

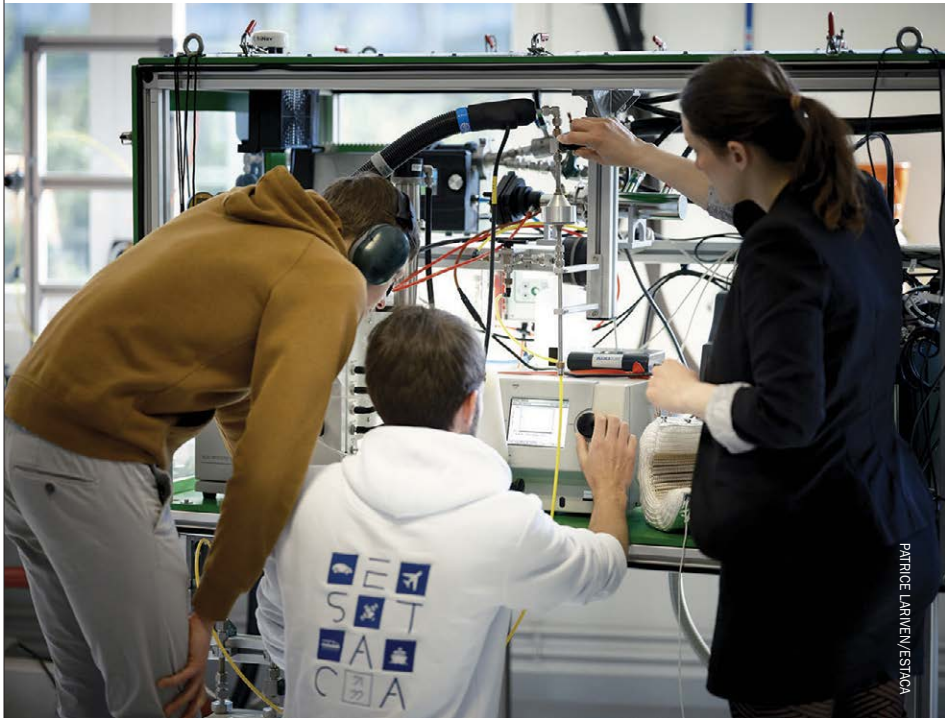
## French Aerospace Engineering Schools Expedite Green Curricula

- > TEACHING PROGRAMS AND CAMPUSES ARE TRANSFORMING
- > WITH TRAINING CENTERED ON SUSTAINABILITY, GRADUATES SHOULD INFLUENCE THE INDUSTRY IN THE COMING YEARS

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**FIRST IN A SERIES** France has half a dozen engineering schools feeding the entire European aerospace sector. Airbus CEO Guillaume Faury graduated from Toulouse-based ISAE-Supaero in 1992; European Union Aviation Safety Agency Executive Director Florian Guillermet gradu-

The teaching programs' greening is in full swing, although some schools are moving faster than others. This means young graduates are well aware of aviation's climate impact, which is taking center stage, and they have an expanding knowledge of breakthrough technologies that may



**Estaca is one of France's engineering schools where students are learning breakthrough technologies that might slash aviation's carbon footprint.**

ated from ENAC, also in Toulouse, in 1997; and numerous senior executives at various companies graduated from Supaero, ENAC, Estaca, ISAE-ENSMA and others.

Those schools have been adjusting to meet a legal requirement that their teaching programs include environmental issues. Among the main factors in the accelerating transformation is the scientific culture of teachers, many of them researchers, which adds to widespread public awareness of climate change.

cut air transport's carbon footprint. The new syllabi are expected to influence the entire industry.

Thanks to their new skills and more comprehensive vision, future engineers' professional profiles should be more attractive, and it should be easier for them to make themselves heard.

Student expectations have helped boost this transformation, although several have remarked that the industry is doing too little, too late. At some schools, such as Supaero, students have voted with their feet, choosing

to work in other sectors in an increasing proportion.

A speech at Supaero's graduation ceremony in December 2023 sent shock waves through the aerospace industry and academia. "Becoming an engineer, is that the solution or the problem itself?" **Anais Bouchet, the student delegate**, asked in her address.

Bouchet had been at the forefront of an awareness-raising campaign at Supaero in the preceding years. "I participated in Supaero's sustainability working group, which was active in 2020-22," she says. "The group spent one year defining a road map and one year starting to implement it. The implementation phase was planned over five years."

She saw fast beginnings in Supaero's three-year program, but after a self-congratulatory period, progress waned, she says. "Supaero did not follow the road map it assigned itself," she recalls. "Environmental issues have yet to be included across the board in teaching programs.

"The industry is not evolving fast enough," she adds. "I believe few promises will be kept. **The sector's thinking is based on techno-solutionism.** In fact, aerospace players do not see a path for the technologies they are researching."

Bouchet understands those who leave aerospace. "To have the greatest impact, you have to feel you belong to where you are," she notes. "**Staying in the industry in the hope of contributing to change is perfectly respectable.** If students leave the sector because they find it is doing too little, too late, then they make their point. **That's a respectable attitude, too.**"

Becoming aware of environmental issues while studying is quite normal, she adds: "That's when you think about your future job. It is commendable. It means the student develops a critical eye and finds motivation for change."

Bouchet created Erable, a finance company outside the aerospace sector, to spur sustainable investments. "Under our revenue-sharing model, investors can fund impactful projects," she explains.

Bouchet's speech echoed widely shared views. **Students have expressed their expectations for more environmentally oriented courses in different ways, with varying levels of success.** Edouard Butaye, who graduated from Poitiers-based ENSMA in

2021, participated in an attempt at the ENSMA level, a partnership of six aerospace schools in France, including Supaero, ENSMA, ENAC and Estaca.

Butaye served as president of the ENSMA social and environmental students' association, which aimed "to discuss social and environmental issues with ISAE's management team," he says. "The idea was approved, but red tape impeded the effort." ENSMA, which also is reviewing its programs, did not return Aviation Week's requests for an interview.

At Paris Saclay-based Estaca, Baptiste Loose leads the environmental branch of the RHEA student association for personal development. RHEA introduced the OGRE, a workshop focusing on what producing energy entails and the energy impact of our ways of life. "Estaca has now integrated it in its teaching programs at the start of the second year [in its five-year program]," Loose says.

While students have pushed engineering schools on including environmental issues in syllabi, most of the power to change lies in the hands of management teams and boards of directors.

ENAC says it is revamping course content. "In every subject, we integrate environmental issues," ENAC Director Olivier Chansou says. "That can take various forms, depending on whether we are talking about a theoretical matter, such as mathematics, or something more applied. We created a large matrix to determine where environmental and societal topics should be added."

Every year, Chansou and his team update more courses. "In two years, we have completed what we see as most important," he says. "Over 3-4 years, we will have ticked all the boxes."

**Estaca** has been thorough when including sustainability issues in teaching programs. **Among five new courses, four are environment-related: carbon footprint, energy technologies and low-carbon energy, design life-cycle assessment and smart city, which has to do with the integration of transport modes in society.** "Over their five years at Estaca, students have time to assimilate those topics," Training Director Philippe Guibert says.

With the help of RHEA, Estaca has created Transition Wednesdays: lectures and panel discussions on the environmental transition. "We orga-

nize 10-14 of them per year, and they are part of mandatory courses," Guibert says. Mining resources and the relationship between capitalism and sustainable development are among the topics covered. **"Engineers must have a critical perspective on their work to assess the impact of their decisions,"** he stresses.

At Estaca's Bordeaux campus, students can spend their fifth and final year focusing on sustainable transport. **"Sustainable aviation fuel (including biomass-based fuel, e-fuel and hydrogen) and eco-design courses** are new and specific to our Bordeaux campus," Guibert says. "In our new courses, we have included hybridization and electrification. Those topics are studied more in-depth in Bordeaux."

Supaero President Marie-Helene Baroux is betting on research. "Most of our teachers are also researchers," she says. "Some 35% of their projects relate to sustainability. By the end of 2026, we are aiming to increase that proportion to 40%. That research work on sustainability feeds into our teaching programs."

Some teachers come from industry, and sustainability has a growing importance in their lectures, she adds.

Supaero has a contract with the French National Center for Scientific Research to create theoretical and practical courses on hydrogen for sustainable aviation. "In technologies, our role is to show students the scope of the possibilities," Baroux says. "They will make their own judgment. Then, when working at a company, they will see concretely what a technology choice involves."

Baroux has more ideas about how to continue the transformation. "With Toulouse University, we would like our teaching programs to reflect the ecological transition even more, with new formats that would better suit the new generation of impatient, connected students," she says. "We are seeking funding to help us evolve in that direction."

Implementation challenges to greening syllabi abound. Under Supaero's Horizons road map, the start of the first year is dedicated to climate issues. "For that period, we created a 'low-tech workshop,'" Bouchet says. "Students would build a small water turbine to generate electricity. Before they delved into theoretical studies, that made them realize what it takes to produce energy, even at a low power level."

Baroux says she found the workshop valuable because students were making something by hand. However, it was terminated for budget reasons. “We are creating a new format on the same theme,” she promises.

ing their physical plants more sustainable. On ENAC’s campus, photovoltaic panels produce most of the school’s electricity. “Our heating system relies on biomass, and the temperature in our buildings is adjusted to their actual

universities, students offer positive feedback overall. “Every student feels environmental issues are crucial,” says Sacha Sayah, president of ENAC’s student association. “No one wants to ignore them.” Some students express reservations because the ongoing changes may mean more work, Guibert notes.

The level of motivation to respond to environmental issues varies from student to student, Loose notes. Some feel they are prevented from studying what they like, such as aeronautics. “Others are aware of the issues but find responding challenging because it requires concessions on their dreams,” he explains. “Some are convinced that change is needed, and they are already committed, both on a personal level and for the industry. Some become aware of the problem and change their minds.”

“Our students see themselves as being about to participate in a transformation,” Chansou says. “In 10 years, the ideal impact of our evolution would be that our students participate in that transformation. In future, there will be aviation, but we do not know its shape or size. And let’s not forget safety!”

Debates are ongoing. Bouchet and Baroux diverge on when graduates have an impact. “At the start of my first year, then-President Olivier Lesbre told students their generation would solve this century’s problems,” Bouchet says. “In fact, if you do the math, this is incorrect. The current state of aviation is the outcome of actions by people in positions of responsibility. By the time today’s young graduates reach such positions, it will be too late for them to have an impact.”

“Our students will be essential actors in aviation’s decarbonization,” Baroux retorts. “As our alumni can already tell, there is no need to be in a high-ranking position to make things change. Let’s not underestimate their power. The industry badly needs engineers, and when an engineer is not happy with their job, they quit.”

A substantial proportion of Estaca’s students will work in R&D departments and will have a direct impact on the future of aviation, Guibert says. They will work on hybridization, airframes, materials or optimization of airport operations. “In the coming years, if we see change, we can say we did our job,” he says. 🌱



### ENAC professors have been reviewing teaching programs, using a large matrix to determine where environmental topics should be added.

Funding is a challenge for Estaca, too. “We need hardware for practical work,” Guibert says.

Training teachers, meanwhile, is a relatively long-term effort. “We have rewritten the definition of our engineering degree, integrating sustainability issues,” Guibert says. “Teachers have to meet those new requirements, and they must train accordingly. Some of them are leaders.” As a result, transforming Estaca’s offering could take 4-5 years, he estimates.

When devising the new programs, teachers find it difficult to add to the syllabus without overloading students. The uncertain future of some technologies, such as hydrogen propulsion, is also a challenge for teachers, Chansou points out.

In addition to incorporating more environmental issues into their programs, engineering schools are mak-

ing use,” Chansou says. “Thermal insulation improvement works are ongoing. We have set a goal in carbon footprint reduction with a defined trajectory.”

Similarly, Supaero has been renewing its buildings’ thermal insulation and installing photovoltaic panels.

Estaca has calculated its carbon footprint. “Travel comes first, from both employees and students,” Guibert notes. “International travel accounts for half of that.” Before students travel, they are required to calculate the carbon impact of their trip. “Some might decide, after a long-haul trip, to pause air travel for 2-3 years,” he says.

Supaero’s Baroux has a more cautious approach to air travel demand management. “We do not want to preach to students,” she says. “Our duty is to teach them how to forge a personal opinion on scientific grounds.”

When they see changes at their