

VENTURI



# VENTURI ANTARCTICA

THE FIRST ELECTRIC  
POLAR EXPLORATION VEHICLE



PRESS KIT



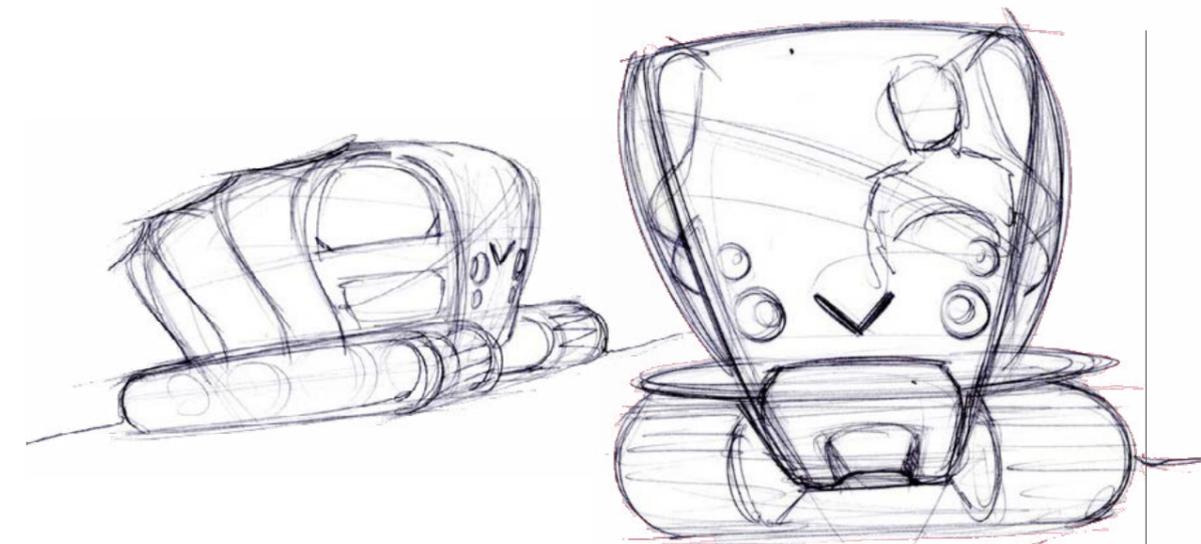
**Gildo PASTOR,**  
President of the Venturi Group

## VENTURI AND CLEAN MOBILITY IN POLAR ENVIRONMENTS

### Twelve years of research and counting

Venturi has extensive experience in the development of the electric polar exploration vehicle. The adventure began in 2009, when H.S.H. Prince Albert II of Monaco returned from an expedition to the Antarctic. The Sovereign had noticed that none of the twenty-two exploration bases he had visited were equipped with a low-carbon vehicle. So he asked Gildo Pastor, President of Venturi, to look into whether a clean means of transport could be created for use by the scientific research stations.

Venturi's engineers immediately set to work designing a "zero emissions" solution, to replace combustion-powered vehicles in research settings with extreme conditions. As early as 2010, an early concept model was unveiled on Venturi's stand at the Paris Motor Show. It was a fascinating glimpse of a future electric tracked vehicle, and showed that electric power is not just for cars. Meanwhile, development work continued.



©Sacha Lakic Design, 2009



Then, in December 2011, the Oceanographic Museum of Monaco was the venue as the first prototype Antarctica was presented to the world, on the one hundredth anniversary of the first successful expedition to the South Pole. With two electric engines with a unit power of 60 kW and weighing around two tonnes, that first prototype electric polar exploration vehicle is capable of carrying up to three people, along with their equipment. Fitted with wheel-mounted caterpillar tracks, it has a top speed of 25 km/h and a range of 50 km.



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## From Auron...

On 30 November 2018, the next generation electric polar exploration vehicle was formally unveiled at the Prince's Palace in Monaco. Equipped with large windows specifically designed to allow the occupants to discover the icy polar terrain, the vehicle can be recharged by means of renewable energy: solar or wind power.

Initial testing took place in Auron (Alpes Maritimes, France), a ski resort near Monaco. Over four days and three nights, Venturi's engineers drove in shifts, collecting as much data as possible in the sub-zero temperatures. Antarctica was then left in a climate-controlled chamber at  $-40^{\circ}\text{C}$ , to put its main functions through their paces in tough conditions. The tests were a success, with the antifreeze and defrosting systems working perfectly, while the opening parts and all of the electronics remained unaffected by the extreme cold.

## ... to Telegraph Creek

On the strength of these results, Venturi decided to move up a gear. In February 2019, the Monegasque group's R&D department set up base in British Columbia, a region of Canada known for its hostile terrain and extreme climatic conditions. In March 2019, three very special drivers took their seats aboard Antarctica for a unique experience: H.S.H. Prince Albert II of Monaco, the Canadian astronaut Chris Hadfield, and Xavier Chevrin, President of Venturi North America, Venturi's R&D arm based in Columbus, Ohio (USA). The three men took turns at the wheel, as they navigated a particularly treacherous route in outside temperatures of  $-35^{\circ}\text{C}$ . They travelled 42 km along the mountainside, between Dease Lake and Telegraph Creek, on the lands of the Tahltan people. This First Nation people, who have been living here for over 10,000 years, welcomed the expedition with open arms, making for a striking contrast with Venturi's futuristic technology, specifically designed to protect natural environments whilst allowing them to be explored.

# ANTARCTICA

FIRST ELECTRIC  
POLAR EXPLORATION VEHICULE



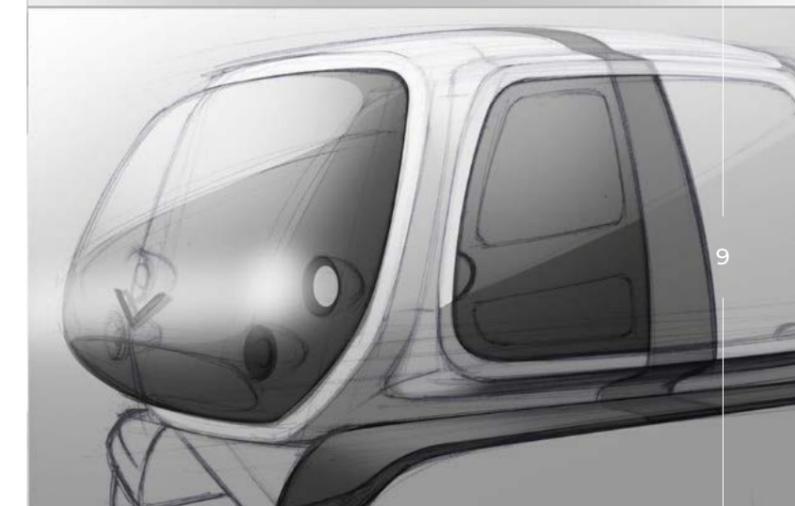
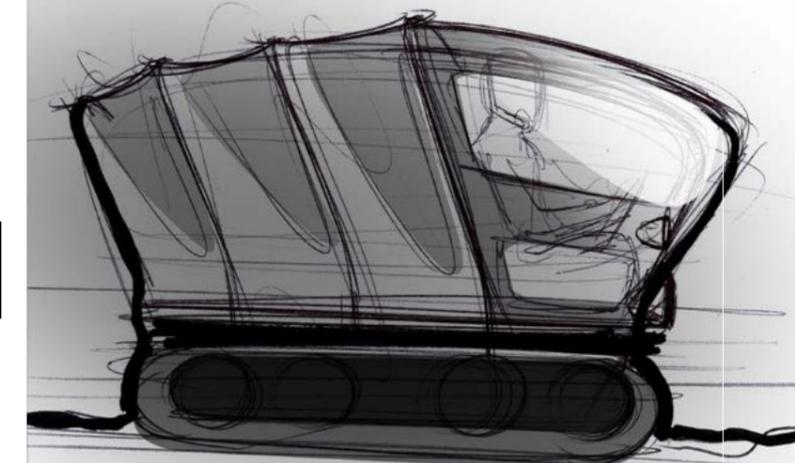


## New bodywork design

The 2021 version of Antarctica shares the distinctive style of the prototype first unveiled in 2010. The design of this next generation vehicle is a new take on the bubble concept for travelling through extreme natural environments, with Venturi's Design Director, Sacha Lakic, skilfully navigating the technical constraints with his inspired styling.

As a deliberately more functional, utilitarian vehicle, this iteration of Antarctica has slightly smaller windows, offering improved thermal insulation while increasing the possibilities for the scientists on board.

But Antarctica is equipped with double-glazed windows specially designed for extreme temperatures, with a full centimetre of space between the two layers of glass.



© Sacha Lakic Design, 2009



## Adhesive-based assembly

While the chassis is made of steel and welded in various places, the parts that make up the carbon-fibre bodywork are glued. The parts are first assembled together, then attached to the vehicle frame itself, along with the glass elements. This technique ensures there are no weld points on the panels that cover the chassis, making for a more effective seal. Venturi's engineers used a special glue that has extremely strong adhesive properties, but retains its elasticity at very low temperatures.

"On its travels, whether in transit or at the poles, Antarctica's chassis is going to be subject to significant variations in temperature," explains Franck Baldet, Venturi's Technical Director. "Depending on the situation, it will expand or shrink. So you need to use an adhesive that won't break, as the bodywork panels won't expand in the same way as the steel chassis."



## Multi-layer insulation

The mechanical parts (under the floor), batteries and passenger compartment use a variety of insulating materials. Polyurethane was chosen for its low weight, along with fibreglass (in places where space is at a premium). Aerogel was also used, a silica-based composite developed by Nasa for space technology that is also highly effective in extremely low temperatures.

"These insulating materials are different yet complementary," says Franck Baldet. "We used several layers of different materials depending on the zone and available space. The thinnest walls are protected in the same way as the thicker ones."

These multiple layers of thermal insulation (as well as an electric system to maintain battery temperature, see page 17) ensure Antarctica can be parked outside in temperatures as low as  $-70^{\circ}\text{C}$ .

## A functional, high-tech interior

The streamlined cockpit has been designed to accommodate additional instruments, sensors, or even to hook up computers. Antarctica has all of the scientific equipment needed. There is space for up to four people in the rear. The bench seats also fold down to free up more space and carry equipment.

Instead of a steering wheel, Venturi has opted to fit a joystick in the centre of the passenger compartment, allowing the vehicle to be steered left or right-handed, from either of the two front seats. This also means two different drivers can take control of the vehicle without switching seats. When the outside temperature is close to 50 below, that's no small advantage...

"But that's not the only advantage!" says Louis-Marie-Blondel, who designed Antarctica. "A joystick eliminates the need for a steering column, and requires only a cable connection. That takes up less space, it's lighter, and it's also easier for driving both engines (one per track). The joystick is mounted on the armrest so the floor is completely flat, and the windshield reaches down fairly low, which provides greater visibility. Buttons can also be mounted on it, to control other functions."

Importantly, Antarctica is also equipped with indicator lights and a horn, since it is officially approved in the same category (T) as tractors. So it is perfectly capable of being driven on the road if necessary, and can even turn on the spot at the press of a single button. Finally, for longer expeditions, it also has cruise control.



## Reversing camera

The design is about more than just looks. Care has also been taken to limit blind spots and save space, particularly inside the passenger compartment. The Venturi Antarctica is equipped with three cameras, with images displayed on a single screen. The driver can see all sides of the vehicle at a glance, and check what's happening on the sides of the caterpillar tracks. In addition, the same information can be accessed from either the left or right-hand front seat, with no need to adjust anything at all. It is important to be able to inspect the tracks' position fully, especially for a vehicle capable of turning on the spot.

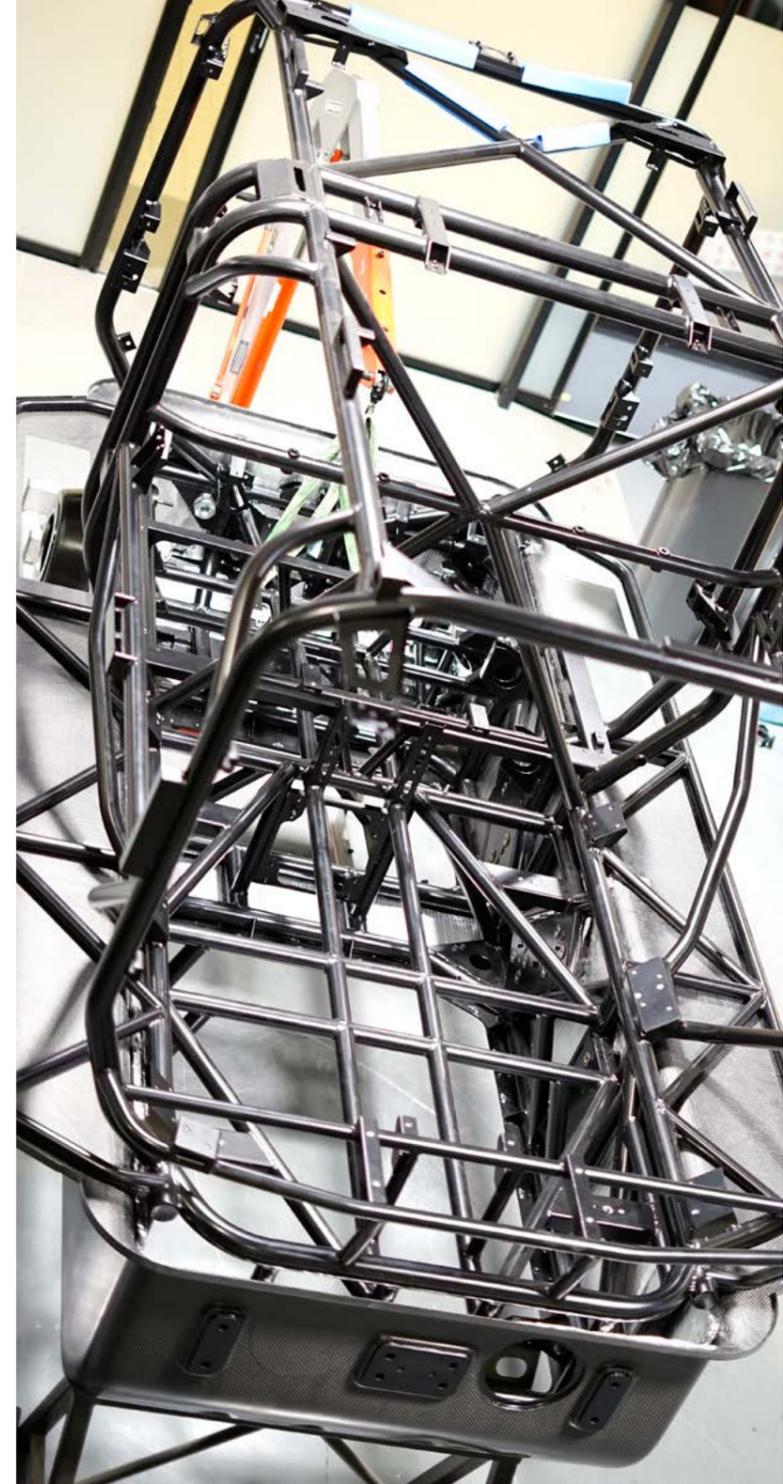


## Rally car chassis

Antarctica's structure was fully designed and assembled at Venturi's workshops in Monaco. The firm's engineers opted for a tubular steel chassis for its rigidity and occupant safety.

"On a tracked vehicle, the demands are enormous, and Antarctica is not as flat as you might think," emphasises Louis-Marie Blondel. "We had to design a safety halo that acts like a roll cage, like in rally cars. In addition, with very low temperatures that require specific zones to be reinforced, this choice enabled us to limit the thickness of certain parts. We drew on our motorsport expertise, but also the lessons we learned from developing our Venturi or Voxan record-breaking vehicles (see inset) to design this unique chassis."

A welded frame is also easier to alter, to reflect the needs of different polar expeditions. "If, tomorrow, a scientist asked us to add a relatively heavy piece of equipment, we would very easily be able to adapt and add new anchor points," concludes Louis-Marie Blondel.



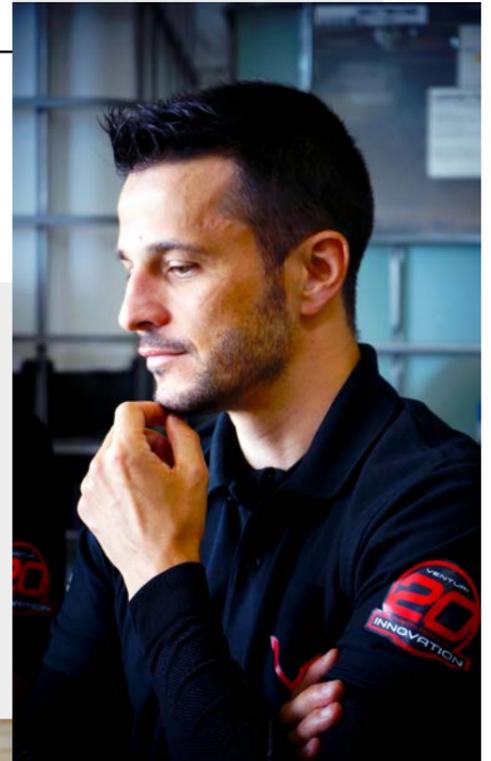
## Venturi, motorsport and record-breaking vehicles

Louis-Marie Blondel, lead designer on the Antarctica project, and Franck Baldet, Venturi's Technical Director, have vast experience in the world of motorsport. Both have been key members of the Venturi team in Formula E, the world championship for electric vehicles, in which the firm has been competing since 2014.

The two men have also worked on the development of several record-breaking vehicles: the Venturi VBB-3, an electric vehicle that set a new world speed record (549.43 km/h) in 2016, and the Voxan Wattman, an electric motorcycle on which rider Max Biaggi set 11 world records, including the outright speed record (366.94 km/h) in November 2020.

Louis-Marie Blondel and Franck Baldet drew on all of their knowledge, combined with lessons learned from the prototype polar exploration vehicles, to design each part of this next generation Antarctica.

Louis-Marie BLONDEL



Franck BALDET

## Two electric engines for Antarctica 2021

The drivetrain of this third generation model was designed by a specialist supplier, who previously worked on the earlier concept vehicles. The two engines – one per track – were chosen from among the very best on the market, and use axial rather than radial flow technology. These two motors are highly compact, relatively lightweight, and offer plenty of torque at low RPM. This means they generate their maximum yield at low speeds, making for a more comfortable driving experience and allowing the vehicle to extricate itself more easily from tricky situations.

The electric engines also act as brakes (one of the unique features of an electric machine), simultaneously allowing the battery to regenerate its cells. Antarctica is, however, also equipped with non-mechanical brake-by-wire technology, mainly used when the batteries are already fully charged (and do not need to recover any additional energy) or when the situation requires. The brake management programme developed by Venturi comes straight from Formula E. The teams also drew on their previous experience with the Voxan Wattman (record-breaking electric motorcycle) to explore other programmes of this software package directly linked to engine operation.

“Venturi is a close-knit team. Whether it’s polar exploration, Formula E, or two or four-wheeled vehicles, it’s always the same teams at work. It’s incredibly productive and a unique sharing experience. – Gildo PASTOR, President of the Venturi Group.



## Optimised batteries

This third generation Antarctica promises a range of 50 km, whatever the external temperature. One of the challenges was also to find ways to preserve the batteries when recharging in very cold conditions, as this causes the cells to age more quickly. The priority here is not fast charging, but rather maximising the battery’s thermal operating limits, extending its lifetime to suit the nature of the vehicle’s mission. “To maintain

the battery in the best possible conditions, we installed an electric heater,” explains Louis-Marie Blondel.

“It can be powered either by the battery itself, or via an external connection, or by solar panel. So the vehicle keeps itself at the right temperature, and that’s where we see the importance of the insulation, which directly impacts energy requirements.”

The power capacity, functions, and performance of batteries already developed by Venturi and its partners provided a perfect starting point. Next, improvements were added: “Because the third generation Antarctica is bigger, we were able to work with a battery with more cells,” explains Franck Baldet. “The batteries we are using are made in Austria, by one of our suppliers specialising in prototyping. The basic design chosen was adapted to our specific needs. The ideal running temperature for a battery is around 20 degrees, whereas we are going to be driving at -50°C. So we had to rethink a lot of things.”



To optimise energy management, Venturi is also using parts taken from Formula E, such as the vehicle’s control unit which manages all of Antarctica’s functions, and uses programmes developed in the world of motorsport, particularly for managing power flows. In milder temperatures, and although the vehicle has been designed for cold conditions, the

thermal stability of the systems and batteries can be maintained by means of “cold plates” above the tracks, through which a coolant is circulated.

## “Extended range” feature

Antarctica has a high-voltage electrical socket that is used to recharge the battery, but which can also be turned into an outlet for powering any other piece of electrical equipment.

So the vehicle’s range could potentially be extended by hooking up an extra battery, either on the rear of the vehicle, or on a towed sled. This would enable scientists not just to get around with their equipment (also stowed on the sled), but to travel longer distances with a heavier load.

All of this makes Antarctica a truly exceptional vehicle, completely fit for purpose in every way, and ready to take on the most extreme assignments.



## Solar panel recharging

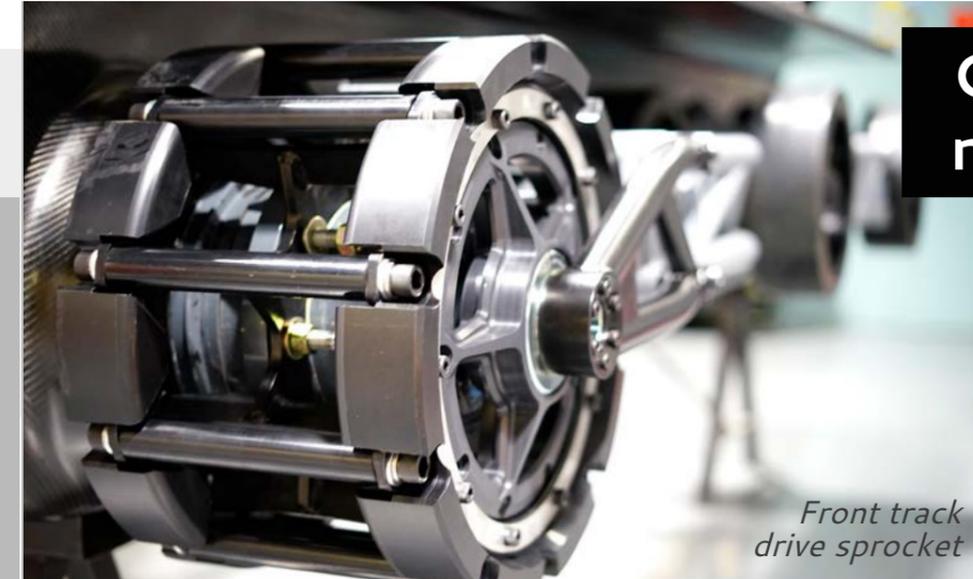
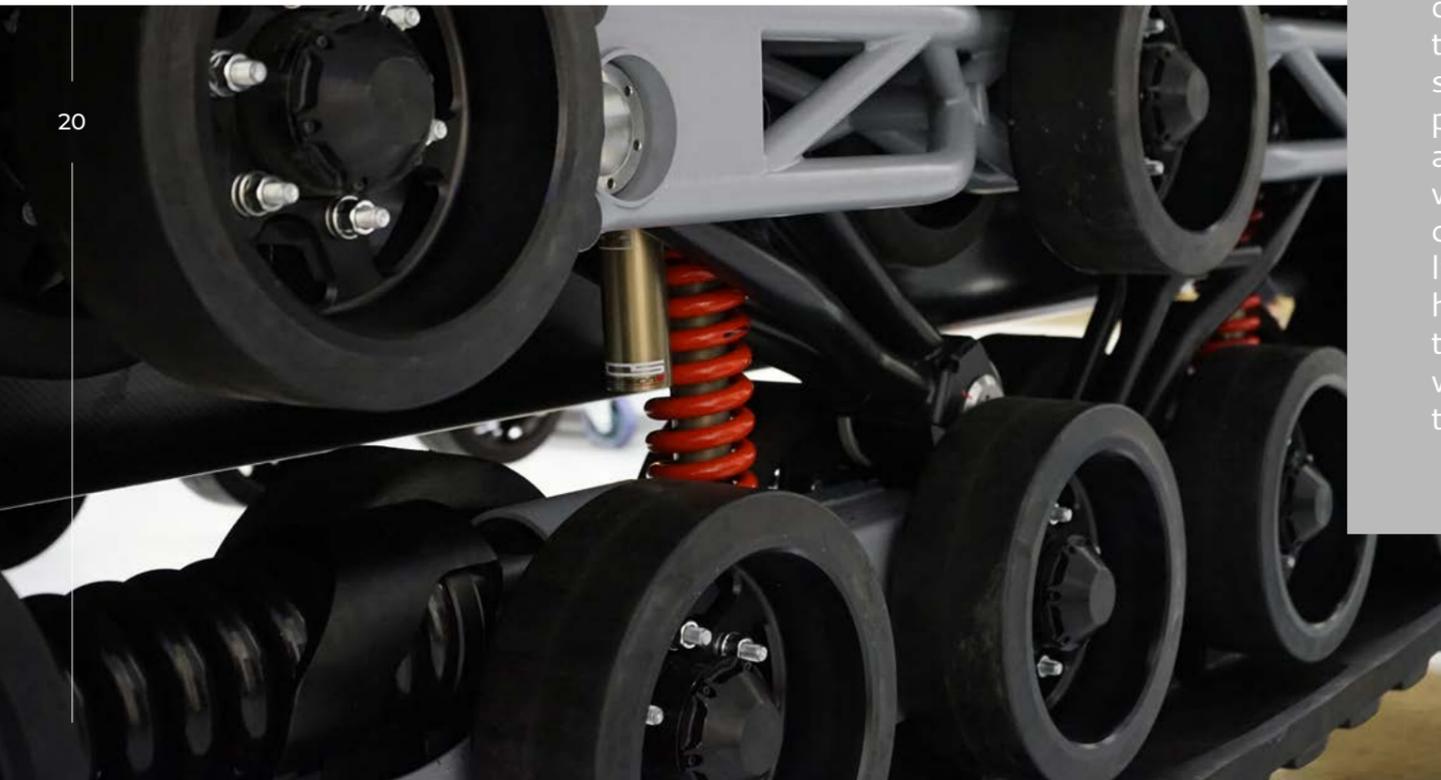
Antarctica is fitted with solar panels that perform multiple roles. The first is to provide a source of energy in any situation. In the event of a problem with the battery or power supply, the solar panels help to keep the vehicle’s vital parts at operating temperature. An electric vehicle has no alternator. Instead, Antarctica is equipped with a DC-to-DC (high/low voltage) converter capable of stepping down the battery output (400V) to 12V electricity for the passenger comfort features. The solar power generation is managed by a dedicated unit, which can also step up the voltage level from 12V to 400V. The various power circuits are linked, and can ensure redundancy if necessary.

Over a period of 24 hours in the Antarctic, the solar panel can supply 2 kW of additional energy, and will provide the minimum power needed for the heating and radio, ensuring the passengers can keep in touch with base at all times.

## Unique suspension

The suspension is the crucial centrepiece of the vehicle, on which Antarctica's locomotion and stability are dependent. It was custom designed at Venturi's own research and development centre. "We looked at what was usually done on this type of vehicle, and also on other machines like snowmobiles," says Louis-Marie Blondel.

"With Antarctica being a unique vehicle, we weren't able to use an existing suspension system, and had to design one that would enable our vehicle to be used in the best conditions. The final design led us towards a multi-link suspension with springs, and two shock absorbers per track. We wanted a vehicle with a suspension that ensured comfort while making obstacles easier to overcome. You can't always see what's lying under the snow, and a rock or hole can be hidden. We also wanted to limit the stress on the chassis and various components, to ensure the tracks are always under tension."



Front track drive sprocket

## Custom-made, natural rubber tracks

Antarctica's caterpillar tracks were custom made by Camso. The Michelin-owned specialist was able to draw on considerable experience gleaned from expeditions to the Antarctic, to supply Venturi with parts tailored to the vehicle's design constraints. Under the track tread is a belt made of aramide, which provides strength while mitigating vibration.

Compared with those mounted on the previous generation Antarctica, the tracks have been widened to increase the amount of rubber in contact with the ground and distribute the vehicle's weight across a larger surface area. This means the tracks do not drive so deeply into the ground, improving rolling resistance and energy efficiency. Traction performance is also higher on icy surfaces.

"We want the tracks to be tensioned at all times, so they offer the best guarantees of traction," explains Franck Baldet. "The tighter the track, the more efficient it is, and that's why we worked with Camso to design custom parts. We were looking for the maximum yield per part."



*These custom tracks do not include any metal architecture at all, which serves to limit vibration. Natural rubber is more flexible, and retains its elastic properties at very low temperatures.*

# TECHNICAL SPECIFICATIONS

## ANTARCTICA

### Dimensions:

- Length: 3.46 m
- Width: 2.02 m
- Height: 2.18 m

### Battery:

- Capacity: 52.6 kWh
- Voltage: nominal 370V

### Tracks (right and left):

- Natural rubber on aramid belts
- Camso origin (Michelin Group)

### Engines (2):

- Electric, axial flow
- Power: 60 kW per engine

### Suspension:

- Multi-link sprung suspension
- Two shock absorbers per track

### Range:

- 50 km

### Recharging time :

- From 2h to 18h  
depending on installation  
and country

### External operating temperature:

- As low as -60°C

### Weight:

- 2,500 kg



## TESTING CONTINUES...

The Venturi Antarctica, the first ever electric polar exploration vehicle, is now to set to continue its testing programme. Trials and measurements will be conducted in a mountain environment in the Provence-Alpes-Côte-d'Azur. The vehicle will be put through its paces, overcoming obstacles such as tree trunks and performing particular manoeuvres. High intensity acceleration and braking tests will also be carried out. All of these tests have already been done in the simulator, but will now be repeated in real-world conditions. Other dynamic trials will be conducted in climate-controlled chambers at -50°C, to simulate true polar conditions. These will test the efficacy of the insulation, and ensure that all of the on-board electronics continue to function correctly. Antarctica will then continue its journey to distant lands, and the polar exploration bases that are its ultimate destination.

## ABOUT VENTURI

Since 2000, the VENTURI Group has specialised in the design and manufacture of high-performance electric vehicles.

Whether through world records, expeditions on hostile terrain, the creation of the first electric sports car, the development of innovative vehicles or its involvement in the Formula E World Championship, the VENTURI Group embodies and demonstrates all the capabilities of the electric vehicle on 2 or 4 wheels.

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