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This Project Report on **Greener Aircraft** is submitted for the fulfillment of Phase - I of National Aerolympics 2015 by :

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of

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1. Introduction

Oh! What a wonder in the sky!

It is an aeroplane flying so high!

I am faster than any other transport!

I hold and rest in the airports.

I fly above the mountains and oceans!

I safely drop my passengers in their destination.

I am a feast to your eyes as a twinking stars.

People come with me to travel fast and far.

Because of continuous greed of human desire
There is now need to change my entire attire
So that humans can live safe for generations and generations
Is the spirit behind the green aircraft and green revolution.

Every child has a dream to fly. This desire sometime becomes so overbearing that it manifests into an ambition. Whenever we hear even the faintest roar of an airplane engine, our heart compels us to look up in the sky and see that magnificent masterpiece of modern engineering which climbs up to the zenith of excellence day by day, setting new record and breaking them all by itself.

Because of tremendous use of various types of aircrafts, we are now facing various environmental related problems leading to hazardous air pollution and so on. So its a need of an hour to go for alternative sources of fuel so as to save our precious atmosphere and mother earth. "Greener aircrafts" is one of the stepping stone on our way to save our mother earth and enjoy our future.

2. Mythology

Human beings have been obsessed by the idea of flight since the dawn of recorded history. Myths and legends have also played an important part in man's conquest of the air. He always wished if he could fly, he would escape the troubles of earth, be free as a bird and be closer to the Gods. This intensity of ancient man's desire to fly can be found in many mythological reproductions of India and abroad.

Triptolemus

Demeter and *Triptolemus*are considered to beresponsible for the vegetation on this earth.They taught the world the art of harvesting.According to Greek mythology, *Triptolemus*received seeds and a chariot of winged dragonfrom*Demeter*. With help of this flying chariot*Triptolemus* sowed the whole earth with theseeds received from *Demeter*.

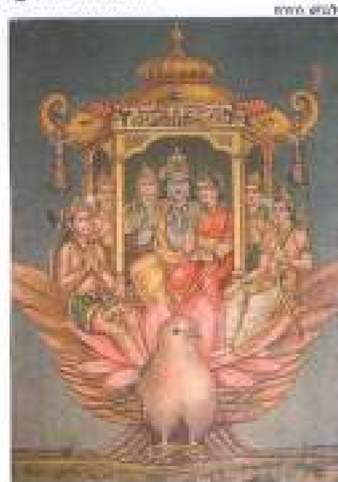
Cupid

In Roman mythology *Cupid* the Roman Godof love is represented as a little boy withwings holding bows and arrows.

Similarly, Egyptian *Griffin* is a legendary-creature termed as king of beast and it has thecharacteristic of lion and eagle, as it has thebody of a lion with his head of an eagle, with erect ears, and feathered breast, with forelegs of an eagle including claws with huge wings. These features indicate a combination of intelligence and strength.

Griffin

Indian mythology is having lots of evidences and is also not behind others, regarding mythological aviation.



PushpakVimana

Amidst that period *Ravana*the King of Sri-Lanka abducted *Sitawife* of Lord *Sri-Rama*, with the help of *PushpakViman*. It was also used by Lord *Sri-Rama* while returning back to Ayodhya after rescuing *Sita*.

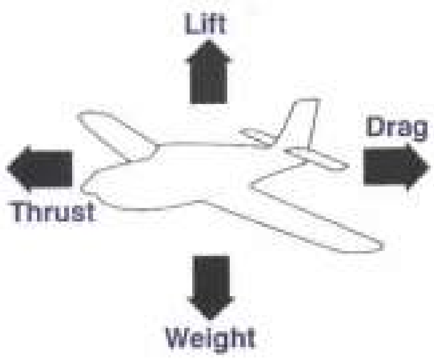
Lord Hanuman

In the same epic there was another excellent example of Lord *Hanuman*, who was able to fly without wings.

3. What is an Aircraft?

The science behind aircraft originates from the study of our feathered friends in the wild. Birds in the flight share all the same flying qualities of our military and commercial aircraft. Man tried to construct aerodynamic wings and fuselage, just like the wings and body of the birds. And the same concept is still continuing in modern aircrafts.

Aircraft is an object that floats on air by overcoming all the resistive forces which birds have to face. However, these forces act differently on aircraft as well as on birds. But the basic principal behind flight depends upon the basic preliminary forces called as weight, lift, drag and thrust.



To move and run an aircraft on ground it has to overcome friction which acts rearwards and retards the motion, called as drag. This drag is overcome by the power of the engine of an aircraft to move the plane in forward direction. This force is called as thrust. To move and run on the runway the thrust should be more than drag. Similarly the lift should be more than its weight. However, when the aircraft is flying at a fixed speed and altitude it is called as level flight. Here thrust equals the drag and lift equals the weight.

Aerodynamic Forces

Aerodynamics is a branch of dynamics, which helps studying motion of air, particularly when it interacts with a moving object. Aerodynamics is a subfield of fluid dynamics and gas dynamics, with much theory shared between them. Aerodynamics is often used synonymously with gas dynamics, with the difference being that gas dynamics applies to all gases. Understanding the motion of air (often called a flow field) around an object enables the calculation of forces and moments acting on the object. Typical properties calculated for a flow field include velocity, pressure, density and temperature as a function of position and time. By defining a control volume around the flow field, equations for the conservation of mass, momentum, and energy can be defined and used to solve the properties. The use of aerodynamics through mathematical analysis, empirical approximations, wind tunnel experimentation, and computer simulations forms the scientific basis for heavier-than-air flight. In physics, the study of the causes of motion and changes in motion is dynamics, in other words study of forces and objects in motion. Dynamics includes study of effect of torque on motion. These are in contrast to Kinematics, the branch of classical mechanics that describes the motion of objects without consideration of the causes leading to the motion.

Thrust

Thrust is the force that moves an aircraft, along a specific path. In aircraft, thrust comes from propellers or jet engines. The force of thrust of aircraft will have a direct bearing on its speed. You may hear the phrase "thrust to weight ratio" in discussions of jet fighter aircraft. This refers to a ratio between the thrust of the jet engine and the weight of the aircraft. All other things being equal, an aircraft with a thrust to weight ratio greater than one (>1) can propel itself straight up against the force of gravity. The *F-16*, with its 25,000 pounds of afterburner thrust, has a thrust to weight ratio of 6.2 : 1.

Lift

Lift is the seemingly magical force that enables aircraft to stay in the air. It is possible due to several interesting principles of physics. When air moves quickly over an arched surface, the air pressure above the surface drops. The wing on an aircraft has a crosssection shaped like the diagram below, which causes air to speed up as it passes over.

As the air speeds up, the pressure drops above the wing. The air pressure under the wing remains normal, which is now at a higher pressure than the air above the wing. This difference in air pressure produces a force in the direction of the low pressure area. This is the force that creates lift in a wing.

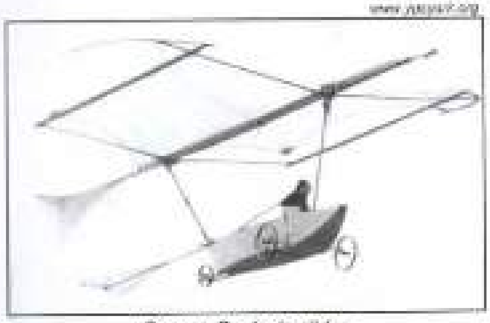
4. Pioneers of an Aviation

Flight has fascinated mankind for centuries and countless unsuccessful flying machines have been designed. The first successful flight was made by the French Montgolfier brothers in 1783, when they flew a balloon over Paris.

Sir George Cayley Father of Aerodynamics

The next major advance was the development of gliders, notably by the Englishman Sir George Cayley, who in 1845 designed the first glider to make a sustained flight, and by the German Otto Lil ienthal, who became known as the world's first pilot because he managed to achieve controlled flights. However, powered flight did not become a practical possibility until the invention of lightweight, petrol driven internal combustion engines at the end of the 19th century.

www.jaayuri.org



George Cayley's glider

Then, in 1905, the American brothers Orville and Wilbur Wright made the first powered flight in their Wright Flyer biplane, which used a four cylinder, petrol driven engine. Aircraft design advanced rapidly, and in 1909 the Frenchman Louis Bleriot made his pioneering flight across the English Channel (sec pp. 400-4001).

www.globpage.info

Wright Flyer, 1903

Shivkar Bāpuji Talpade was an Indian scholar who is said to have constructed and flown an unmanned airplane in 1895. Talpade lived in Mumbai and was a scholar of Sansk ritliterature and the Vedas. He belongedto the Pathare Prabhu community who were the early settlers of Mumbai city.

www.youtube.com

ShivkarTalpade flied first aircraft of world

Talpade's airplane was named *Marutsakhā*, *Marut* ('stream') and *sakhā* ('friend') which together mean 'Friend of wind'. In 1985 D K Kanjilal's book "Vimana in ancient India" and Marathi language newspaper Kesari suggested '*Marutsakhā*' is supposed to have been inspired from Vimāna, ancient flying-machines in Hindu mythology.

The American Glenn Curties also achieved several "firsts" in his Model-D Pusher and its variants, most notably winning the world's first competition for airspeed at Reims in 1909.

www.blog.bubbasgarage.com

Curtis Model-D Pusher, 1911

An organization of pioneers who flew solo before December 17, 1916

earlyaviators.com

5. Transitions: Past and till Date...

Early Monoplanes

Monoplanes have one wing on each side of the fuselage. The principal disadvantage of this arrangement in early, wooden framed aircraft was that single wings were weak and required strong wires to brace them to king posts above and below the fuselage. However, single wings also had advantages, they experienced less drag than multiple wings, allowing greater speed, they also made aircraft more manoeuvrable because single wings were easier to warp (twist) than double wings, and warping the wings was how pilots controlled the roll of early aircraft. By 1912 the French pilot Louis Bleriot had used a monoplane to make the first flight across the English Channel and the Briton Robert Blackburn and the Frenchman Armand Deperdussin had proved the greater speed of monoplanes. However, a spate of crashes caused by broken wings discouraged monoplane production, except in Germany, where all metal monoplanes were developed in 1917. The wings of all metal monoplanes did not did not need strengthening by struts or bracing wires, but despite this, such planes were not widely adopted until the 1930s.

www.en.wikipedia.org

Bleriot XI, 1909

www.biplane-pictures.net

Blackburn Monoplane, 1912

Biplanes and Triplanes

Biplanes Dominated Aircraft Design until the 1930s largely because some early mononplanes were too fragile to withstand the stresses of flight. The struts between biplanes wings made the wings strong compared with those of early monoplanes, although the greater surface area of biplanes wings increased drag and reduced speed. Many aircraft designers also biplanes; more wings meant a shorter wingspan gave greater maneuverability.

www.en.wikipedia.org

Avro Tutor Biplane, 1931

Triplanes were most successful as fighters during World War 1, the German Fokker triplane being a notable example. However, the greater maneuverability of triplanes was no advantage for normal flying and so most manufacturers continued to make biplanes.

Avro Triplane IV, 1910

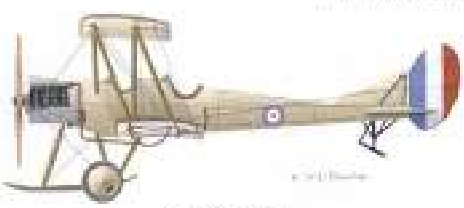
Many other aircraft designs were attempted. Some were quadruplanes, with four pairs of wings. Some had tandem wings (two pairs of monoplane wings, one behind the other) One of the most bizarre designs was by the Englishman Horatio Phillips; it had 20 sets of narrow wings and looked rather like a venetian blind.

www.en.wikipedia.org

Horatio Phillips Aircraft

World War I Aircrafts

When World War 1 started in 1914 the main purpose of military aircraft was reconnaissance. The British built BE 2. Of which the BE 2B was a variant was well, suited to this duty; it was very stable in flight, allowing the occupants to study the terrain, take photographs and make notes. The BE 2 was also one of the first aircraft to drop bombs. One of the biggest problems for aircraft designers during the war was mounting machine guns. On aircraft that had front mounted propellers the field of fire was restricted by the propeller and other parts of the aircraft. The problem was solved in 1915 by the Dutchman Anthony Fokker, who designedan interrupter gear that prevented a machine gun from firing when a propeller blade passed in front of the barrel. The German LVG CVI had a forward firing gun to the right of the engine, as well as a rear cockpit gun, and a bombing capability. It was one of the most versatile aircraft of the war.



BE 2B, 1914

Helicopters

Helicopters use rotating blades for lift, propulsion and steering. The first machine to achieve sustained, controlled flight using rotating blades was the autogiro built in the 1920s by the Spaniard Juan de la Grerva. His machine had unpowered blades above the fuselage that relied on the flow of air to rotate them and provide lift as the autogiro was driven forwards by a conventional propeller. Then, in 1939, the Russian born American Igor Sikorsky produced his VS 300, the forerunner of modern helicopters. Its engine driven blades provided lift, propulsion, and steering. It could take off vertically, hover, and fly in any direction, and had a tail rotor to prevent the helicopter body from spinning. The introduction of gas turbine jet engines to helicopters in 1955 produced quieter, safer, and more powerful machines. Because of their versatility in flight, helicopters are today used for many purposes, including, crop spraying traffic surveillance and transporting crews to deep sea oil rigs, as well as acting as gunships, air ambulance and air taxis.

N53HB_Bell_47G2A

Light Aircrafts

Light Aircraft sugh as the arv super 2 shown here, are small, lightweight, and of simple construction. More than a million have been built since World War 1, mainly for recreational use by private owners. Virtualy all light aircraft have piston engines, most of which are air-cooled, although some are liquid cooled. Open cocopits, almost universal in the 1920s, have today been replaced by enclosed cabins. The cabins of high wing aircraft usually have a sliding or hinged canopy. Most modern light aircraft are made of aluminium alloy, although some are made of wood or of fibre. Reinforred materials. Light aircraft today also usually have navigational instruments, an electrical system, cabin heating, wheel brakes, and a two way radio.

www.en.wikipedia.org

ARV Super2

Gliders, Hang-Gliders and Microlights

Modern gliders are among the most graceful and aerodynamically efficient of all aircraft. Unpowered but with a large wingspan (up to about 25 m, or 82 ft), gliders use currents of hot, rising air (thermals) to stay a lot, and a rudder, elevators and ailerons for control. Modern gliders have achieved flights of more than 1,450 km (900 miles) and altitudes above 15,000 m (49,000 ft). Hang gliders consist of a simple frame across which rigid or flexible material is stretched to form the wings. The pilot is suspended below the wings in a harness or body-bag and, gripping a triangular.

A frame steers by shifting weight from side to side. Lake gliders, hang gliders rely on thermals for lift. Microlights are basically powered hang gliders. A small engine and an open fiberglass car (trike), which can hold a crew of two, are supended benefit a stronger version of a hang glider frame; the frame many have rigid or flexible wings. Microlight pilots, like hang glider pilots, steer by shifting their weight against a frame. Microlights can reach speeds of up to 160 kph (100 mph).

RC Sailplanes: RC Gliders, Slope Soaring

Hang-gliders

www.suggestkeyword.com

Micro-lights

Early Passenger Aircrafts

Until the 1950 most passenger aircraft were biplanes, with two pairs of wings and a wooden or metal framework covered with fabric or sometimes, plywood. Such aircraft were restricted to low speeds and low altitudes because of the drag on their wings. Many had an open cockpit, situated behind or in front of an enclosed but unpressurized – cabin that carried a maximum of ten people. The passengers usually sat in wicker chairs that were not bolted to the floor, and the journey could be bumpy when flying through turbulence.Warm clothing and ear plugs to reduce the effects of prolonged noise, were often required. During the 1930s, powerful, streamlined, all-metal monoplanes, such as the Lockheed Electra shown here, became widespread. By 1959 the advent of pressurized cabins allowed fast flights at high altitudes, where there is less turbulence. Flying boats were still necessary on many routes until 1945 because of inadequate runways and the frequency of emergency sea-landings. World War II, however, resulted in enough good runways being built for land planes to become standard on all major airline routes.

Side view of Lockheed Electra, 1934

World War II Aircrafts

When World War II began in 1939, air forces had already replaced most of their fabric skinned biplanes with all metal stressed skin monoplanes. Aircraft played a far greater role in military operations during World War II than ever before. The wide range of aircraft duties, and the introduction of radar tracking and guidance systems, put pressure on designers to improve aircraft performance. The main areas of improvement were speed, range, and engine power. Bombers became larger and more powerful – converting from two to four engines – in order to carry a heavier bomb load: the US B-17 Flying Fortress could carry up to 6.2 tonnes (6.1 tons) of bombs over a distance of about 3,200 km (2,000 miles). Some aircraft increased their range by using drop tanks (fuel tanks that were jettisoned when empty to reduce drag). Fighters needed speed and maneuverability: the Hawker Tempest shown here had a maximum speed of 700 kph (435 mph), and was one of the few Allied aircraft capable of catching the German jet-powered V1 "flying bomb". By 1944, Britian had introduced its first turbojet-powered aircraft, the Gloster Meteor fighter, and Germany had introduced the fastest fighter in the world, the turboject-powered Me 262, which had a maximum speed of 868 khp (540 mph).

B-17G Flying Fortress Bomber 1943

Modern Piston Aero-Engines

Piston Engines today are used mainly to power the vast numbers of light aircraft and microlights, as well as crop-sprayers and crop-dusters, small helicopters, and fire-bombers (which dump water on large fires). Virtually all heavier aircraft are now powered by jet engines. Modern piston aero-engines work on the same basic principles as the engine used by the Wright brothers in the first powered flight in 1903. However, today's engines are more sophisticated than earlier engines. For examples, modern aero-engines may use a two-stroke or a four-stroke combustion cycle; they may have from one to nine air-or water-cooled cylinders, which may be arranged horizontally, in-line, in V formation, or radially; and they may drive the aircraft's propeller either directly or through a reduction gearbox. One of the more unconventional types of modern aero-engines is the rotary engine shown here, which has a trilobite (three-sided) rotor spinning in a chamber shaped like a fat figure-of-eight.

Napier Gazelle Aircraft Engine

Modern Jetliners 1

Modern Jetliners Have Enabled ordinary people to travel to places where once only the wealthy could afford to go. Compared with the first jetliners (which were introduced in the 1940s), modern ones are much quieter, burn fuel more efficiently, and produce less air pollution. These advances are largely due to the replacement of turbojet engines with turbofan engines. The greater power of turbofan engines at low speeds enables modern jetliners to carry more fuel and passengers than turbojet aircraft; a modern Boeing 747 -400 (popularly known as a "jumbo jet") can fly 400 people for 13,700 km (8,500 miles) without needing to refuel. Jetliners fly at high altitudes, typically cruising at 8,000 – 11,000 m (26,000 – 36,000 ft), where they can use fuel efficiently and usually avoid bad weather.

Modern Jetliner Engine

The pilot always controls the aircraft during takeoff and landing, but at other times the aircraft is usually controlled by an autopilot. Autopilots are complex on board mechanisms that detect deviations from an aircraft's rout and make appropriate adjustments to the flight controls. Flight decks are also equipped with radars that warn pilots of approaching hazards, such as mountain ranges, bad weather and other aircraft.

Modern Airliner

Supersonic Jetliners

Supersonic aircraft fly faster than the speed of sound (Mach I). There are many supersonic military aircraft, but only two supersonic passenger carrying aircraft (also called (SSTs, or supersonic transports) have been produced the Russian Tu – 144 and Concorde, produced jointly by Britain and France. The Tu-144 was withdrawn in 1978 after only seven months in service. The concorde remained in service from 1976 until 2002, with a break for modifications from July 2000 until October 2001. Its features included a droop nose, which lowered during take off and landing to aid visibility from the cockpit; the pumping of fuel between forward and aft trim tanks helped stabilize the aircraft. The concorde had a narrow fuselage and shortspan wings to reduce drag during supersonic flight. Its noisy turbojet engines with afterburners enabled it to carry 100 passengers at a cruising speed of Mach 2 at 15,000 – 18,000 m (50,0000 – 60,000 ft). Once an aircraft is flying faster than Mach 1, it produces a continuous air pressure wave, which is heard as a "sonic boom".

www.lightcrossovde.deviantart.com

Concorde

Jet Engines

Jet engines are used by most military and heavy aircraft, and by many helicopter. The simplest type of jet engine, or gas turbine, is the turbojet. It works by continuously burning a mixture of fuel and air in a combustion chamber to produce a jet of hot exhaust gas that is expelled through a nozzle to produce thrust. The hot gas also spins turbine blades, which, in turn, spin the blades of an air compressor; the compressor forces air into the combustion chamber. Many of the fastest aircraft use turbojets, with additional booster units called afterburners, but their use is restricted by their high noise emission. Most jetliners use turbofan jet engines, which are quieter. An enormous fan, driven by a low pressure turbine, feeds some air into the compressor but feeds most of it through by pass ducts to join the exhaust jetstream in the tail cone. The bypass stream produces most of the thrust. Many smaller, propeller driven aircraft use turboprop jet engines, in which the engine powers a propeller.

www.en.wikipedia.org

J58 engine on display at the Evergreen Aviation & Space Museum

Modern Military Aircrafts

Modern military aircraft are among the most sophisticated and expensive products of the 21^{st} century. Fighters need computer operated controls for maneuverability, powerful engines, and effective air-to-air weapons. Most modern fighters also have guided missiles, radar, and passiveinfra-red sensors. These developments enable today's fighters to engage in combat with adversaries that are outside visual range. Bombers carry a large weapon load and enough fuel for long range flights. A few military aircraft, such as the 'Tornado and the F-14 Tomcat, have variable sweep ("swing") wings. During takeoff and landing their wings are fully extended but for high speed flight and low level attacks the wings are pivoted fully back. A recent development is the "stealth" bomber, which is designed to absorb of deflect enemy radar in order to remain undetected. Earlier bombers, such as the Tornado, use terrain following radars to fly so close to the ground that they avoid enemy radar detection.

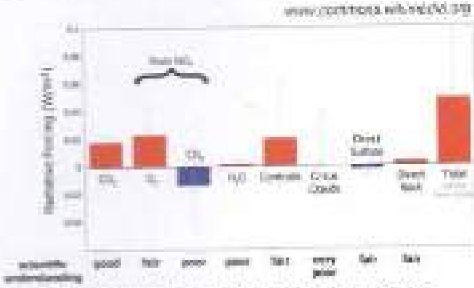
www.wired.com

Stealth Fighter Planes

6. Environmental Impact of Aviation

The bad impact of aviation occurs because aircraft engines emit heat, noise, particulate matters and gases which contribute to climate changes and global warming. Total pollution attributable to aviation has been found to increase despite of various advancements in technologies such as emission reductions from automobiles, more fuel-efficient and less polluting turbo fan and turbo POP engines. In the European Union, greenhouse gas emissions from aviation increased by 87% between 1990 and 2006.

www.commons.wikimedia.org



Radioactive Forcing from Aviation Effects

Mechanism and Cumulative Effects of Aviation on Climate:

The contribution of civil aircraft-in-flight to global CO_2 emissions has been estimated at around 2%. However, in the case of high-altitude airliners which frequently fly near or in the stratosphere,non-CO_2 altitude - sensitive effects may increase the total impact on anthropogenic (human-made) climate change significantly. A 2007 report from Environmental Change Institute / Oxford University posits a range closer to 4 percent cumulative effect. Subsonic aircraft-in-flight contribute to climate change in four ways.

Carbon dioxide (CO_2)

CO_2 emissions from aircraft-in-flight are the most significant and best understood element of aviation's total contribution to climate change. The level and effects of CO_2emissions are currently believed to be broadly the same regardless of altitude (i.e. they have the same atmospheric effects as ground based emissions). In 1992, emissions of CO_2 from aircraft were estimated at around 2% of all such anthropogenic emissions, and that year the atmospheric concentration of CO_2 attributable to aviation was around 1% of the total anthropogenic increase.

Oxides of Nitrogen (NO_x)

At the high altitudes flown by large jet airliners around the tropopause, emissions of NO_x are particularly effective in forming ozone (O_3) in the upper troposphere. High altitude (8-13km) NO_x emissions result in greater concentrations of O_3 than surface NO_x emissions, and these in turn have a greater global warming effect. The effect of O_3 concentrations are regional and local (as opposed to CO_2 emissions, which are global).

NO_x emissions also reduce ambient levels of methane, another greenhouse gas, resulting in a climate cooling effect. But this effect does not offset the O_3 forming effect of NO_x emissions. It is now believed that aircraft sulfurand water emissions in the stratospheretend to deplete O_3, partially offsetting the NO_x induced O_3 increases. These effects have not been quantified. This problem does not apply to aircraft that fly lower in the troposphere, such as light aircraft or many commuter aircraft.

www.en.wikipedia.org

Cirrus cloud formation

One of the products of burning hydrocarbons in oxygen is water vapour, a greenhouse gas. Water vapour produced by aircraft engines at high altitude, under certain atmospheric conditions, condenses into droplets to form Condensation trails, or contrails. Contrails are visible line clouds that form in cold, humid atmospheres and are thought to have a global warming effect (though one less significant than either CO_2 emissions or NO_x induced effects). Contrails are extremely rare from lower-altitude aircraft, or from propeller-driven aircraft or rotorcraft.Water vapor (H_2O), and contrails.

Contrails

Cirrus clouds have been observed to develop after the persistent formation of contrails and have been found to have a global warming effect over-and-above that of contrail formation alone. There is a degree of scientific uncertainty about the contribution of contrail and cirrus cloud formation to global warming and attempts to estimate aviation's overall climate change contribution do not tend to include its effects on cirrus cloud enhancement. However, a 2015 study found that artificial cloudiness caused by contrail "outbreaks" reduce the difference between daytime and nighttime temperatures. The former are decreased and the latter are increased, in comparison to temperatures the day before and the day after such outbreaks.

Particulates

Least significant is the release of soot and sulfate particles. Soot absorbs heat and has a warming effect; sulfate particles reflect radiation and have a small cooling effect. In addition, they can influence the formation and properties of clouds. All aircraft powered by combustion will release some amount of soot.

Greenhouse Gas Emissions per Passenger Kilometres

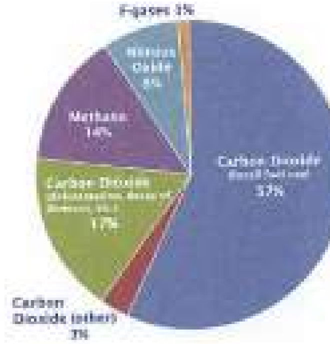
Averaged Emissions

Emissions of passenger aircraft per passenger kilometre vary extensively because of differing factors such as the size and type of aircraft, the altitude and the percentage of passenger or freight capacity of a particular flight, and the distance of the journey and number of stops en route. Also, the effect of a given amount of emissions on climate (radiative forcing) is greater at higher altitudes: see below. Some representative figures for CO_2 emissions are provided by LIPASTO's survey of average direct emissions (not accounting for high-altitude radiative effects) of airliners expressed as CO_2 and CO_2 equivalent per passenger kilometre:

- Domestic, short distance, less than 463 km (288 mi): 257 g/km CO_2 or 259 g/km (14.7 oz/mile) CO_2.
- Domestic, long distance, greater than 463 km (288 mi): 177 g/km CO_2 or 178 g/km (10.1 oz/mile) CO_2.
- Long distance flights: 113 g/km CO_2 or 114 g/km (6.5 oz/mile) CO_2.

Total Climate Effects

In attempting to aggregate and quantify the total climate impact of aircraft emissions the Inter governmental Panel on Climate Change (IPCC) has estimated that aviation's total climate impact is some 2-4 times that of its direct CO_2 emissions alone (excluding the potential impact of cirrus cloud enhancement). This is measured as radiative forcing. While there is uncertainty about the exact level of impact of NOx and water vapour, governments have accepted the broad scientific view that they do have an effect. Globally in 2005, aviation contributed "possibly as much as 4.9% of radiative forcing." UK government policy statements have stressed the need for aviation to address its total climate change impacts and not simply the impact of CO_2.



The IPCC has estimated that aviation is responsible for around 3.5% of anthropogenic climate change, a figure which includes both CO_2 and non-CO_2 induced effects. The IPCC has produced scenarios estimating what this figure could be in 2050. The central case estimate is that aviation's contribution could grow to 5% of the total contribution by 2050 if action is not taken to tackle these emissions, though the highest scenario is 15%. Moreover, if other industries achieve significant cuts in their own greenhouse gas emissions, aviation's share as a proportion of the remaining emissions could also rise.

Future Emission Level

Even though there have been significant improvements in fuel efficiency through aircraft technology and operational management as described here, these improvements are being continually eclipsed by the increase in air traffic volume.

What is the scope for improving efficiency to reduce emission?

Aircraft Efficiency

While it is true that late model jet aircraft are significantly more fuel efficient (and thus emit less CO_2 in particular) than the earliest jet airliners, new airliner models in the first decade of the 21st Century were barely more efficient on a seat-mile basis than the latest piston-powered airliners of the late 1950 (e.g. ConstellationL-1649-A and DC-7C).

Claimsfor a high gain in efficiency for airliners over recent decades (while true in part) has been biased high in most studies, by using the early inefficient models of jet airliners as a baseline. Those aircraft were optimized for increased revenue, including increased speed and cruising altitude, and were quite fuel inefficient in comparison to their piston-powered forerunners.

Today, turboprop aircraft - probably in part because of their lower cruising speeds and altitudes (similar to the earlier piston-powered airliners) compared to jet airliners- play an obvious role in the overall fuel efficiency of major airlines that have regional carrier subsidiaries. For example, although Alaska Airlines scored at the top of a 2011-2012 fuel efficiency ranking, if its large regional carrier - turbo-prop equipped Horizon Air- were dropped from the lumped-in consideration, the airline's ranking would be somewhat lower, as noted in the ranking study.

Aircraft manufacturers are striving for reductions in both CO_2 and NOx emissions with each new generation of design of aircraft and engine. While the introduction of more modern aircraft represents an opportunity to reduce emissions per passenger kilometre flown, aircraft are major investments that endure for many decades, and replacement of the international fleet is therefore a long-term proposition which will greatly delay realizing the climate benefits of many kinds of improvements. Engines can be changed at some point, but nevertheless airframes have a long life. Moreover, rather than being linear from one year to the next the improvements to efficiency tend to diminish over time, as reflected in the histories of both piston and jet powered aircraft.

Operation Efficiency

Adding an electric drive to the airplane's nose wheel may improve fuel efficiency during ground handling. This addition would allow taxiing without use of the main engines.

Other opportunities arise from the optimisation of airline timetables, route networks and flight frequencies to increase load factors (minimise the number of empty seats flown), together with the optimisation of airspace.

Another possible reduction of the climate-change impact is the limitation of cruise altitude of aircraft. This would lead to a significant reduction in high-altitude contrails for a marginal trade-off of increased flight time and an estimated 4% increase in CO_2 emissions.

Life-cycle Assessment of Emissions by Airliners made of Composites

A life-cycle assessment of the cradle-to-grave energy consumption of airliners made of carbon-fiber-reinforced polymer (CFRP) has shown that by 2050 such aircraft could result in a 14-15% reduction in CO_2 emissions by the airline industry, compared to conventional airliners. The study considers the CO_2 emissions of the construction, operation and eventual disposal of aircraft like the Boeing 787. While the emissions reduction for an individual aircraft is estimated to be 20%, the study arrived at the 14-15% fleet-wide estimate "because of the limited fleet penetration by 2050 and the increased demand for air travel due to lower operating costs."

Alternative Fuels

Some scientists and companies such as GE Aviation and Virgin Fuels are researching biofuel technology for use in jet aircraft. Some aircraft engines, like the Wilksch WAM120 can (being a 2-stroke Diesel engine) run on straight vegetable oil. Also, a number of Lycoming engines run well on ethanol.

In addition, there are also several tests done combining regular petrofuels with a biofuel. For example, as part of this test Virgin Atlantic Airways flew a Boeing 747 from London Heathrow

Airport to Amsterdam Schiphol Airporton 24 February 2008, with one engine burning a combination of coconut oil and babassu oil.Greenpeace's chief scientist Doug Parr said that the flight was "high-altitude greenwash" and that producing organic oils to make biofuel could lead to deforestation and a large increase in greenhouse gas emissions. Also, the majority of the world's aircraft are not large jetliners but smaller piston aircraft, and with major modifications many are capable of using ethanol as a fuel. Another consideration is the vast amount of land that would be necessary to provide the biomass feedstock needed to support the needs of aviation, both civil and military.

In December 2008, an Air New Zealand jet completed the world's first commercial aviation test flight partially using jatropha-based fuel. Jatropha, used for biodiesel, can thrive on marginal agricultural land where many trees and crops won't grow, or would produce only slow growth yields. Air New Zealand set several general sustainability criteria for its Jatropha, saying that such biofuels must not compete with food resources, that they must be as good as traditional jet fuels, and that they should be cost competitive with existing fuels.

In January 2009, Continental Airlines used a sustainable biofuel to power a commercial aircraft for the first time in North America. This marks the first sustainable biofuel demonstration flight by a commercial carrier using a twin-engined aircraft, a Boeing 737-800, powered by CFM International CFM56-7B engines. The biofuel blend included componentsderived from algae and jatropha plants.

One fuel biofuel alternative to avgas that is under development is Swift Fuel. Swift fuel was approved as a test fuel by ASTM International in December 2009, allowing the company to continue their research and to pursue certification testing. Mary Rusek, president and co-owner of Swift Enterprises predicted at that time that "100SF will be comparably priced, environmentally friendlier and more fuel-efficient than other general aviation fuels on the market".

Kyoto Protocol

Greenhouse gas emissions from fuel consumption in international aviation, in contrast to those from domestic aviation and from energy use by airports, are excluded from the scope of the first period (2008-2012) of the Kyoto Protocol, as are the non-CO_2 climate effects. Instead, governments agreed to work through the International Civil Aviation Organization (ICAO) to limit or reduce emissions and to find a solution to the allocation of emissions from international aviation in time for the second period of the Kyoto Protocol starting from 2009; however, the Copenhagen climate conference failed reach an agreement.

Recent research points to this failure as a substantial obstacle to global policy including a CO_2 emissions reduction pathway that would avoid dangerous climate change by keeping the increase in the average global temperature below a 2°C rise.

Effects of Climate Change on Aviation

Increased Turbulence

A report published in the science journal *Nature Climate Change* forecasts that increasing CO_2 levels will result in a significant increase in in-flight turbulence experienced by trans-Atlantic airline flights the middle of the 21st century. The lead author of the study, Paul Williams, a researcher at the National Center for Atmospheric Science, at the University of Reading stated, "air turbulence does more than just interrupt the service of in-flight drinks. It injures hundreds of passengers and aircrew every year - sometimes fatally. It also causes delays and damage to planes."

Noise

Aircraft noise is seen by advocacy groups as being very hard to get attention and action on. The fundamental issues are increased traffic at larger airports and airport expansion at smaller and regional airports.

Air Quality

Air quality around airports is another major issue and a 2006 study found that a level of nitrogen dioxide exceeds EU guidelines at morethan two thirds of airports surveyed. Birmingham airport dismissed the findings, asserting that the results were skewed by M42 motorway traffic unrelated to the airport, whilst studies at Southampton Airport attribute 5.55 per cent of total pollutants to airport activities, the majority of the remainder being generated by non-airport related road traffic.

7. Need of Aviation to "GO GREEN"

www.sandvik.coromant.com

We observe the bad impact of various types of pollution on our atmosphere. This ultimately will lead to hazardous effects on all living organisms of the world. So their is a need to "Go Green" in aviation sector. This includes changes in engines mechanism, optional conventional fuels, aircraft body etc.

Everyone agrees that aircraft engines needs to get greener. Does the answer lie in revolutionary propulsion systems, or will our future travels will be powered by the same old jet engine running on renewable fuels? The present Metal working World looks into the aero engines of the future. The gas turbine jet engine has served the airline industry well for more than 50 years, with relatively few changes in the propulsion system. But with the aircraft industry facing increasingly stringent legislation on emissions and noise pollution as well as continuously increasing fuel costs, researchers are working to ratchet up the speed of technology development.

Aviation contributes about 2 percent of the CO_2 emissions from fossil fuel use, and as demand for air travel rises, so do emissions. Mean while, airport nitrogen oxide (NOx) emissions from burning jet fuel, which cause acid rain and smog and cost society billions of dollars each year from illnesses and death, are expected to double before 2020. To counter this, in 2001 the European aviation industry set a target to reduce fuel consumption by 50 percent per passenger-kilometre by 2020 and NOx emissions from commercial aircraft by 80 percent in the same year.

In the short term, experts agree that progress in making engines cleaner and more efficient will take place via a series of small evolutions, rather than a revolution. Development projects at universities, research institutions and engine manufacturers are constantly coming up with minor tweaks to engines to improve their fuel efficiency, such as the Rolls-Royce PANACEA project in which Sandvik Coromant was a key partner. By introducing new materials for engine components, the project will reduce fuel consumption by 0.3 to 0.5 percent, saving 600 kilograms of CO_2 every time an aircraft crosses the Atlantic.

Meanwhile, competing engine manufacturer GE Aviation recently announced a new propulsion system for business jets that draws on a combination of military and civilian technologies. Its Passport engines, which are under development and expected to enter full-scale testing in 2013, feature a higher pressure ratio and a compressor made of new – and unnamed – advanced materials. GE predicts that the engines will achieve 8 percent lower fuel consumption and considerably lower NOx emissions. "Passport is … the world's first integrated propulsion system specifically designed for ultra-long-range, large-cabin business jets, giving customers the power to fly … more quietly and efficiently".

The pulse detonation engine, which has the potential to radically increase thermal efficiency, is one of the more exciting propulsion technologies being researched. "Algae could provide a solution to produce the necessary amounts of biofuels without competing with food production.

Open rotor engines:

Also known as propfans and ultra-high bypass engines, open rotor engines offer the fuel economy of a turboprop with the speed and performance of a turbofan. Patented in 1979, open rotor engines have the potential to deliver fuel savings of around 30 percent, but they are noisier than other engine types.

Intercooled recuperated engine:

The integration into the aircraft engine of an intercooler and a recuperator, or heat exchanger, makes it possible to recover heat from the hot exhausts to the combustion chamber and to decrease the temperature rise of the burner. This can contribute to fuel savings of around 30 percent and at the same time reduce NOx and noise levels.

Renewable fuels:

Jatropha, a weed-like plant that grows on barren land, is being hailed as a potential source of jet fuel. Several airlines have successfully tested the oil produced from jatropha seeds, which, it is claimed, offers greenhouse gas reductions of up to 60 percent compared with petroleum-based jet fuel. In June 2011 a Gulfstream G450 powered by equal amounts of traditional fuel and a camelina-based biofuel made the first-ever transatlantic biofuel-powered flight.

8. Green Revolution in Aviation Sector

Taking the cognizance of ill-effects of aviation, various efforts throughout the world are being taken to control the bad impact. Organizations working in these fields are as follows.

Aviation Environment Federation

The **Aviation Environment Federation** (AEF) is the principal UK non-profit making organisation concerned with the environmental effects of aviation. These range from aviation noise issues associated with small airstrips or helipads to the contribution of airline emissions to global warming (the current climate change). The AEF is widely quoted in international media as a source of research and analysis on issues related to aviation and the environment.

The AEF was established in 1975 and now has over 120 affiliated members comprising community and environmental groups, local authorities, parish councils, businesses and consultancies.

AEF is a member of AirportWatch, a UK-wide network of conservation and residents' groups, and GreenSkies, an umbrella organisation comprising all the major European NGOs who hold a stake in aviation policy.

Carbon credits

Carbon based molecules are crucial for life on earth, as it is main component of biological compounds. Carbon is also a major component of many minerals carbon also exists in various.

An important step in this process was made in 1995 when over 2500 scientist around the world agreed for the first time that the emissions of green house gases from human activities have influenced the global climate. So the resultant conclusion was to reduce this emissions drastically.

The mechanism was formalised in the Kyoto protocol, an international agreement between more than 170 countries. The main aim was to reduce the emissions.

In this process emerged a new experimental concept known as CARBON CREDIT.

Now what do 'credits' mean ideally, here 'credit' means a 'certificate' just like a stock. It is also called as 'CER' (Certified Emissions Reductions).

Under the Kyoto protocol every country have been given assigned amounts or 'caps' or quotas. These quotas or caps represent an allowance for eg one metric tones of carbon-dioxide equivalent and these are entered into the country's national registry.

The countries in turn then set quotas on the emissions for the local business other industries or organisations. These organisationsare called as operators.

Kyoto protocol was voluntarily signed by 141 countries. The preliminary phase ended in 2007. Whereas the second phase started from 2008.

The emissions cap, as well as the time frame has been specified.

Kyoto protocol provides certain flexible mechanisms to enable the countries to meet the objectives in any manner. The industry must find the lowest cost solutions to meet these objectives, with all the raw material they have at their disposal.

But the underlying thumb rule is the decided baseline against time frame.

Carbon based molecules are crucial for life on earth. Since the industrial revolution, the entire globe has been converted to two main zones. First developed countries like US, Western European countries eg - Germany, France, whose economy is flourishing on industries and factories. But in turn because of this human activity, it has modified the carbon cycle. By burning fossil fuels, it is changing the terrestrial and oceanic biosphere.

India, China and some other Asian countries fall into developing countries whose main economy is based on agriculture. These developing countries are already following the standard level of carbon emission.

Kyoto protocol is acknowledging the efforts of low carbon emission put up by these countries by awarding them certificates called as CARBON CREDITS.

All the developing countries who are emitting more carbon other gases should voluntarily bring down the level of carbon they are emitting to the levels of early 1990's.

The time frame allotted to bring down the emission is from 2008 to 2012.

These developed countries have decided different norms to bring down the level of emission fixed for their companies and factories.

A developed country can 'sponsor' a greenhouse gas reduction project in a developing country where the cost of the project is usually much lower.

In this transaction, the developing countries can trade the carbon credits by selling them to developed countries that are exceeding their emission targets.

Some more important efforts are in the pipe line of various technologies which will ultimately help to reduce the pollution level to the great extent. Some important efforts are listed below.

Ecofriendly Plane

www.en.wikipedia.org

According to the Stern Review on the Economics of Climate Change, the CO_2 from aviation accounts for 1.6% of all global greenhouse gas emissions and is set to reach 2.5% by 2050. IATA started the environmental movement for airlines by setting an important and significant goal – creating a zero-emissions airplane within 50 years. Taking this into consideration some airlines have taken steps to develop ecofriendly planes which will help the environment by the reduction of CO_2 emission. These airlines are-

Virgin Airlines started its environmental efforts by signing a deal with *Boeing* that supposes the purchasing a number of ecofriendly aircrafts to use on their routes. The airline will receive 15 *787-9 Dream liners*, that use 20% less fuel for every passenger onboard than other planes of a similar size.

www.en.wikipedia.org

The new aircrafts will also be able to offer less bumpy takeoffs and landings, cleaner air, larger windows, more storage space and enhanced lighting onboard.

Continental Airlines replaced a large part of their fleet with planes that are more energy efficient. The company saved an impressive amount of fuel and reduced emissions by 5%, after installing winglets on all their *Boeing 737's and 757's*. Moreover, the airline has begin experimenting *Boeing737's* flights with bio fuel, which is made from extracts of algae and jartopha plants.

Easy Jet plans on installing new energy efficient engines on all their *Airbus A319's*. By doing that, the company intends to cut the mono-nitrogen oxide emissions by 25 percent. By 2015, the Easy Jet officials have in mind reducing noise by 25%, CO_2 emissions by 50% and NOx by more than 75%. According to the company's officials, Easy Jet has cut its CO_2 emissions per passenger kilometre by 18% since 2002. Their efficiency and use of smaller airports allows easy Jet to fly more passengers /flight and emit 27% less carbon per passenger km than regular companies.

www.de.wikipedia.org

www.greendiary.com

Eco-friendly Engine

Lufthansa is one of the companies that made a commitment to the environment. The airline plans to use at least 10% of bio fuel of the total fuel needed for flying and adopts new technologies and rules that will cut carbon dioxide emissions by 25% until 2020. *Lufthansa* also has a set of instruments onboard (Mozart) ozone, water vapor, NO_2 or CO_2, which scientist use to understand weather and make forecast more precise.

Nature Air is an airline built on a 100% carbon neutral aviation program. Nature Air, Costa Rica's national airline, engages passengers in a carbon offset scheme and a commitment for fuel reduction, both on the ground and in the air. Nature Air has developed Costa Rica's only bio-diesel fueling station and aims to become climate neutral by 2021.

The *EcoJet* is a proposed short-haul aircraft for 100 to 200 passengers using propfan engines till 2015 by Easy Jet in June 2007. The aim of the EcoJet is to build a passenger aircraft that would be more environmentally friendly than current generation jets (like its direct competitors *Boeing 737* and the *Airbus A320* family), because the intended design using would reduce carbon dioxide emissions by 50%, nitrogen oxide emissions by 75%, and noise pollution by 25% versus current Boeing 737 standards.

www.design-engine.com

Eco-friendly Aircraft Crew 1

In an era when everything else is accelerating, airplanes are actually flying at similar speeds than they used to. Fuel efficiency and noise is the major reason behind doing so.

Airliners are always trying to make more profits by cutting costs like overheads, cutting stoppages to save landing charges of different airports, avoiding diversions to save fuel, making the flights fuel efficient.

The less fuel planes have to burn the friendlier they are to the environment as far as emissions are concerned. Efforts are on to reduce emissions by sustainable bio-fuels for aviation which could reduce CO_2 emissions 80%, on a full carbon life cycle basis. IATA's focus is on bio-fuels sourced from second or new generation (e.g. Algae, Jatropha, Camelina) biomass. The industry also tries to reduce aircrafts' emissions by developing cleaner burning combustion chambers. Another reason is the passenger planes don't go faster than the speed of sound because they would produce sonic booms. Aircraft noise has always been a problem, and even though some piston-engine planes produced noise that many found annoying, it was the arrival of jet engines that increased the level of noise on many aircraft.

www.blogspot.com

The biggest source of aircraft noise is the engines. Designers have succeeded in reducingthe noise by different methods like Advanced Chevron designs, application of fluidics and smarter materials. It is not that these jet engines cannot travel faster than speed at which they are cruising. But regulations and fuel economy restrict them from doing so. Safety is the major component in development of Aviation Industry. Many major changes occurred in the industry with respect to safety of passengers, crew and nature also. What if all the aircraft engines fail during flight? This was the major concern. Reliability has increased tremendously in past 50 years. Boeing 707, 737, DC-3, DC-7 were the aircrafts flying with 3-4 engines. Although they were running on only one engine in flight but as a safety measures these aircrafts had 3-4 engine, so that if any engine fails pilot could use another engines.

When we talk of Boeing 787 Dreamliner, aircraft which is 2.5 times bigger than his predecessors, have only two engines. This aptly shows the increased reliability of the engines in these days.

Ecofriendly Airports

Following are the best three eco-friendly airports present in the world which have taken congnigence of saving our earth from pollution.

Boston Logan International Airport (BOS)

Boston Logan proved to be one of the leaders in green initiatives with the first LEED certified airport terminal in the U.S. In addition, the airport has wind turbines and solar panels. More recently, the gates at BOS were outfitted with aircraft plug-in power options at each gate so that airplanes don't have to run the auxiliary power units as much while located at the gate.

BOS gained approval and notoriety for an environmentally-friendly asphalt mix that reduced CO_2 emissions drastically and saved fuel and energy during construction.

Denver International Airport (DIA)

Tied with Atlanta Hartsfield for best domestic airport in Executive Travel Magazine, Denver International Airport is an all-around green airport. DIA has the largest solar farm at a commercial airport in the United States.

In addition to recycling the usual paper, plastic bottles and aluminum, DIA recycles over 20 types of materials, including restaurant grease, organics, aircraft deicing fluid, glass and demolition materials.

Gates at DIA provide plug-in power and pre conditioned air so that aircraft APUs don't have to run as often, which lowers emissions. And alternative-fuel vehicles are plentiful at DIA, which offers a fee reduction to taxicab companies and others that choose to use hybrid vehicles.

Seattle-Tacoma Airport (SEA)

SEA-TAC's new consolidated rental car facility meets LEED requirements with organic compound paint, sealant, adhesive and carpet. And SEA-TAC expects to recycle about 96% of excess building material from the project.

Along with the usual recyclables, SEA-TAC airport offices and vendors recycle at least 10 different materials, including cooking oil and coffee grounds. The recycling program is a rewards-based one in which electronic trash monitoring devices charge retailers for trash receptacle usage, and recycling is free.

Alternative sources of fuel

Tremendous research is going on in the field of studying alternative sources of fuel for future aircrafts. Some of the important fuels are discussed below.

Biofuel

A biofuel is a fuel that is produced through contemporary biological processes, such as agriculture and anaerobic digestion, rather than a fuel produced by geological processes such as those involved in the formation of fossil fuels, such as coal and petroleum, from prehistoric biological matter. Biofuels can be derived directly from plants, or indirectly from agricultural, commercial, domestic, and/or industrial wastes. Renewable biofuels generally involve contemporary carbon fixation, such as those that occur inplants or microalgae through the process of photosynthesis. Other renewable biofuels are made through the use or conversion of biomass (referring to recently living organisms, most often referring toplants or plant-derived materials). This biomass can be converted to convenient energy containing substances in three different ways: thermal conversion, chemical conversion, and bio-chemical conversion. This biomass conversion can result in fuel in solid, liquid, or gas form. This new biomass can also be used directly for biofuels.

Bio electric hybrid aircraft

Bioethanol is an alcohol made by fermentation, mostly from carbohydrates produced in sugar or starch crops such as corn,sugarcane, or sweet sorghum. Cellulosic biomass, derived from non-food sources, such as trees and grasses, is also being developed as a feedstock for ethanol production. Ethanol can be used as a fuel for vehicles in its pure form, but it is usually used as a gasoline additive to increase octane and improve vehicle emissions. Bioethanol is widely used in the USA and in Brazil. Current plant design does not provide for converting the lignin portion of plant raw materials to fuel components by fermentation.

Biodiesel can be used as a fuel for vehicles in its pure form, but it is usually used as a diesel additive to reduce levels of particulates,carbon monoxide and hydrocarbons from diesel-powered vehicles. Biodiesel is produced from oils or fats using transesterification and is the most common biofuel in Europe.

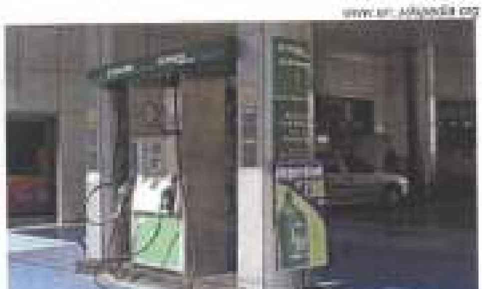
In 2010, worldwide biofuel production reached 105 billion liters (28 billion gallons US), up 17% from 2009, and biofuels provided 2.7% of the world's fuels for road transport, a contribution largely made up of ethanol and biodiesel. Global ethanol fuelproduction reached 86 billionliters (23 billion gallons US) in 2010, with the United States and Brazil as the world's top producers, accounting together for 90% of global production. The world's largest biodiesel producer is the European Union, accounting for

53% of all biodiesel production in 2010. As of 2011, mandates for blending biofuels exist in 31 countries at the national level and in 29 states or provinces. The International Energy Agency has a goal for biofuels to meet more than a quarter of world demand for transportation fuels by 2050 to reduce dependence on petroleum and coal.

First-generation biofuels

"First-generation" or conventional biofuels are made from sugar, starch, or vegetable oil.

www.en.wikipedia.org



Neat ethanol on the left (A), gasolineon the right (G) at a filling station inBrazil

Biologically produced alcohols, most commonly ethanol, and less commonly propanol and butanol, are produced by the action of microorganisms and enzymes through the fermentation of sugars or starches (easiest), or cellulose which is more difficult. Bio-butanolalso called bio-gasoline) is often claimed to provide a direct replacement for gasoline, because it can be used directly in a gasoline engines.

Ethanol fuel is the most common biofuel worldwide, particularly in Brazil. Alcohol fuels are produced by fermentation of sugars derived from wheat, corn, sugar beets, sugar cane, molasses and any sugar or starch from which alcoholic beverages such as whiskey, can be made such as potato and fruit waste, etc. The ethanol production methods used are enzyme digestion to release sugars from stored starches, fermentation of the sugars, distillation and drying.

In high-altitude i.e. thin air locations, some states mandate a mix of gasoline and ethanol as a winter oxidizer to reduce atmospheric pollution emissions.

Biodiesel

Biodiesel is the most common biofuel in Europe. It is produced from oils or fats using transesterification and is a liquid similar in composition to fossil/mineral diesel. Chemically, it consists mostly of fatty acid methyl (or ethyl) esters (FAMEs). Feedstocks for biodiesel include animal fats, vegetable oils, soy, rapeseed, jatropha, mahua, mustard, flax, sun-flower, palmoil, hemp, field pennycress, *Pongamiapinnata* and algae. Purebiodiesel currently reduces emissions with up to 60% compared to diesel Second generation.

Biodiesel can be used in any diesel engine when mixed with mineral diesel. In some countries, manufacturers cover their diesel engines under warranty for B100 use, although Volkswagen of Germany, for example, asks drivers to check by telephone with the VW environmental services department before switching to B100. B100 may become more viscous at lower temperatures, depending on the feedstock used. In most cases, biodiesel is compatible with diesel engines from 1994 onwards, which use 'Viton' synthetic rubber in their mechanical fuel injection systems. However, no vehicles are certified for using neat biodiesel before 2014, as there was no emission control protocol available for biodiesel before this date.

Electronically controlled 'common rail' and 'unit injector' type systems from the late 1990s onwards may only use biodiesel blended with conventional diesel fuel. These engines have finely metered and atomized multiple-stage injection systems that are very sensitive to the viscosity of the fuel. Many current-generation diesel engines are made so that they can run on B100 without altering the engine itself, although this depends on the fuel rail design. Since biodiesel is an effective solvent and cleansresidues deposited by mineral diesel, engine filters may need to be replaced more often, as the biofuel dissolves old deposits in the fuel tank and pipes. It also effectively cleans the engine combustion chamber of carbon deposits, helping to maintain efficiency. In manyEuropean countries, a 5% biodiesel blend is widely used and is available at thousands of gas stations. Biodiesel is also an oxygenated fuel, meaning it contains a reduced amount of carbon and higher hydrogen and oxygen content than fossil diesel. This improves the combustion of biodiesel and reduces the particulate emissions from unburnt carbon. However, using neat biodiesel may increase NOx-emissions Biodieselis also safe to handle and transport because it is non-toxic and biodegradable, and has a high flash point of about 300 °F (148 °C) compared to petroleum diesel fuel, which has a flash point of 125 °F (52 °C).

Other bioalcohols

Methanol is currently produced from natural gas, a non-renewable fossil fuel. In the future it is hoped to be produced from biomass as bio-methanol. This is technically feasible, but the economic viability is still pending. Themethanol economy is an alternative to thehydrogen economy, compared to today's hydrogen production from natural gas.

Butanol (C_4H_9OH) is formed by ABE fermentation (acetone, butanol, ethanol) and experimental modifications of the process show potentially high net energy gains with butanol as the only liquid product. Butanol will produce more energy and allegedly can be burned "straight" in existing gasoline engines (without modification to the engine or car), and is less corrosive and less water-soluble than ethanol, and could be distributed via existing infrastructures. Viton and BP are working together to help develop butanol. *E.coli* strains have also been successfully engineered to produce butanol by modifying their amino acid metabolism.

Green diesel

Green diesel is produced through hydro cracking biological oil feedstocks, such as vegetable oils and animal fats. Hydrocracking is a refinery method that uses elevated temperatures and pressure in the presence of a catalyst to break down larger molecules, such as those found in vegetable oils, into shorter hydrocarbon chains used in diesel engines. It may also be called renewable diesel, hydro treated vegetable oil or hydrogen-

www.hcfrog.in

derived renewable diesel. Green diesel has the same chemical properties as petroleum-based diesel. It does not require new engines, pipelines or infrastructure to distribute and use, but has not been produced at a cost that is competitive withpetroleum. Gasoline versions are also being developed.Green diesel is being developed in Louisiana and Singapore by Conoco Phillips, Neste Oil, Valero, Dynamic Fuels, and Honeywell UOP as well as Preem in Gothenburg, Sweden, creating what is known as Evolution Diesel.

Biofuel gasoline

In 2013 UK researchers developed a genetically modified strain of Escherichia coli (*E.Coli*), which could transform glucose into biofuel gasoline that does not need to be blended. Later in 2013 UCLA researchers engineered a new metabolic pathway to bypass glycolysis and increase the rate of conversion of sugars into biofuel, while KAIS researchers developed a strain capable of producing short-chain alkanes, free fatty acids, fatty esters and fatty alcohols through the fatty acyl (acyl carrier protein (ACP)) to fatty acid to fatty acyl-CoA pathway *in vivo*. It is believed that in the future it will be possible to "tweak" the genes to make gasoline from straw or animal manure.

Vegetable oil

www.commons.wikimedia.org

Walmart's truck

It fleet logs millions of miles each year, and the company planned to double the fleet's efficiency between 2005 and 2015. This truck is one of 15 based at Walmart's Buckeye, Arizona distribution center that was converted to run on a biofuel made from reclaimed cooking grease produced during food preparation at Walmart stores.

As with 100% biodiesel (B100), to ensure the fuel injectors atomize the vegetable oil in the correct pattern for efficient combustion, vegetable oil fuel must be heated to reduce its viscosity to that of diesel, either by electric coils or heat exchangers. This is easier in warm or temperate climates. Big corporations like MAN B&W Diesel, Wärtsilä, and Deutz AG, as well as a number of smaller companies, such as Elsbett, offer engines that are compatible with straight vegetable oil, without the need for after-market modifications.

Vegetable oil can also be used in many older diesel engines that do not use common railor unit injection electronic diesel injection systems. Due to the design of the combustion chambers in indirect injection engines, these are the best engines for use with vegetable oil. This system allows the relatively larger oil molecules more time to burn. Some older engines, especially Oils and fats can be hydrogenated to give a diesel substitute. The resulting product is a straight-chain hydro-carbon with a high cetane number, low in aromatics and sulfur and does not contain oxygen. Hydrogenated oils can be blended with diesel in all proportions. They have several advantages over biodiesel, including good performance at low temperatures, no storage stability problems and no susceptibility to microbial attack.

Bioethers

Bioethers (also referred to as fuel ethers or oxygenated fuels) are cost-effective compounds that act as octane rating enhancers. "Bioethers are produced by the reaction of reactive iso-olefins, such as iso-butylene, with bioethanol. "Bioethers are created by wheat or sugar beet. They also enhance engine performance, whilst significantly reducing engine wear andtoxic exhaust emissions. Though bioethers are likely to replace petroethers in the UK, it is highly unlikely they will become a fuel in and of itself due to the low energy density. Greatly reducing the amount of ground-levelozone emissions, they contribute to air quality.

When it comes to transportation fuel there are six ether additives-

1. Dimethyl Ether (DME)
2. Diethyl Ether (DEE)
3. Methyl Teritiary-Butyl Ether (MTBE)
4. Ethyl *Ter*-butyl Ether (ETBE)
5. Ter-amyl methyl Ether (TAME)
6. *Ter*-amyl ethyl Ether (TAEE)

Biogas

www.chemical-technology.com

Pipes carrying biogas

Biogas is methane produced by the process of anaerobicdigestion of organic material by anaerobes. It can be produced either from biodegradable waste materials or by the use of energy crops fed into anaerobic digesters to supplement gas yields. The solid by product, digestate, can be used as a biofuel or a fertilizer.

- Biogas can be recovered from mechanical biological treatment waste processing systems.

  Note: Landfill gas, a less clean form of biogas, is produced in landfills through naturally occurring anaerobic digestion. If it escapes into the atmosphere, it is a potential greenhouse gas.

- Farmers can produce biogas frommanurefrom their cattle by using anaerobic digesters.

Syngas

Syngas, a mixture of carbon monoxide, hydrogen and other hydrocarbons, is produced by partial combustion of biomass, that is, combustion with an amount of oxygen that is not sufficient to convert the biomass completely to carbon dioxide and water. Before partial combustion, the biomass is dried, and sometimes pyrolysed. The resulting gas mixture, syngas, is more efficient than direct combustion of the original biofuel; more of the energy contained in the fuel is extracted.

- Syngas may be burned directly in internal combustionengines, turbines orhigh-temp-erature fuel cells. The wood gas generator,a wood-fueled gasification reactor, can be connected to an internal combustion engine.
- Syngas can be used to produce methanol, DME and hydrogen, or converted via the Fischer-Tropsch processto produce a diesel substitute, or a mixture of alcohols that can be blended into gasoline. Gasification normally relies on temp-eratures greater than 700 °C.
- Lower-temperature gasification is desirable when co-producing biochar, but results in syngas polluted with tar.

Second-generation (advanced) biofuels

Second generation biofuels, also known as advanced biofuels, are fuels that can be manufactured from various types of biomass. Biomass is a wide-ranging term meaning any source of organic carbon that is renewed rapidly as part of the carbon cycle. Biomass is derived from plant materials but can also include animal materials.

First generation biofuels are made from the sugars and vegetable oils found in arable crops, which can be easily extracted using conventional technology. In comparison, second generation biofuels are made from lignocellulosic biomass or woody crops, agricultural residues or waste, which makes it harder to extract the required fuel. A series of physical and chemical treatments might be required to convert lignocellulosic biomass to liquid fuels suitable for transportation.

Sustainable biofuels

Biofuels in the form of liquid fuels derived from plant materials, are entering the market, driven mainly by the perception that they reduce climate gas emissions, and also by factors such as oil price spikes and the need for increased energy security. However, many of the biofuels that are currently being supplied have been criticised for their adverse impacts on the natural environment, food security, and land use. In 2008, the Nobel-prize winning chemist Paul J. Crutzen published findings that the release of nitrous oxide (N_2O) emissions in the production of biofuels means that overall they contribute more to global warming than the fossil fuels they replace.

The challenge is to support biofuel development, including the development of new cellulosic technologies, with responsible policies and economic instruments to help ensure that biofuel commercialization is sustainable. Responsible commercialization of biofuels represents an opportunity to enhance sustainable economic prospects in Africa, Latin America and Asia.

Ethanol biofuels

As the primary source of biofuels in North America, many organizations are conducting research in the area of ethanol production. The National Corn-to-Ethanol Research Center (NCERC) is a research division of Southern Illinois University Edwardsville dedicated solely to ethanol-based biofuel research projects. On the federal level, the USDA conducts a large amount of research regarding ethanol production in the United States. Much of this research is targeted toward the effect of ethanol production on domestic food markets. A division of the U.S. Department of Energy, the National Renewable Energy Laboratory (NREL), has also conducted various ethanol research projects, mainly in the area of cellulosic ethanol.

www.energydigital.com

Cellulosic ethanol commercialization is the process of building an industry out of methods of turning cellulose-containing organic matter into fuel. Companies, such as Iogen, POET, and Abengoa, are building refineries that can process biomass and turn it into bioethanol. Companies, such as Diversa, Novozymes, and Dyadic, are producing enzymes that could enable a cellulosic ethanol future. The shift from food crop feedstocks to waste residues and native grasses offers significant opportunities for a range of players, from farmers to biotechnology firms, and from project developers to investors.

As of 2013, the first commercial-scale plants to produce cellulosic biofuels have begun operating. Multiple pathways for the conversion of different biofuel feedstocks are being used.

In parts of Asia and Africa where drylands prevail, sweet sorghum is being investigated as a potential source of food, feed and fuel combined. The crop is particularly suitable for growing in arid conditions, as it only extracts one seventh of the water used by sugarcane. In India, and other places, sweet sorghum stalks are used to produce biofuel by squeezing the juice and then fermenting into ethanol.

Algae biofuels

From 1978 to 1996, the US NREL experimented using algae as a biofuels source in the "Aquatic Species Program". A self-published article by Michael Briggs, at the UNH Biofuels Group, offers estimates for the realistic replacement of all vehicular fuel with biofuels by using algae that have a natural oil content greater than 50%, which Briggs suggests can be grown on algae ponds at waste water treatment plants.This oil-rich alga can then be extracted from the system and processed into biofuels, with the dried remainder further reprocessed to create ethanol. The production of algae to harvest oil for biofuels has not yet been undertaken on a commercial scale, but feasibility studieshave been conducted to arrive at the above yield estimate.

Jatropha

Several groups in various sectors are conducting research on *Jatrophacurcas*, a poisonous shrub-like tree that produces seeds considered by many to be a viable source of biofuels feedstock oil much of this research focuses on improving the overall per acre oil yield of Jatropha through advancements in genetics, soil science, and horticultural practices.

SG Biofuels, a San Diego-based jatropha developer, has used molecular breeding and biotechnology to produce elite hybrid seeds that show significant yield improvements over first-generation varieties.SG Biofuels also claims additional benefits have arisen from such strains, including improved flowering synchronicity, higher resistance to pests and diseases, and increased cold-weather tolerance.

Fungi

A group at the Russian Academy of Sciences in Moscow, in a 2008 paper, stated they had isolated large amounts of lipids from single-celled fungi and turned it into biofuels in an economically efficient manner. More research on this fungal species, *Cunninghamella japonica*, and others, is likelyto appear in the near future. The recent discovery of a variant of the fungus*Gliocladiumroseum* points toward the production of so-called myco-diesel from cellulose. This organism was recently discovered in the rainforests of northern Patagonia, and has the unique capability of converting cellulose into medium-length hydrocarbons typically found in diesel fuel.

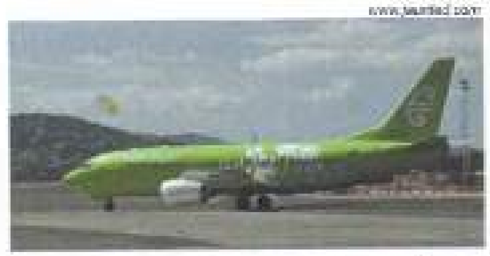
Microbial gastrointestinal flora in a variety of animals have shown potential for the production of biofuels. Recent research has shown that TU-103, a strain of *Clostridium* bacteria found in Zebra feces, can convert nearly any form of cellulose into butanol fuel. Microbes in panda waste are being investigated for their use in creating biofuels from bamboo and other plant materials.

Althought we have so many optional biodiesel fuels, various researches are still going on due to constrain in specific impulse. The thrust required while taking off and landing of an aircraft is a high rate. This fuel has constrains of the required thrust, efforts are on to overcome this issue.

What is Greener Aircraft?

Greener Aircraft basically means an aircraft that produces less emission in both respects namely manufactures and operations, thus helps in keeping the environment relatively clean. There are various steps towards this direction: use of better and lighter ecofriendly materials, improvement in manufacturing technologies thus requiring less energy, improvement in engine technology thus burning less fuel and producing clean exhaust, improvements in operations (lesser taxing time, less time wasted in landing and so on), lesser movement of vehicles and support equipment on airports thus reducing emissions.

www.jaunted.com



Indian skies are seeing more and more Aircraft year after year and the trend is going to continue in the years to come. The latest and biggest Civilian aeroplane in the world, the Airbus-380 has entered the Indian skies. We have developed and manufactured the Advanced Light Helicopter (ALH) and our Light Combat Aircraft (LCA), christened 'Tejas' has been cleared for induction into the Indian Air Force.

9. Present Initiatives..

In this section we are going to read about various advancements in the field of aircraft technologies. Various types of aircrafts which are in existence and the research development in the given field will us proud feeling of our great scientist for their remarkable achievements in the field of aviation.These examples of aircrafts will help us to make our flight green. It will protect our environment from the evils of all bad effects which otherwise can spoil our precious atmosphere. Let us read about this types of aircraft.

Electric Aircraft

www.en.wikipedia.org

An electric aircraft is an aircraft that runs on electric motors rather than internal combustion engines, with electricity coming from fuelcells, solar cells, ultracapacitors, power beaming, or batteries.

Currently flying electric aircraft are mostly experimental demonstrators, including manned and unmanned aerial vehicles. Electrically powered model aircraft have been flown since the 1970s, with one report in 1957. The first man-carrying electrically powered flights were made in 1973. In 2015, a manned, solar-powered plane, Solar Impulse, began a planned 5-month circumnavigation of the Earth.

Solar Powered Aircraft

China's first solar-powered aircraft "Soaring" was designed and built by Danny H. Y. Li and Zhao Yong in 1992. The body and wings are hand-built predominantly of carbon fiber, Kevlar and wood. The design uses winglets to increasethe effective wing span and reduce induced drag.

Icaré II

The German solar-powered aircraft "Icaré II" was designed and built by the institute of aircraft design (Institutfür Flugzeugbau) of the University of Stuttgart in 1996. The leader of the project and often pilot of the aircraft is Rudolf Voit-Nitschmann the head of the institute. The design won the Berblinger prize in 1996, the EAA Special Achievement Award in Oshkosh, the Golden Daidalos Medal of the German Aeroclub and the OSTIV-Prize in France in 1997.

LF20

Built by Lange Flugzeugbau GmbH, the LF20 was a heavily modified DG800. First flown on 7 May 1999, the aircraft was used as a flying testbed and technology demonstrator. Powered by NiMh cells and using the same EA42 propulsion system as the later Antares 20E, the LF20 could climb 1725 m on one charge.

2000s

Lange Antares

The Lange Antares 20E is an electric, self-launching 20-meter sailplane with a 42-kilowatt DC/DC brushless motor and lithium-ion batteries. It can climb up to 3,000 meters with fully charged cells.The first flight was in 2003. The Antares 20E was the first aircraft with an electric propulsion system to obtain a certificate of air worthiness. In 2011 the aircraft won the 2011 Berblinger competition,an ambitious aerial challenge for "green" aircraft. The Lange Antares 23E is a 23-meter version of the 20E featuring a wider range of wing-loading and higher performance, using the same propulsion system as the 20E and Arcus E. The Lange Antares 23E first flew in December 2011, with series production commencing in early 2012.

Alan Cocconi and the SoLong

In 2005, Alan Cocconi, who founded the California (USA) electric-propulsion research company AC Propulsion, flew, with the assistance of several other pilots, an unmanned airplane named "SoLong" for 48 hours non-stop, propelled entirely by solar energy. This was the first such around-the-clock flight, on energy stored in the batteries mounted on the plane.

Solar Impulse

www.en.wikipedia.org

The Swiss solar aircraft *Solar Impulse* 1 made itsfirst "flea hop" test flight on December 2009. Solar Impulse 2 achieved the longest non-stop solo flight in history and plan to make the first solar-powered aerial circum navigation of the globe in 2015.

The first short-hop (350 m) test flight of the Solar Impulse prototype was made on 3 December 2009.The prototype and its successor, Solar Impulse 2, are each powered by four electric motors. Energy from solar cells on the wings and horizontal stabilizer is stored in lithium polymer batteries and used to drive propellers. In 2010 it completed the first manned 24-hour flight completely powered by solar power.

In 2012, the Solar Impulse successfully completed an intercontinental flight, the first-ever by a solar plane, flying a 19-hour trip from Madrid, Spain, to Rabat, Morocco. The following year, the aircraft set a new world distance record for solar aviation on a flight from Phoenix, Arizona to Dallas-Fort Worth International Airport as part of its multi-segment trip across the United States.

A second aircraft, completed in 2014 and named Solar Impulse 2, carries more solar cells and more powerful engines, among other improvements. In March 2015, the plane began a circumnavigation of the Earth, departing from Abu Dhabi in the United Arab Emirates. It was originally scheduled to return to Abu Dhabi in August 2015, upon the completion of its multi-stage journey.However, due to battery damage, continuation of the flight beyond Hawaii has been postponed until April 2016.

Electravia BL1E Electra

www.en.wikipedia.org

French BL1E Electra F-PMDJ: the first registered electric aircraft in the world. First Flight in 2008.

Electro Trike

www.en.wikipedia.org

E-Trike: French electric

www.en.wikipedia.org

The Boeing Fuel Cell Demonstrator achieved straight-level flight on a manned mission powered by a hydrogenfuel cell.

A hydrogen-powered aircraft is an airplane that uses hydrogenfuel asa power source. Hydrogencan either be burned in some kind of jet engine, or other kind of internal combustion engine, or can be used to power a fuel cell to generate electricity to power apropeller.

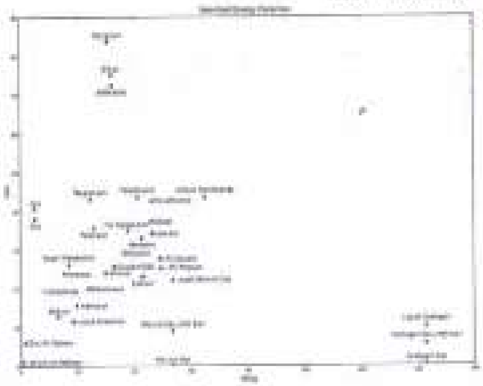
Unlike normal aircraft, which use wings for storing fuel, hydrogen aircraft are usually designed with the liquid hydrogen fuel carried inside the fuselage, in order to minimize surface-area and reduce boil-off.

According to research at the Pennsylvania State University in 2006, large commercial hydrogen aircraft could be built by 2020 but "will probably not enter service until closer to 2040."

The European Union's research project in cooperation with Airbus and 34 other partner companies dubbed CRYOPLANE assessed the technical feasibility, safety, environmental compatibility and economic viability of using liquid hydrogen as an aviation fuel. This was concluded in 2002 (with the final report published in 2003).

Properties of hydrogen

www.en.wikipedia.org



Energy density of fuels - horizontal per mass, vertical per volume.

Being an alternative to traditional jet fuel, hydrogen has a higher energy density per unitmass but a lower energy density per unitvolume, and containing the hydrogen at high pressure would require a heavy container. In aircraft heavy containers are not an option, and therefore regular carbon fibre tanks are often used, which can only sustain a pressure of about 350 bar. This is significantly lower compared to steel hydrogen containers (used in cars and ships) which can sustain 500 to 700 bar. This limitation decreases the amount of energy that can be spent on the propulsion by about half. Alternatively, as with some rockets, cryogenic liquid hydrogen could be employed.

If hydrogen were available in quantity from renewable energy sources, its use in aircraft would produce fewer greenhouse gases (water vapor and a small amount of nitrogen) than current aircraft. Currently, however, very little hydrogen is produced using renewable energy sources, and there are several serious obstacles to the use of hydrogen in aircraft and other vehicles. Due to the way it is produced, and the relative inefficiencies of its production given current technology, hydrogen is a much more expensive fuel than fossil fuels.

Liquid hydrogen is one of the best coolants used in engineering, and it has been proposed to use this property for cooling intake air for very high speed aircraft, or even for cooling the vehicle's skin itself particularly for scramjet-powered aircraft.

Properties of hydrogen aircraft

Liquid hydrogen has about four times the volume for the same amount of energy of kerosene based jet-fuel. In addition, its highly volatile nature precludes storing the fuel in the wings, as with conventional transport aircraft. Therefore, most liquid hydrogen aircraft designs store the fuel in the fuselage, leading to a larger fuselage length and diameter than a conventional kerosene fueled aircraft. This lowers the performance due to the extra wetted area of the fuselage. The larger fuselage size causes more skin friction drag and wave drag. On the other hand, hydrogen is about one-third of the weight of kerosene jet-fuel for the same amount of energy. This means that for the same range and performance (ignoring the effect of volume), the hydrogen aircraft would have about one-third of the fuel weight. For a Boeing 747-400 type aircraft, this would reduce the Takeoff Gross Weight from 800,000 lb (360,000 kg) to approximately 600,000 lb (270,000 kg). Thus, the performance of a hydrogen-fueled aircraft is a trade-off of the larger wetted area and lower fuel weight. This trade-off depends essentially on the size of the aircraft.

Prototypes

The Russian manufacturer Tupolev builta prototype hydrogen-powered version of the Tu-154 airliner,named the Tu-155, which made its first flightin 1989.This was the first experimental aircraft in the world operating on liquid hydrogen.

Boeing Research & Technology Europe (BR & TE) made a civilian aircraft from a 2-seat Diamond Aircraft Industries DA20 motor glider running on a fuel cell (called Theator Airplane)". Lange Aviation GmbH also made a hydrogen-powered airplane with its Antares DLR-H2 airplane.These aircraft are of course configured in such fashion that the current low energy output from hydrogen propulsion (a result of the low-pressure hydrogen tanks) do not pose a problem. For example the

Boeing Theator airplane only required 45 kW to take off, and 20 kW to stay airborne. In July 2010 Boeing also unveiled its hydrogen powered Phantom Eye UAV, that uses two Ford Motor Company internal combustion engines convertedto operate on hydrogen.

ENFICA-FC demonstrated its Rapid 200-FC aircraft in 2010.

In 2011, an AeroVironment Global Observer which was fitted with a hydrogen-fueled propulsion system.

Current

Reaction Engines Skylon orbital hydrogen fuelled jet plane

- Reaction Engines A2 antipodal hypersonic jet airliner
- DLR Smartfish
- Boeing Phantom Eye

Radio-controlled aircraft

www.en.wikipedia.org

A radio control flyer (holding a transmitter) guides his aircraft in for a landing.

A radio-controlled (model) aircraft (often called RC aircraft or RC plane) is a small flying machine that is controlled remotely by an operator on the ground using a hand-held radio transmitter. The transmitter communicates with a receiver within the craft that sends signals to servomechanisms (servos) which move the control surfaces based on the position of joysticks on the transmitter. The control surfaces, in turn, affect the orientation of the plane.

Flying RC aircraft as a hobby has been growing worldwide with the advent of more efficient motors (both electric and miniature internal combustion or jet engines), lighter and more powerful batteries and less expensive radio systems. A wide variety of models and styles is available.

Scientific, government and military organizations are also utilizing RC aircraft for experiments, gathering weather readings, aerodynamic modeling and testing, and even using them as drones or spy planes.

The earliest examples of electronically guided model aircraft were hydrogen-filled model airships of the late 19th century. They were flown as a music hall act around theater auditoriums using a basic form of spark-emitted radio signal.

Sailplanes and gliders

www.en.wikipedia.org

F3A Pattern Ship – ZNline Alliance by CPLR

www.en.wikipedia.org

Shinden by Bryan Hebert

Gliders are planes that do not typically have any type of propulsion. Unpowered glider flight must be sustained through exploitation of the natural lift produced from thermal sorwind hitting a slope. Dynamic soaring is another popular way of providing energy to gliders that is becoming more and more common. However, even conventional slope soaring gliders are capable of achieving speeds comparable with similar sized powered craft. Gliders are typically partial to slow flying and have high aspect ratio, as well as very low wing loading (weight to wing area ratio). 3-channel

10. Our Vision

Today the burning topic in the world is Global warming. Aircrafts are also playing a significant role in spoiling the environment through various means, like air pollution, sound pollution, land pollution, exploitation of materials, etc. As in past, we have witnessed that science is satisfying human's need in every aspect of life. Similarly this integral need of man to conserve the environment should also be satisfied by science. For this science has taken a step forward by introducing Eco-friendly aircrafts. It is now turn of man to join helping hand of science and take a step forward to save our mother earth by making the positive use of the aviation technology.

Bengaluru International Airport, Devanahalli, Bengaluru - A Greenfield airport project at Devanahalli near Bengaluru has been implemented on a Build Own Operate and Transfer (BOOT) basis for 30 years with Public-Private-Participation (PPP) at a revised cost of Rs 2668 crore. Government of Karnataka and AAI together hold 26% equity and the strategic joint venture partners hold the balance 74% AAI's investment in the equity is capped at Rs 50 crore. A Consortium led by Siemens, Germany with Unique Zurich, Switzerland and Larsen and Tourbo, India Limited, as other members have been chosen as the strategic Joint Venture Partners. The airport was commissioned on 24 May, 2008.

Rajiv Gandhi International Airport, Shamshabad, Hyderabad - A Greenfield airport has been developed in Shamshabad, near Hyderabad on Build Own Operate and Transfer (BOOT) basis with PPP by the Government of Andhra Pradesh. The approximate cost of the Project is Rs 2920 crre. AAI and Government of Andhra Pradesh together hold 26% equity with AAI's equity being capped at Rs 500 million. The balance 74 per cent is being held by the strategic partner, a consortium consisting of M/s GMR Enterprises and Malaysian Airport Holdings Berhand (MAHB). The airport was commiss-ioned on 23 March, 2008.

It is worth mentioning that Airports Council International has adjudged Rajiv Gandhi International Airport, Shamshabad near Hyderabad as the 'World's Best Airport' for the airport service quality amongst the airports handling 5-15 million passengers, category for the year 2009.

The above examples coated are the best options on the way to achieve greener and cleamer aircraft along with eco-friendly airports. Such efforts are continuously needed.

Biofuel options

Switchgrass

Biofuel development and use is a complex issue because there are many biofuel options which are available. Biofuels, such asethanol and biodiesel, are currently produced from the products of conventional food crops such as the starch, sugar and oil feedstocks from crops that include wheat, maize, sugar cane, palm oil and oilseed rape. Some researchers fear that a major switch to biofuels from such crops would create a direct competition with their use for food and animal feed, and claim that in some parts of the world the economic consequences are already visible, other researchers look at the land available and the enormous areas of idle and abandoned land and claim that there is room for a large proportion of biofuel also from conventional crops.

Second generation biofuels are now being produced from a much broader range of feedstocks including the cellulose in dedicated energy crops (perennial grasses such as switchgrass and Miscanthus giganteus), forestry materials, the co-products from food production, and domestic vegetable waste. Advances in the conversion processes will improve the sustainability of biofuels, through better efficiencies and reduced environmental impact of producing biofuels, from both existing food crops much like any other product. In 2008 the Nobel prize-winning chemist Paul J. Crutzen published findings that the release of nitrous oxide (N_2O) emissions in the production of biofuels means that they contribute more to global warming than the fossil fuels they replace.

According to the Rocky Mountain Institute, sound biofuel production practices would not hamper food and fibre production, nor cause water or environmental problems, and would enhance soil fertility. The selection of land on which to grow the feedstocks is a critical component of the ability of biofuels to deliver sustainable solutions. A key consideration is the minimisation of biofuel competition for prime cropland.

Jatropha

India and Africa

Crops like Jatropha, used for biodiesel, can thrive on marginal agricultural land where many trees and crops won't grow, or would produce only slow growth yields. Jatropha cultivation provides benefits for local communities:

www.en.wikipedia.org

Jatrophagossipifolia in Hyderabad, India.

Cambodia

Cambodia has no proven fossil fuel reserves, and is almost completely dependent on imported diesel fuel for electricity production. Consequently Cambodians face an insecure supply and pay some of the highest energy prices in the world. The impacts of this are widespread and may hinder economic development.

Biofuels may provide a substitute for diesel fuel that can be manufactured locally for a lower price, independent of the international oil price. The local production and use of biofuel also offers other benefits such as improved energy security, rural development opportunities and environmental benefits. The Jatropha curcas species appears to be a particularly suitable source of biofuel as it already grows commonly in Cambodia. Local sustainable production of biofuel in Cambodia, based on the Jatropha or other sources, offers good potential benefits for the investors, the economy, rural communities and the environment.

Mexico

Jatropha is native to Mexico and Central America and was likely transported to India and Africa in the 1500s by Portuguese sailors convinced it had medicinal uses. In 2008, recognizing the need to diversify its sources of energy and reduce emissions, Mexico passed a law to push developing biofuels that don't threaten food security and the agriculture ministry has since identified some 2.6 million hectares (6.4 million acres) of land with a high potential to produce jatropha producing region, also contains abandoned sisal plantations, where the growing of Jatropha for biodiesel production would not displace food.

On April 1, 2011 Interjet completed the first Mexican aviation biofuels test flight on an Airbus A320. The fuel was a 70:30 traditional jet fuel biojet blend produced from Jatropha oil provided by three Mexican producers, Global Energias Renovables (a wholly owned subsidiary of U.S. based Global Clean Energy Holdings, Bencafser S.A. and Energy JH S.A. Honeywell's UOP processed the oil into Bio-SPK (Synthetic Paraffinic Kerosene). Global Energias Renovables operates the largest Jatropha farm in the Americas.

On August 1, 2011 Aeromexico, Boeing, and the Mexican Government participated in the first biojet powered transcontinental flight in aviation history. The flight from Mexico City to Madrid used a blend of 70 percent traditional fuel and 30 percent biofuel (aviation biofuel). The biojet was produced entirely from Jatropha oil.

PongamiaPinnata in Australia and India

www.en.wikipedia.org

Pongamiapinnata seeds inBrisbane, Australia

Pongamiapinnata is a legume native to Australia, India, Florida (USA) and most tropical regions, and is now being invested in as an alternative to Jatropha for areas such as Northern Australia, where Jatropha is classed as a noxious weed.Commonly known as simply 'Pongamia', this tree is currently being commercialised in Australia by Pacific Renewable Energy, for use as a Diesel replacement for running in modified Diesel engines or for conversion to Biodiesel using 1st or 2nd Generation Biodiesel techniques, for running in unmodified Diesel engines.

Sweet sorghum in India

Sweet sorghum overcomes many of the shortcomings of other biofuel crops. With sweet sorghum, only the stalks are used for biofuel production, while the grain is saved for food or livestock feed. It is not in high demand in the global food market, and thus has little impact on food prices and food security. Sweet sorghum is grown on already-farmed drylands that are low in carbon storage capacity, so concerns about the clearing of rainforest do not apply. Sweet sorghum is easier and cheaper to grow than other biofuel crops in India and does not require irrigation, an important consi-deration in dry areas.Some of the Indian sweet sorghum varieties are now grown in Uganda for ethanol production.

A study by researchers at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) found that growing sweet sorghum instead of grain sorghum could increase farmers incomes by US$40 per hectare per crop because it can provide food, feed and fuel.

Roundtable on Sustainable Biofuels

Public attitudes and the actions of key stake-holders can play a crucial role in realising the potential of sustainable biofuels. Informed discussion and dialogue, based both on scientific research and an understanding of public and stakeholder views, is important.

The Roundtable on Sustainable Biofuels is an international initiative which brings together farmers, companies, governments, non-governmental organizations, and scientists who are interested in the sustainability of biofuels production and distribution. During 2008, the Roundtable used meetings, teleconferences, and online discussions to develop a series of principles and criteria for sustainable biofuels production.

In 2008, the Roundtable for Sustainable Biofuels released its proposed standards for sustainable biofuels. This includes 12 principles:

1. "Biofuel production shall follow international treaties and national laws regarding such things as air quality, water resources, agricultural practices, labor conditions, and more.
2. Biofuels projects shall be designed and operated in participatory processes that involve all relevant stakeholders in planning and monitoring.
3. Biofuels shall significantly reduce greenhouse gas emissions as compared to fossil fuels. The principle seeks to establish a standard methodology for comparing greenhouse gases (GHG) benefits.
4. Biofuel production shall not violate human rights or labor rights, and shall ensure decent work and the well-being of workers.
5. Biofuel production shall contribute to the social and economic development of local, rural and indigenous peoples and communities.
6. Biofuel production shall not impair food security.
7. Biofuel production shall avoid negative impacts on biodiversity, ecosystems and areas of high conservation value.
8. Biofuel production shall promote practices that improve soil health and minimize degradation.
9. Surface and groundwater use will be optimized and contamination or depletion of water resources minimized.

10. Air pollution shall be minimized along the supply chain.

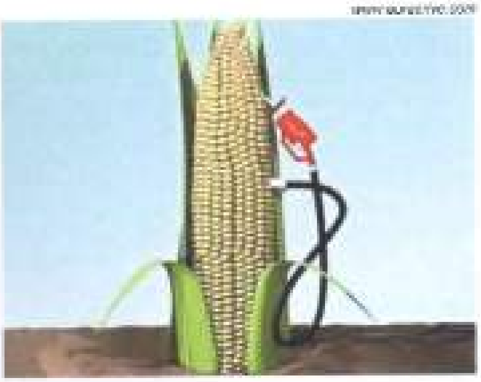
11. Biofuels shall be produced in the most cost-effective way, with a commitment to improve production efficiency and social and environmental performance in all stages of the biofuel value chain.

12. Biofuel production shall not violate land rights".

In April 2011, the Roundtable on Sustainable Biofuels launched a set of comprehensive sustainability criteria - the "RSB Certification System." Biofuels producers that meet to these criteria are able to show buyers and regulators that their product has been obtained without harming the environment or violating human rights.

Sustainable Biofuels Consensus

The Sustainable Biofuels Consensus is an international initiative which calls upon governments, the private sector, and other stakeholders to take decisive action to ensure the sustainable trade, production, and use of biofuels. In this way biofuels may play a key role in energy sector transformation, climate stabilization, and resulting worldwide revitalisation of rural areas.



The Sustainable Biofuels Consensus envisions a "landscape that provides food, fodder, fiber, and energy, which offers opportunities for rural development; that diversifies energy supply, restores ecosystems, protects biodiversity, and sequesters carbon".

Better Sugarcane Initiative / Bonsucro

In 2008, a multi-stakeholder process was initiated by the World Wildlife Fund and the International Finance Corporation, the private development arm of the World Bank, bringing together industry, supply chain intermediaries, end-users, farmers and civil society organisations to develop standards for certifying the derivative products of sugar cane, one of which is ethanol fuel.

The Bonsucro standard is based around a definition of sustainability which is founded on five principles:

1. Obey the law
2. Respect human rights and labour standards
3. Manage input, production and processing efficiencies to enhance sustainability
4. Actively manage biodiversity and ecosystem services
5. Continuously improve key areas of the business

Sustainability standards

Several countries and regions have introduced policies or adopted standards to promote sustainable biofuels production and use, most prominently the European Union and theUnited States. The 2009 EU Renewable Energy Directive, which requires 10 percent of transportation energy from renewable energyby 2020, is the most comprehensive mandatory sustainability standard in place as of 2010. The Directive requires that the lifecycle greenhouse gas emissions of biofuels consumed be at least 50 percent less than the equivalent emissions from gasoline or diesel by 2017 (and 35 percent less starting in 2011). Also, the feedstocks for biofuels "should not be harvested from lands with high biodiversity value, from carbon-rich or forested land, or from wetlands".

As with the EU, the U.S. Renewable Fuel Standard (RFS) and the California Low Carbon Fuel Standard (LCFS) both require specific levels of lifecycle greenhouse gas reductions compared to equivalent fossil fuel consumption. The RFS requires that at least half of the biofuels production mandated by 2022 should reduce lifecycle emissions by 50 percent. The LCFS is a performance standard that calls for a minimum of 10 percent emissions reduction per unit of transport energy by 2020. Both the U.S. and California standards currently address only greenhouse gas emissions, but California plans to "expand its policy to address other sustainability issues associated with liquid biofuels in the future".

In 2008, Brazil also adopted new sustainability policies for sugarcane ethanol, including "zoning regulation of sugarcane expansion and social protocols".

Sustainable transport

Biofuels have a limited ability to replace fossil fuels and should not be regarded as a 'silver bullet' to deal with transport emissions. Biofuelson their own cannot deliver a sustainable transport system and so must be developed as part of an integrated approach, which promotes other renewable energy options and energy efficiency, as well as reducing the overall energy demand and need for transport. Consideration needs to be given to the development of hybrid and fuel cell vehicles, public transport, and better town and rural planning.

In December 2008 an Air New Zealand jet completed the world's first commercial aviation test flight partially using jatropha-based fuel. More than a dozen performance tests were undertaken in the two-hour test flight which departed from Auckland International Airport. A biofuel blend of 50:50 jatropha and Jet A1 fuel was used to power one of the Boeing 747-400's Rolls-Royce RB211 engines. Air New Zealand set several criteria for its jatropha, requiring that "the land it came from was neither forest nor virgin grassland in the previous 20 years, that the soil and climate it came from is not suitable for the majority of food crops and that the farms are rain fed and not mechanically irrigated". The company has also set general sustainability criteria, saying that such biofuels must not compete with food resources, that they must be as good as traditional jet fuels, and that they should be cost competitive.

Can airlines go green?

The downside to the most environmentally friendly ways of getting around is that they tend to be on the slow side. Walking, biking and riding trains are great for the planet, but sometimes you need to get around the world quickly and that often involves crossing oceans. The airline industry is one of the largest contributors to global carbon emissions, but it's possible to fly and do minimal damage to the environment.

First of all, figure out whether it's really necessary to fly. If it's for a business trip, maybe you can make do with a phone call orvideo conference. If it's for pleasure, consider the element of discovery that a train ride can add to a journey- you'll see a lot more than you do from an airplane. But if you only have one week of vacation and your heart is set on Europe, go with an airline that's as concerned about the environment as you are.

Sustainable aviation fuel (SAF) is the name given to advanced aviation biofuel types used in jet aircraft and certified as being sustainable by a reputable independent third-party, such as the Roundtable on Sustainable Biomaterials (RSB). This certification is in addition to the safety and performance certification, issued by global standards body ASTM,that all jet fuel is required to meet in order to be approved for use in regular passenger flights.

In the current news

China is poised to open its first express highway built with construction waste, showcasing a new way to make use of the material which otherwise ends up as garbage.

With a designed speed of 120 kmph, the 122-km expressway links Lintong district with Huxian country under the provincial capital of Xi'an. The expressway is the first in China to use construction waste as building material for the roadbed, officials of the Shaanxi transportation department said.

A total of 5.7 million tonne of construction waste was used to build the expressway, with an average of 46,700 tonne used in each kilometre.

The use of recycled waste has helped the project avoid using 3.4 million cubic meters of sand and burning 32,000 tonnes of coal. A 360mu area of landfill was cleared and over 700 mu of land has been saved from excavation. The land saved has created about 300 million yuan ($47.07 million) in economic benefits.

11. Conclusion

Thank God men cannot as yet fly and lay waste the sky as well as the earth!

— Henry David Thoreau

Above line shows the negative side of the aviation field. Today the burning topic in the world is Global warming. Aircrafts are also playing a significant role in spoiling the environment through various means like air pollution, sound pollution, land pollution, exploitation of materials etc. As the past is witness that Science is satisfying human's need in every aspect of life, similarly this integral need of man to conserve the environment should also be satisfied by science. For this science has taken a step forward by introducing Eco-friendly aircrafts. It's the turn of humans to accept the helping and of science and take a step forward to saveour mother earth by making the positive use of the aviation technology...............

There is a famous quote –

It is not work that kills man, it is worry.

Worry is rust upon the blade. Many people spend a lot of time focused on and worried about things that might happen or could happen.

All we need is to come up with an alternative approach. On the other hand, there are people who consciously avoid broading over.

Greener aircrafts were dream project few years before but with the continuous efforts of our scientist it has now come into existence.

If we do not dream big, we cannot achieve success. Our works will always allow us to dream of a positive outcome and it will result in great enthusiasm which is necessary to carry on efforts to succeed. It will keep us from trying new things that carry some element of risk. If we do not take some risk, we will certainly miss opportunities to achieve our goal.

We have seen with the discovery of biofuels as an alternative source of fuel in today's engine there were many if's and not's. But this will not be a hurdle on the way to achieve our vision of Green Aircrafts.

Everything is possible if we are ready for change of approach. The great poet and philosopher Goethe says "Life belongs to the livings and he who lives must be prepared for changes". We should never regret for our past mistakes because it will fill our mind with the sense of guilt which is road block and prevent every plan for going ahead. We should take responsibility to save our mother earth from the evils of various pollutants which are hazardous for our nature. In the words of Noble laureate Winston Churchill - "Responsibility is the price of greatness". Take on every new responsibility with self confidence and emerge victorious.

So let's fly high in the green aircraft....

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