



## CAN WE AFFORD TO FLY?

When airplanes first caught Keith Debbage's fancy, the term "carbon footprint" didn't exist. It was the 1960s, and he was a kid happy to accompany his father to air shows on weekends. Never mind that watching planes was what his dad, a Royal Air Force radar operator, did at his day job. People who love flight never tire of planes.

Debbage is still a fan. Now, as a geography and entrepreneurship professor, he is able to combine his passion for flight with professional interests. The airline industry is one of his areas of study, and lately he's been thinking a lot about one of the downsides of flight.

Jet aircraft are major polluters, and Americans – who love to travel – bear the responsibility for much of that pollution.

"Right now," Dr. Debbage says, "about a fifth of the global carbon footprint from tourism is attributable to air travel." Americans – just 4% of the global population – "account for 50% of all carbon dioxide emissions from airplanes worldwide."

That sort of tidbit motivates a geographer to dig deeper. Or in this case, two geographers, both named Debbage.

Debbage's son, Neil, is an assistant professor at the University of Texas at San Antonio. "He's got a bigger green ethic than I do," his father cracks. The younger geographer challenged his dad to work together on an examination of airline tourism's carbon footprint, with the added goal of being published in a prestigious journal, the *Annals of Tourism Research*.

They did, and it was.

There's been ongoing debate about whether direct flights are less polluting than itineraries with short hops and connecting flights. Often it's a question of big planes versus smaller jets. Carbon footprint data exists for all sorts of commercial aircraft, from regional jets to the largest wide-body Boeing and Airbus planes. The Debbages looked at more than 1,000 flights originating from 10 major Northeastern airports destined for 13 popular destinations, mostly in the Sunbelt. They compared emissions generated by connecting routes vs. direct flights and found conclusive evidence.

"Bottom line is, direct routes are more green," he says.

How green? The difference is about 100 kilograms of carbon, or about equivalent to the amount of energy needed to run a refrigerator for a year. That sounds pretty good, right?

But then there's this: Scientists have determined that to keep global warming from exceeding 2 degrees Celsius, each person on earth must not consume more than 2,300 kilograms of carbon per year. Of that amount, 575 kilos are allocated for travel, including daily commutes and vacations.

The Debbages found a round trip between those Northeast and Sunbelt airports, even without connections, consumes "on average, two-thirds of an individual's entire mobility budget for the year."

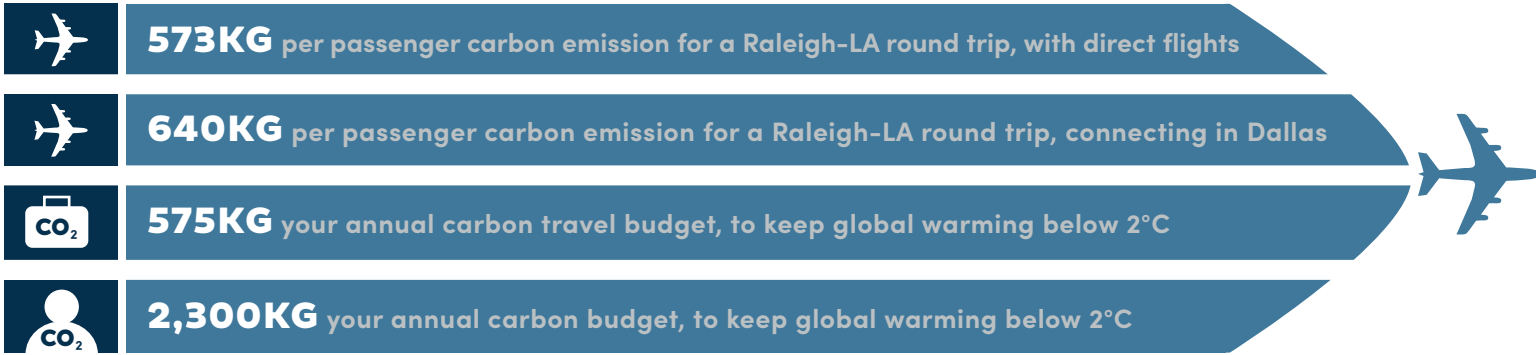
It was a sobering revelation for a lifelong aviation fan.

"Airline travel may be one of our worst environmental sins," Debbage says. "It was really kind of shocking."



**Debbage's findings on flight's carbon footprint have netted national media coverage and invitations to present his paper at conferences in Sweden and Dubai. This year he also won an American Association of Geographers' Best Paper Award.**

**He flew to the Middle East aboard an Airbus A380, "probably the biggest gas-guzzler, carbon-emitter civilian aircraft in the world," he says. The irony is not lost on him.**



**GREEN INNOVATION**

The most effective way to cut global airline industry carbon emissions is also the most drastic: Don't fly. Since that isn't a practical option, engineers, economists, and geographers are studying other ways that airlines can reduce their carbon footprints.

Strategies range from increased use of lightweight composite materials, such as those employed by Greensboro-based HondaJet in the airframe of its light business jet, to better aircraft engine design, to green fuels.

Green fuels, also known as biofuels, are sourced from plant-based and other organic materials. When burned, biofuels release drastically reduced amounts of carbon as compared to petroleum-based jet fuel.

Debbage and his son are writing a chapter on these trends for the upcoming "Handbook of Innovation for Sustainable Tourism."

"Virgin Airlines and several U.S. carriers have already experimented with biofuels," the elder Debbage says. Early results prove that large commercial aircraft can be powered by biofuels. "Right now, the goal is to elevate the share of aircraft that do that."

Scandinavian Airlines, also known as SAS, is another carrier in the forefront of testing biofuels. "You can figure out why," Debbage notes, "because it's based in Sweden." Greta Thunberg is not the only Swede with climate concerns.

Debbage expects it may be another decade before aircraft biofuels become widely adopted. The stakes are higher than in

the automotive industry, which is rapidly transitioning to hybrid systems and electric power.

"The pace of change for aviation cannot be what it is for automobiles," he says. "A fuel failure at 30,000 feet is catastrophic. Aviation is a much more delicate proposition."

**BOOSTING REGIONAL DEVELOPMENT**

Economic developers preach that an airport can be an economic driver for an entire region, attracting industry and spurring long-term job growth. Oftentimes that's true. But sometimes it isn't. Why the difference?

An ambitious project, led in part by Debbage, is sifting through economic, industrial, and demographic data in regions surrounding scores of airports nationwide to identify commonalities of success.

"It's one of the most exciting things I've worked on," Debbage says, "because I'm working with a big team of about 15 researchers." They are part of a larger project managed by an airline industry consulting firm, with funding from the National Academies of Science.

The team will study air passenger traffic patterns, air cargo, types of industries and their proximity to the airport, as well as regional wage and salaries. All sorts of data go into the hopper. It's a geographer's dream.

Working in concert with Debbage is his colleague James Nelson, director of the Spatial Analysis Lab at UNCG. "He's doing all the heavy lifting in terms of mapping airline and airport-related businesses," Debbage says.

The group will also collaborate with airport managers to develop an assessment procedure. In the end, he says, airports, local governments, and economic developers will have a web-based tool to analyze the regional strengths of an airport and target specific industries for recruitment.

With the COVID-19 pandemic crippling air travel, the study has become even more critical.

"We hope to provide airports with a leg up as we come out of the pandemic and passenger traffic comes back," Debbage says. "That's my goal."

by Tom Lassiter • learn more [go.uncg.edu/debbage](http://go.uncg.edu/debbage)



**Debt of a lifetime**

Social scientists, politicians, and others have long held that higher education has the power to overcome inequities – and to lay the foundation for everyone to achieve the American Dream.

But what happens when you are 18 and have to take out the equivalent of a home mortgage to pay for a four-year degree? Or when you begin your adult life spending up to \$1,000 a month on loan payments?

Questions like these drive research by Arielle Kuperberg, associate professor of sociology and women's, gender, and sexuality studies.

Dr. Kuperberg and collaborator Dr. Joan Maya Mazelis at Rutgers University-Camden are examining how student loans affect the trajectory of our lives, with their most recent project receiving support from the National Science Foundation.

Their research is timely. Student loan debt has nearly doubled over the last decade, reaching \$1.6 trillion. Of the 45 million Americans with student debt, says Kuperberg, as many as 10 million may be out of work due to the pandemic and ensuing recession. The government has paused payments on some federal loans until at least year end.

While loans play a vital role in helping 70% of students afford higher education, Kuperberg warns against unintended consequences. She has found that many, when faced with steep college loan payments, worry more about the future, delay marriage, and even put off seeking medical and dental care.

In one survey, one-third of respondents with student debt said they would postpone having children because of it. Kuperberg also found that, by age 35, women who graduated college with student loans were 15% less likely to have children than those who graduated without loans.

"This not only has negative effects on young people's ability to establish themselves," she notes, "it also could have long-term implications for society."

A major focus of the new NSF-funded project – a longitudinal study involving approximately 6,000 surveys and over 200 detailed interviews – is social mobility. People with student loans are more likely to come from families with fewer resources, and the researchers found they are also 34% more likely to give money to their families during college.

By age 32, people with student loans and a college degree earned about \$8,000 less than their debt-free counterparts.

These dynamics both reflect and perpetuate a class divide, Kuperberg says.

She hopes her research will make a difference for her children and future generations.

"Understanding these mechanisms is key to designing policy," she says. "How do we best ensure that student loans don't restrict social mobility and instead do what they're supposed to do, which is help people get ahead? It shouldn't have to be a trade-off."

by Dawn Martin • learn more [go.uncg.edu/kuperberg](http://go.uncg.edu/kuperberg)

**18%**  
of graduates with loans were delaying serious romantic relationships 15 months after graduation



**25%**  
of the graduates were delaying marriage



**32%**  
of students with loans say they will put off having children