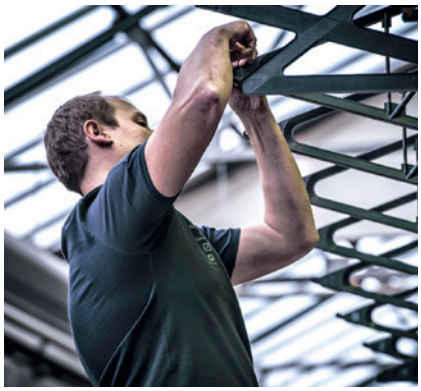
KEY INNOVATIONS ON BOARD

By bringing companies together to work on a common project, Solar Impulse highlighted the beneficial impact of teamwork in overcoming hurdles in order to find innovative solutions and make the impossible possible. The 80 engineers and technicians working under the leadership of its pioneering pilots have combined their expertise with partner companies to build bridges between disciplines and devise many novel solutions in energy storage, materials and propulsion. These key innovations are making the round-the-world flight possible - which implies being able to cross oceans and continents by flying an aircraft day and night without any fuel.

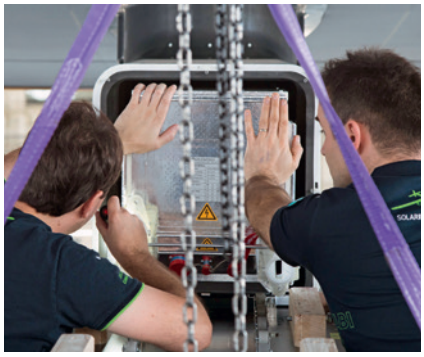


Structure

Although it has the wingspan of a Boeing 747, Si2 tips the scales at around 5,100 pounds, about the weight of a full-size sedan. The ultra-light design was based on composite materials found in competitive yachting, as well as carbon fiber composites manufactured by Decision that could be mass produced for the first time thanks to a process developed by Covestro. The plane was built with carbon "sandwich" sheets made in collaboration between laboratories of EPFL University and an innovative start-up North TPT: this manufacturing process requires no epoxy glue and the resulting carbon layers are three times lighter than a sheet of paper. Insulation foam also from Covestro wit protects the pilots from extreme conditions in lieu of a heating system.

Solar Cells

With 17,248 solar cells on top of its wings, Si2 harnesses power from the sun during the day and glides through the night on stored energy. The solar cells by SunPower which are just 135 microns thick (roughly as thin as human hair) are covered by a UV-resistant and waterproof resin conceived by Solvay. But they still pack a punch, having the best weight to efficiency ratio on the market. At 22.7% efficiency, they're more efficient than standard home-use solar panels by about 6%.



Batteries

To make Si2's night flight possible, an improved oxidizing process invented by Kokam maximizes the energy density of lithium-polymer batteries, while an innovative binder from Solvay improves their chemical stability. These innovations enable to store surplus energy for power during the night without increasing the weight and increase the number of charge and discharge cycle the batteries can withstand, making them more reliable. Surrounded by groundbreaking insulation foam, with pore 40% smaller, invented by Covestro, the batteries can remain at suitable operating temperature, never dropping below -4°F. (The same foam is used protects the pilots from extreme conditions in the cockpit in lieu of a heating system.)

Motors

Most thermal motors operate at around 30% efficiency, but Si2 boasts breakthrough with electrical motors - jointly manufactured by motion control specialist Etel and permanent magnet provider Vacuumschmelze - that reach heights of 97% efficiency. This was accomplished by cutting the motor's magnets into thin slices and lining them up side by side to minimize weight and energy loss at the same time. An enhanced lubricant developed by Solvay decreases the friction in the engine. If one motor fails, a smart dispatcher technology from Omega enables the power to redistribute among the remaining motors so the plane stays balanced in the air.

Man-machine interface

Anytime Si2 banks its wings more than 5 degrees, an instrument by Omega transmits a vibration in the pilot's sleeves. To withstand long duration flights lasting several days and nights, the stabilization augmentation system designed by Altran lets him sleep for 20 minutes every 5 hours while custom alerts warn them of safety concerns. On the pilots' bodies are matchbox-sized electrocardiograms from EPFL to track their fatigue as they fly, while smart nylon fibers by Solvay stabilize their body temperature, re-injecting infrared heat onto their skin when it's cold and preventing them from sweating when it's hot.