

Virgin Atlantic and LanzaTech at critical breakthrough point with new low-carbon jet fuel

- This week marks **10 years since Virgin Atlantic pioneered the first ever biofuel flight**
- Virgin Atlantic and LanzaTech are on the **verge of a breakthrough with commercially viable, waste-gases based, low-carbon fuel**
- New technology has promising support from UK government departments, but **urgently needs further action to turn it into a world first commercial reality**

This week marks ten years since Virgin Atlantic became the first commercial airline to operate a flight using a biofuel mix – a ground-breaking initiative that proved it was possible to power aircraft with low carbon alternatives. Now, the race is on for the world's first truly low-carbon, *commercially-affordable* solution to traditional jet fuel.

A huge amount of progress has been made since 2008, and Virgin Atlantic has continued to lead the charge through its partnership with LanzaTech – a pioneer of technology that can turn industrial waste gases and other plentiful waste streams into sustainable jet fuel.

The partnership is on the verge of a major breakthrough in its aim of creating commercially viable, sustainable aviation fuel and is now calling for UK government to provide the firm and swift commitment needed to bring this exciting new technology to the UK. Government measures such as critical access to existing low-carbon fuel incentives and de-risking support for a worldwide, first-of-a-kind, commercial plant in the UK will mean LanzaTech can quickly bring the product to market, at a price on a par with traditional jet fuels.

The technology will bring wider benefits, including supporting existing low carbon, bioeconomy intellectual property and developments, jobs, international trade, and UK fuel security – all fitting perfectly the UK's ambitious industrial and clean growth plans.

Since 2011, with Virgin Atlantic's unerring support, LanzaTech has raised \$100s millions of investment, secured funding towards five commercial ethanol plants (the first stage in turning waste into jet fuel) and – with help from HSBC and others – has produced the first 4,000 US gallons of ethanol-based, low-carbon jet fuel.

The LanzaTech fuel has also so far performed well under rigorous testing and review processes – required for new fuels to be considered equivalent to or better than fossil jet fuel and be qualified for use on commercial flights. Virgin Atlantic fully intends to fly this waste-derived ethanol-to-jet fuel as soon as it is qualified for use on commercial flights – and hopes that will be later this year.

Craig Kreeger, CEO of Virgin Atlantic, said: *“The industry has come a long way since our first biofuel flight in 2008, and we're really proud to work alongside the UK government, manufacturers, and industry bodies to maintain the momentum behind sustainable aviation fuel developments. Since 2011, we've partnered closely with LanzaTech to pursue the world's first low carbon fuel derived from waste products to the market at a commercially viable price. The project is now tantalisingly close to becoming a reality – with the potential to deliver massive carbon savings as well as economic and technological benefits to the UK. Once again, we're committed to pioneering a low carbon aviation future by becoming the first airline to use LanzaTech fuel on commercial flights.”*

Sir Richard Branson, Founder of Virgin Group, said: *“The search to find a sustainable aviation fuel has been a long standing challenge for airlines and fuel companies. In the decade since Virgin Atlantic became first airline to operate a commercial flight using a biofuel blend, tremendous progress has been made. We have invested in and worked with a number of fuel companies over the years and today, we are partnered with LanzaTech because of its impressive sustainability profile and commercial potential. LanzaTech is pioneering technology we couldn't even imagine ten years ago, and we are now at the critical point where bringing the world's first commercial, low carbon fuel to market is within touching distance.”*

Dr Jennifer Holmgren, LanzaTech's CEO added: *“The aviation sector's commitment to achieving a low carbon future is evidenced by its investment in the development of sustainable jet fuel supply chains. Remarkably, due to this*

commitment, we have gone from 'it can't be done' to over 100,000 commercial flights on low carbon jet fuel in under 10 years. This is tremendous progress and we are thrilled to partner with Virgin Atlantic, the airline that first showed that synthetic, low carbon jet fuel flight was possible. We look forward to taking our partnership with Virgin Atlantic to the next level with commercial production of synthetic jet from recycled pollution and hope that we are able to jointly realise our ambition of creating a world first production facility in the UK."

-ENDS-

Notes to Editors

The LanzaTech production process explained

- Steel and other heavy industries produce waste carbon monoxide (CO) gas, which is frequently flared (burnt off) to the atmosphere as greenhouse gas CO₂ (or sometimes used less efficiently for other purposes).
- The LanzaTech process involves capturing carbon from the waste gas via fermentation to ethanol, which is recovered to produce ethanol feedstock for a variety of products, including aviation fuel.
- Each gallon of ethanol is converted to produce 1/2 gallon of aviation fuel.
- It's scalable, e.g. the process could be used to capture and recycle around 1/3 of the carbon that steel facilities would otherwise release into the atmosphere.
- LanzaTech is also pursuing a range of waste-based solutions around the globe.

Future potential of this technology

- Ground energy can be sourced carbon free – think solar or wind – but to make liquid fuels as per those needed for aviation you need a carbon source. Where this carbon comes from is up to us – new fossil resources, or recycled carbon.
- Recycling waste carbon streams is an effective way to keep fossil resources in the ground. Worldwide, around 1.7 billion metric tonnes of steel is produced every year and waste gases are produced through the chemistry of steel making.
- LanzaTech estimates that its process could be retrofitted to 65% of the world's steel mills.
- This offers the potential to produce 30 billion gallons of ethanol worldwide, for around 15 billion gallons of jet fuel p.a.
- This would represent just under 19% of all aviation fuel currently used worldwide p.a. (80 billion gallon total world aviation fuel use).

About Virgin Atlantic

- Virgin Atlantic was founded by entrepreneur Sir Richard Branson over 30 years ago after he decided the UK aviation industry needed shaking up and style injected back into it. On 22nd June 1984, Virgin Atlantic's inaugural flight to Newark took place, on an aircraft filled with personal friends, celebrities and the media. Today, Virgin Atlantic flies to over 30 destinations worldwide, including locations across the United States, the Caribbean, Africa, the Middle East and Asia.
- Virgin Atlantic has been active in the sustainable aviation space for more than ten years. Its Change is in the Air sustainability programme was established in 2007. Along with a range of other measures, sustainable aviation fuels (SAF) are a key part of the airline's carbon reduction focus. For full information see the accompanying Fact Sheet and Timeline. For more information about Change is in the Air and its carbon results so far visit: www.virgin-atlantic.com/changeisintheair.
- Virgin Atlantic formally partnered with LanzaTech on its low carbon jet fuel in 2011. The two companies have been working hard behind the scenes to progress the programme since then. HSBC supported jet fuel developments partnership in 2014.

Supporting statements

Rolf Hogan, Executive Director of the Roundtable on Sustainable Biomaterials (RSB) said:

“Since their first biofuel flight, Virgin Atlantic has continued to show huge dedication and leadership in supporting the development of truly sustainable aviation fuels. Their partnership with LanzaTech in developing RSB-certified sustainable aviation fuel highlights their commitment in delivering not only GHG reductions, but also in ensuring social and environmental stewardship is at the forefront of their business. The Roundtable on Sustainable Biomaterials is proud to support that commitment, through our most-trusted and peer-reviewed sustainability Standard, and we would like to congratulate Virgin Atlantic on over 10 years of leadership!”

Barbara Bramble, Vice President for International Conservation and Corporate Strategies, at the National Wildlife Federation (NWF) said:

“Safeguarding wildlife and habitat in the face of climate change is one of the biggest challenges of our time. Technologies that reduce carbon emissions in transportation while meeting broader sustainability objectives can help to avoid the worst impacts of climate change on our wildlife and the habitats they call home. The progress announced today on a new pathway to sustainable aviation fuel is tremendously exciting, and we are pleased that LanzaTech fuels have the added assurance of RSB sustainability certification. National Wildlife Federation congratulates the global team, led by Virgin Atlantic, who has worked to make this a reality.

Sheila Remes, Vice President of Strategy at Boeing Commercial Airplanes said: “Boeing is proud of the significant progress that’s been made to develop sustainable aviation fuel in the 10 years since our partner, Virgin Atlantic, flew the world’s first commercial flight on biofuel. Our long-term partnership with Virgin Atlantic and LanzaTech reflects the innovative spirit and deep commitment of our industry to reduce airplane emissions.”

Gurhan Andac, Engineering Leader, Aviation Fuels and Additives at GE Aviation said: “Virgin Atlantic Airlines biofuel flight in 2008, conducted in collaboration with GE, Boeing, and Imperium, was a breakthrough aviation effort demonstrating that airplanes could be flown with fuel blends including bio-derived, sustainable components. It opened up the floodgates to a global interest and a flurry of activities for the next ten years, both for civil and military Aviation. It helped align the airlines, engine and airframe manufacturers, fuel producers, research organizations, governments, academic institutions, aviation stakeholder and fuel specification organizations, and most importantly, the public, to one goal – sustainable future for aviation. Virgin Atlantic Airlines and other Operators are driven to adopt sustainable aviation fuels today, realizing further the original vision of this landmark event.”

Ms. Dong Yan, Managing Director of the Beijing Shougang LanzaTech New Energy Technology Co. Ltd. Said:

“Shougang has long been committed to creating a sustainable future and to demonstrating the importance of Chinese innovation in creating that future. Our JV is showing that carbon emissions from our steel mill can be recycled into jet fuel and used to fly planes around the world! 10 years ago, people believed you couldn’t fly on sustainable aviation fuel. Virgin Atlantic proved that it was possible. In that same timeframe, people didn’t believe you could make fuels from steel mill emissions and today we are doing just that. We are very happy to be part of creating this change.”

John Holladay, Manager, Transportation Sector at Pacific Northwest National Laboratory said:

“PNNL is proud to be part of this project, taking waste emissions to make synthetic paraffinic kerosene! It is especially exciting to see that we can produce such a high quality jet fuel in a process that combines the exceptional biotechnology of LanzaTech with catalysis expertise at PNNL. “