

MADE OF STRONGER STUFF

In the ongoing battle to **reduce carbon emissions** and optimise engineering design, **manufacturers are examining all of their options**, right down to the materials being used in everything from wings to wind turbines. In the process, **a new business opportunity is opening for engineering**, one that could play a vital and sustainable part in the future.

At the tail end of 2009, just as the UK was emerging from recession, the then-Labour Government launched a new strategy that focused on a growing trend in the country's manufacturing sector – the use of advanced composites.

According to the UK Composites Strategy, the Government estimated the high-value composites sector could be worth as much as £1bn to the overall economy.

These lighter materials combine greater flexibility in design with a step-change in strength and durability relative to their weight. And in the simplest possible terms, less weight and longer lifespan equals less fuel required to move things from A to B and less maintenance in the long term.

"The fight against CO₂ emissions is a major issue for most governments these days," points out Atkins structural engineer Tim Edwards. "And unless manufacturers as well as design and engineering firms like Atkins are proactive in introducing new lightweight materials, such as carbon composites, then we cannot answer the challenge.

"Composite materials don't suffer from corrosion and are fairly immune to fatigue, but they are more complex to design in than metals. They offer great potential, but also present new challenges."

In November 2009, the then-secretary of state for business, Lord Mandelson, unveiled plans for a £16m National Composites Centre (NCC) to spearhead innovation and meet manufacturing challenges. A consortium of businesses, universities and

government departments was also formed to discuss the various barriers and benefits.

"Any modern economy is built on the ability to exploit the opportunities on offer by new and existing high value markets – such as composites," said Lord Mandelson at the launch of the strategy. "Our approach is now to back areas of the economy which have the biggest potential to create wealth and jobs and take advantage of the skills of our people.

"[This] new strategy will help us to exploit the potential of composite materials, which could help us lower carbon emissions, make cost savings by making things which last longer and boost our position globally, making the UK the place to produce and develop composites.

"Government has an irreplaceable role in ensuring that the right conditions are in place to support long term growth. This means investing in the country's high-tech low carbon future including supporting and investing in composites."

Beyond blue skies

One sector that has been quick to get on board with this new strategy is the airline industry. Even though the industry only represents 1.6 per cent of global greenhouse gas emissions, these could increase if left unchecked. Consequently, the aerospace sector expects to see increased demands for composites over the next five years, with the construction of leaner, lighter aircraft leading to lower levels of emissions through reduced demand for fuel.

"WE'RE LEARNING TO CONFIGURE AEROSTRUCTURES TO EXPLOIT THE ADVANTAGES OF COMPOSITES, INCLUDING FEATURES THAT ENABLE SOME CONTROL OF LOADS ON A WING DURING FLIGHT; SOMETHING METALS DON'T GIVE YOU"

The new A350 XWB from Airbus, one of Atkins' key clients, is one such example. Scheduled to enter service by 2013, it will be an impressive 52 per cent composite.

"The design challenges involved in using composites are greater because they are more difficult materials to understand," says Edwards.

"We're learning to configure aerostructures to exploit the advantages of composites, including features that enable some control of loads on a wing during flight; something metals don't give you."

While aircraft are a natural fit for composites, the UK Government strategy sees a much wider market for these materials. With expertise and a bit of manufacturing muscle, composites can be made to work in other engineering sectors, from renewable energy such as wind and wave, to roads and bridges.

In wind power, for example, lighter-weight long turbine blades can be created, reducing manufacturing costs and making this alternative energy source a more attractive proposition.

"The loads at the root of each blade depend on the length of the blade due to the disproportionate increase in both blade bending and inertial forces," explains Edwards. "Advanced composite materials can help mitigate against the associated increase in costs and the reduced fatigue life of larger wind turbines."

Sector expansion will pose its own challenges of course. Atkins engineers have recently embarked on a programme of multi-disciplinary research into the rapid sizing needed when building new and unique components. Their aim: to create a software-based sizing and optimisation tool – dubbed the aerofoil structural model (ASM) – that will assist in the construction of aerofoils for aircraft wings, air propellers and more resilient turbine blades alike.

Composites are complex, but with the low carbon economy set to be a key engine of the UK's future growth, the incentive to improve and integrate this emerging industry is vast. According to Edwards, manufacturers will already have noticed an increase in the amount of composite material being ordered – "We're going to be using this kind of material a hundredfold in the future," he concludes.