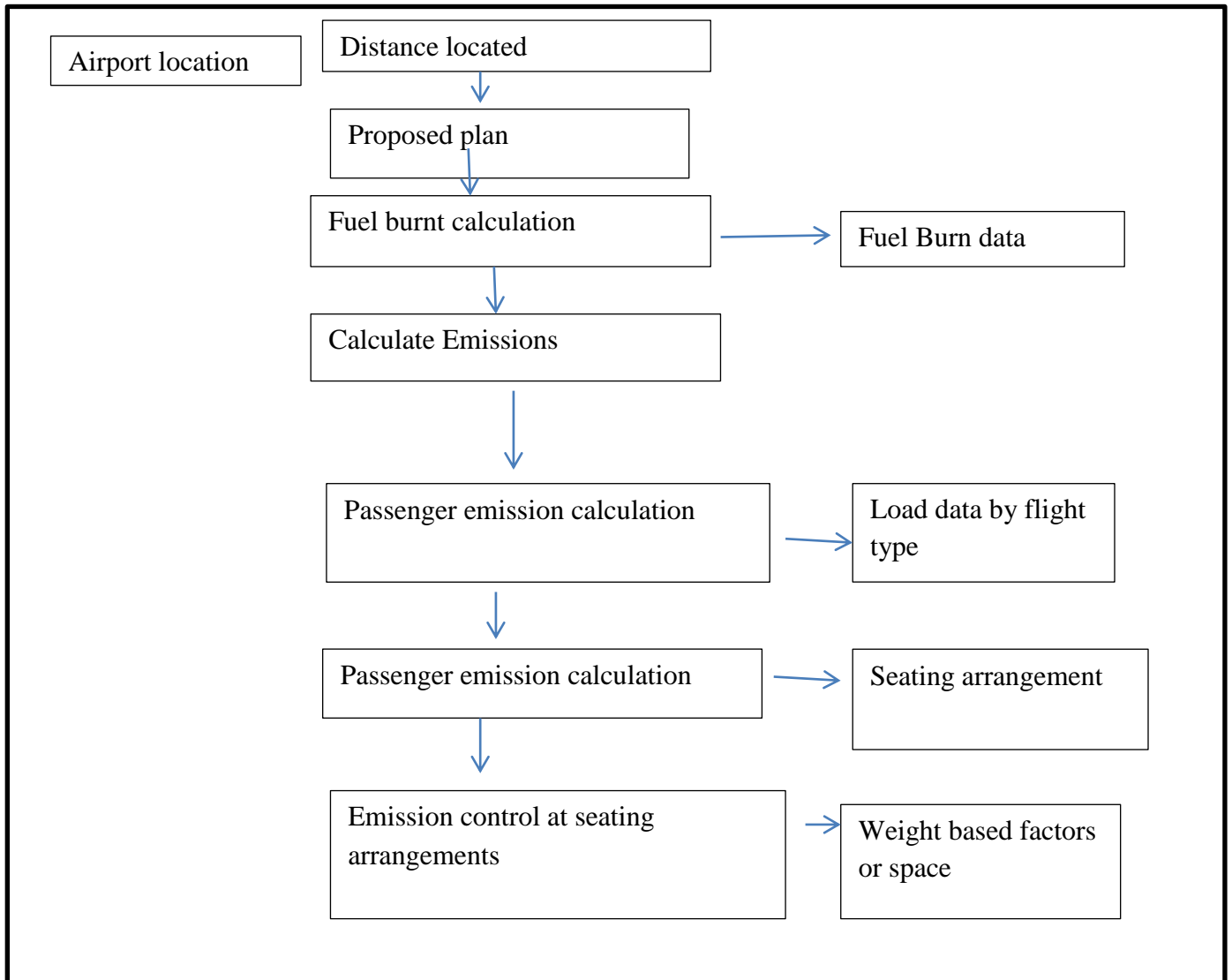
Emission Calculation:

All emission is calculated by using the same this same methodology.



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Emission calculator methodology:



Note:

The fuel burn is calculated by converting into CO₂ and then multiplication of an emissions factor by 3.157 kgCO₂/kgfuel.

Sensitivity to distance flown

The emission and the distance of the flight are not linear always because emission is linked with the takeoff of the flight rather than the distance. The short flight has a Greater level of emission than the large flight.

Secondly the increase in distance can causes a huge amount of emission.

DEFRA MODEL OF Emission:

The DEFRA model has different types of emission factors for every category of flight.

1. Fuel burn data are calculated by the trip distance of the particular aircraft.
2. Freight load is classified in two ways
 - Allocated according the weight of the Passenger and freight.
 - Other weights which are needed for the passengers are like (seats, gallery, etc.)
3. Under DEFRA emission based on per passenger load
4. Seating arrangement is based on Domestic, long, medium haul flights
5. Emission are allocated between Economy and business classes.
6. Multiplier is not recommended.

International Civil Aviation Authority Model

The key features are the following

1. Uses the given data to find out the typical form of emission within any distance.
2. Freight load weight depends mainly whether the flight is narrow or wide body. Based on the passenger load factor emission are allocated, there is a variation by route and whether narrow or widened.

3. Seating arrangements are determined by the number of economy seats and business seats that can fit into the cabinet.

4. A multiplier is not used here

THE SABRE HOLDINGS MODEL”

These are computer reservation system used by the airlines in maintaining the emission of CO₂. This one of the best models used for aviation CO₂ emissions calculators.

1. SAGE sub-model has data available for any kind of flight.

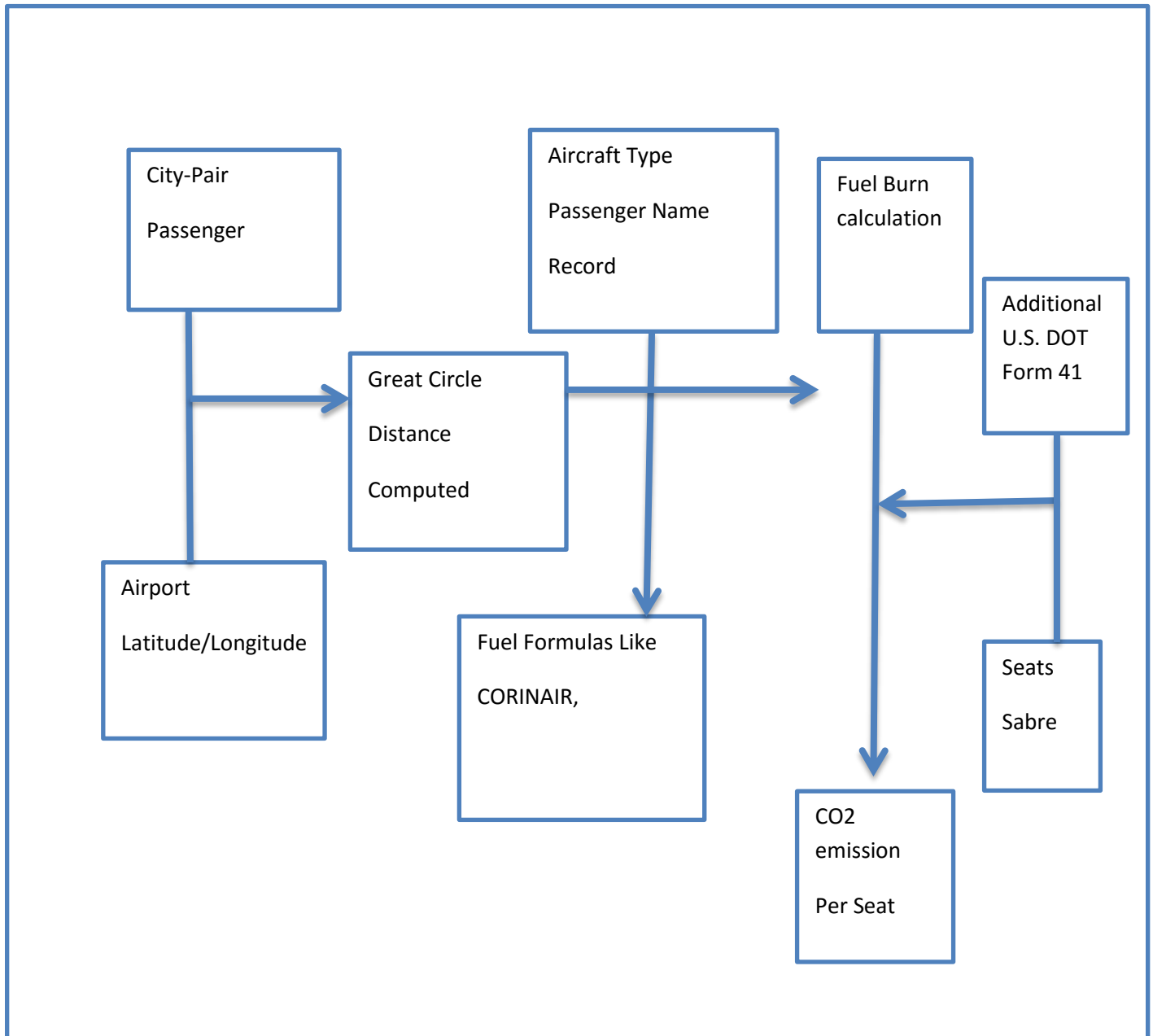
2. This model has a different seating arrangement by airline and by the type of the flight. Thus the carbon emission calculated is efficient.

3. The information can be got in advance the CO₂ emission can be calculated and displayed to the passenger.

4. Making the customers to select the lower emission of carbon flights can make the market competitive one for developing green aviation.

5. Provides an efficient tools for calculating carbon emission.

Model of Saabre Holdings model:



Airport Emission Models:

Emissions and Dispersion Modeling System (EDMS)

Emissions and Dispersion Modeling System (EDMS) was developed in the mid-1980s, this was later designed into Aviation Environmental Design Tool (AEDT) in May 2015. This mainly to assess the Airport Environment and the ground service.

- Power supply of Aircrafts
- Maintenance of aircraft
- Support equipment needed
- Access and other stationary

Emissions and Dispersion Modeling System (EDMS) was one of the quality tool assessments for carbon emission in the airport and its sources before takeoff.

Aviation Environmental Design Tool (AEDT)

This is a software system that control the performance of the noise reduction, fuel intake, carbon emission.

These Models are necessary to assess the carbon emission in aircraft and as well in Airport.

Technological and operational improvements and provide some recommendations for future developments in Carbon Emission in Aircraft:

“One of the biggest challenges for today’s aviation industry is the need to mitigate its contribution to climate change”.

For years there has been concerns regarding the effect of aviation on the environment (such as air pollution ,noise) and for the past twenty years changes in the climate due to global warming as created a big challenges in the modern life. Most of the industries are taking effective steps to control this air pollution.

A four pillar strategy:

The IATA four-pillar strategy helps to achieve in reduction of carbon emission gases. The four pillar strategy includes the following

- 1 New technology used in the aircraft equipment and engine with less weight, the other most important is the use of biofuels.
2. Skillful operations and back up
3. Best infrastructure (improve air routes, air traffic management and airport procedures)
4. Lower economic budgets

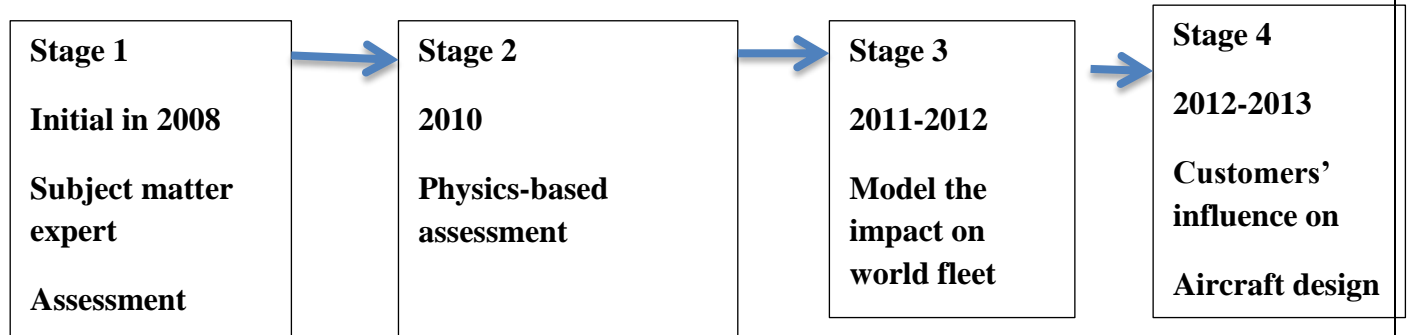
The first of these is the new technology that is the major contribution and is main achievement in reduction of emission. The achievement depends on designing new engines, aircraft and other equipment’s for better fuel efficiency and low carbon emission.

IATA's Four Pillar strategy in 2013



The TERESA Project:

The Theresa project has four phases



Future Concepts and Technologies:

Structural wing

Strut braced wing (SBW) or truss braced wing (TBW), this increases in structural weight of the aircraft thus reducing the engine weight.

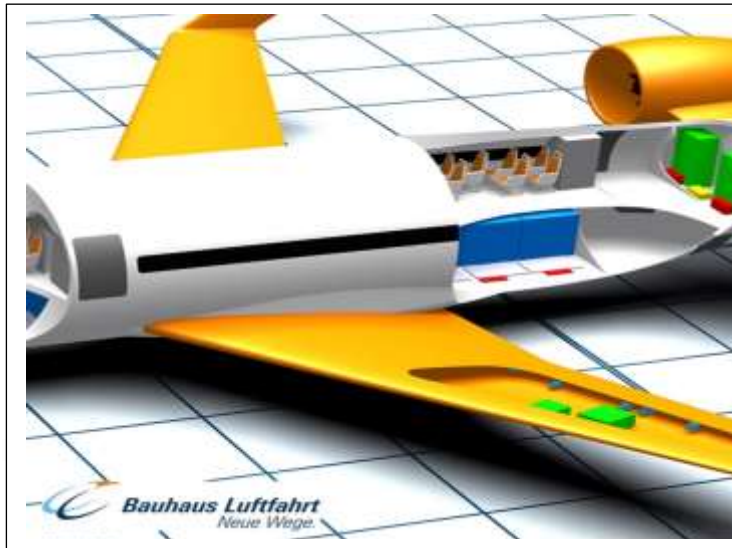
Electrically Propelled Aircraft

The concept is a combination of C shaped wings and electric propulsion system for a new technology.

Hybrid Wing Body:

To increase in efficiency of fuel by eliminating the tail section of the flight. This can be the effective structural development.

A future technology of Ce-Liner a complete Emission free Aircraft:



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Propulsive System



C shaped wings

FUTURE ENGINES IN AVIATION

Propulsion Engine:

Propulsion engine has two types or two forms of models:

Electric propulsion motor: this motor is connected between the fan and gear box, the batteries are easily replaced and recharged.

Hybrid fuel Cell Engine which just uses a single phase of gas for takeoff and landing.

JET ENGINES:

Super jet engines with turbo jet and fans which can contribute fuel efficiency and the increase in speed also. This can save up to 25% of carbon emission.

Green Aviation by NASA:

The recent technology adapted by NASA to create an aircraft in free from emission, noise and of less weight .Thus to promote an Environmental friendly Aircraft

2. Propulsion Engines which can reduce the carbon emission.
3. Systems integrations to reduce the Noise by acting as noise shield.

Aircraft designed to reduce the noise and carbon emission By NASA





Green Aviation:

Technology used:

- Light weight structures and thin surfaces
- Decrease in vertical distances
- Communication system improved between two aircrafts.
- Effective noise shields
- And use of bio fuels to reduce carbon emissions.

Solar Aviation:

The solar aviation which broke the world record in the year of 2015 to 2016 which uses the solar energy and hence this Aviation is an environmental friendly. The projects have started and still major solar aircrafts are under investigations.

Effects of carbon emission:

The carbon emission has affected both the environment and the human beings.

Effects of carbon emission in Environment:

- Unchecked emission of carbon leads to severe changes in the atmosphere, Like
- Increase in the temperatures globally.
- Increase in the sea level
- Weather pattern changes abruptly.
- This as a result leads to changes in the ecosystem, species habitats.

Effects of carbon emission in Human Beings:

- Pollution can lead to respiratory problems (like asthma, wheezing etc.)
- Sometimes can cause skin disorder also.

Recommendations For future Development:

The most important recommendation for future development is

- Planting more trees and plants around the airport and avoid deforestation. If we maintain lots of trees and promote planting we can at least maintain a normal carbon cycle pattern.
- Use of wind turbines for Aviation.
- Promote awareness among the public regarding the carbon emission and its effects to the environment and as well human being. This can promote to develop a Green Aviation.

- Impose taxes on higher emission aircrafts and thus promoting a emission free environment.
- Encourage green Aviation and use of solar Aircrafts.

My recommendation would be to make the environment safe from all man made emission should implement a strong and creative and safe environment.

“By supporting a range of technologies, we can help airports to manage their long term risk while ensuring they have a solution that best fits their individual needs” keep Green and promote a healthy environment.

“High emissions reductions can only be achieved if sufficient efforts are made for new technologies to mature”.



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