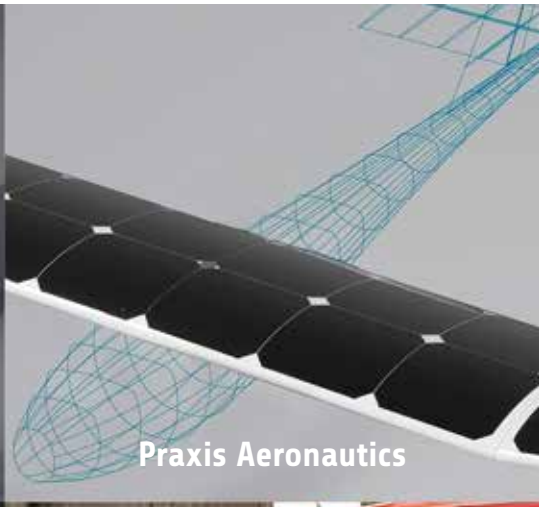
Issue 56 • July 2021

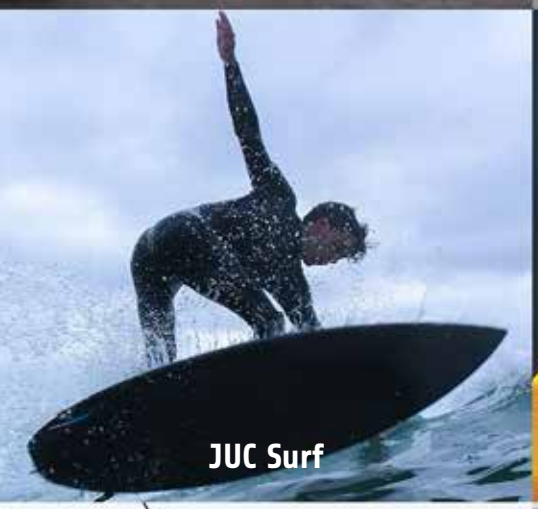
Connection

The official magazine of Composites Australia

Carbonix


Lorimer Composites


Praxis Aeronautics


JUC Surf

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aquaguard® X
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Aquaguard® X – an exciting new range of pool gelcoats, manufactured in Australia, to withstand harsh outdoor conditions

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Outstanding UV Protection	The Aquaguard® X technology protects the decorative finishes from harsh effects of the sun
Excellent Chemical Resistance	Products are tested extensively for chemical fade resistance to ensure a longer lifespan for the cosmetic finish

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- Improved chemical (chlorine) & water resistance
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Aquaguard® X gelcoats are available in a range of contemporary colours and striking finishes.

For more information, please contact allnex on 1800 789 607 or visit www.allnex.com

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Front Cover

Startups: enabled by the material properties of composites.

Feature article

Carbonix is a company that specialises in high quality, fully integrated RPAS (Remotely Piloted Aircraft Systems) and Unmanned Aerial Vehicles (UAVs) – commercial drones – which are manufactured from its purpose built site in Artarmon on the lower North Shore of Sydney.

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President's Letter

This time last year we had no idea what the future would look like with many things about operating our businesses outside of our control as we managed our priority to keep employees safe. Life was filled with uncertainty and worries about the future. And now here we are on a post-pandemic journey, albeit with disruptions still being felt, so it seemed timely to shift our focus to some new and inspiring Australian composite manufacturing adventures.

This edition of the magazine features startups, young companies which are embracing the bold challenge of bringing a new product or process to market. The companies, product offerings and entrepreneurial journeys all differ. But the stories confirm what we already know, which is that composites technology is a fertile medium for new products and that the need for stronger and lighter low maintenance structures will continue to inspire the development of new composite products.

Our story on Composite Stands on page 6 is a heartening account of developing a robust, ergonomically and operationally safe jack stand by harnessing the lightweight and corrosion resistant properties of pultruded composites.

The story on Carbonix, which specialises in manufacturing Remotely Piloted Aircraft Systems and Unmanned Aerial Vehicles using composites to model and tune aeroelastic behaviour to maximise the performance of hydrodynamic and aerodynamic craft, is inspiring. So too, the story on Praxis Aeronautics, and how its founder invented the first structural solar cell encapsulation system on the market.

Veitch Boats and The Fibreglass Factory are two young companies thriving in regional locations and capitalising on social media to market their products. The theme of sustainability runs through the stories of JUC Surf, the environmentally friendly startup making surf boards from high value industrial carbon fibre waste that would otherwise be sent to landfill, and the story on Kinetic NRG which has purposed composite technology to generate clean energy.

As a business owner with an understanding of the challenging journey of managing a manufacturing operation I am heartened with this healthy collection of Australian manufacturing startups.

Now that we've commenced a new financial year, I urge you to register for the annual **Composites Australia Conference** that will be held on 8th – 9th September in Toowoomba. Now in its 18th year, I find the event always provides a unique and strategic insight into a wide range of aspects associated with operating and growing a composites business and collaborating with composite companies. I'm looking forward to gathering with you in Toowoomba..

Leona Reif
President

LinkedIn: compositesaustralia
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Join us for two days in September 2021 that will be filled with stimulating presentations from composites practitioners and thought-leaders.

With a focus on **'Acting on Vision'**, attending will help you gain insight, hone skills, make connections and shape new ideas. With an exclusive tour of Wagner's Composite Fibre Technologies, and technology demonstrations of working production equipment, this conference is not to be missed

Join us for the conference dinner under the stars at the Toowoomba Golf Course, which will showcase the best of the Darling Downs region. Direct flights to Wellcamp airport operate from most states and through Sydney from Perth and SA.

Early bird registration is now available
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Composite Stands
Brisbane, Queensland

Written by Kerryn Caulfield, Executive Director of Composites Australia Inc.

Composites Stands is a Brisbane based company established in 2018 to produce a range of innovative lightweight jack stands that are used to raise and support industrial equipment and vehicles during service and maintenance activities and/or while in storage.

Paul Carman, Foreman at Hastings Deering with Matthew Dow Composite Stands company founder demonstrating a robust, ergonomically and operationally safe jack stand.

Conventionally made of steel, regular jack stands are heavy and cumbersome and pose a risk of personal injury during manual handling. Most larger stands need to be lifted into position by forklifts or loaders which are slow, awkward and costly. "In industrial workplaces, workers are prohibited from working on or under a machine or vehicle unless it is supported by a stand. The reality is that everything that moves must be elevated and then supported on a stand, but the stands that workplaces are compelled to use were, at times, not fit for purpose," says Matthew Dow, Composite Stands company founder.

With safety his paramount objective, Matthew set out to design and develop a robust, ergonomically and operationally safe jack stand. Harnessing the lightweight and corrosion resistant properties of composites, Matthew chose an FRP pultruded profile to develop columns which have significant compressive strength for use as the main post in the support stands.

Matthew's research had also identified the adjustable height mechanism system of conventional stands as a probable failure point. This problem also had to be reimagined with a safer solution.

The stands have been designed to meet the requirements of Australian Standard AS/NZS 2538:2016 and were independently tested and subsequently certified by the University of Newcastle, NSW and the University of Southern Queensland.

"A single idea morphed into a single product which has since developed into a full range of products that are fully certified and compliant. Their lightweight nature makes them easy to transport. With the addition of the new wheel kit, they can be unloaded and wheeled into place, hassle free. We're not standing still. It's a range that's constantly developing and expanding to meet specific applications as customers' expectations increase," advises Matt. The heaviest jack stand produced by Composite Stands is 1000mm high, weighs less than 80kg and is rated to hold 75 tonnes. Their lowest capacity Jack Stand is 140mm high, weighs less than 3kg and is rated to hold 8 tonnes. The tallest stand is 2200mm tall, weighs 65kgs and has a safety rating of 12.5 tonnes.

At great expense and effort, the company has since patented its technology in Australia, South Africa, the United States and Europe and has applications pending in a number of other countries.

Matt acknowledges that the last few years have been challenging. "Cashflow is always worrying for a startup; particularly with funds tied up in R&D and patents. Jack stands are an industrial product in an established market. Obstacles to getting an idea fully commercialised are considerable. Even with the best business plan, it always takes longer than you planned for an innovation to get acceptance in a market."

Composite Stands products are now being used in maintenance fleets for mining equipment, construction equipment, forklifts, machinery, on and off-road trucks, buses, cranes and even aircraft. The company's many customers include industrial giants like HASTINGS DEERING, KOMATSU Australia, HITACHI, SANDVIK, FMG and BHP.

The Fibreglass Factory
Yarram, Victoria

Written by Kerryn Caulfield, Executive Director, Composites Australia Inc.

Operating from a rural location outside the Victorian township of Yarram, The Fibreglass Factory (TFF) is owned and operated by husband and wife, Ben and Bek Muir along with a growing team of traditional fabrication workers.

Commencing as an extension of Ben's hobby of restoring Bedford vans, TFF offers fibreglass fabricating services for a multitude of end uses – from water slides to BIG tourist structures (such as the BIG Brussel sprout at the start of Melba Highway in Coldstream Victoria). They also offer a repair service for boats, trucks, and car parts as well as almost anything that is composite. Bek left her career as an accountant in 2020 to work in the business full-time as it grew.

But it is their business in fabricating vintage and classic car parts that has exploded in the last two years – particularity since COVID-19 afflicted the country in early 2020. With borders closed, and travel and events cancelled, car enthusiasts turned to the restoration job that had been parked patiently in their garage for years. Others went online and bought the vintage or classic car they'd dreamed of, or towed in rust-ravaged paddock-finds. "When Australian borders were closed, we were inundated with enquiries for vintage and classic car parts, especially for Australian cars by those nostalgic for their youth. The phone just kept ringing and our inbox kept filling up!" said Bek.

Observing that options to fix, replace or personalise vintage and classic car parts were limited, Bek and Ben set about collecting moulds of every part and model they could find. Today, they have one of the most comprehensive collections in the country of close to 1,000 moulds stored across several sites. According to Bek, the most popular models are those that qualify for the VicRoads club permit scheme that allows members of recognised vehicle clubs to drive eligible historic vehicles on the road network, subject to certain conditions.

Marketing and ordering for car parts and body kits are done online through TFF's website - https://thefibreglassfactory.com.au – that lists its catalogue of scoops, roofs, guards, skirts, front bars, spoilers, bonnets, doors and bumpers. Parts are paid for in advance, manufactured to order and sent directly to customers. TFF operates out of two large sheds and has expansion plans which include a third and larger shed on the front of the current block.

Ben Muir, Co-Founder of the Fibreglass Factory.

Yarram is a three-hour drive from the Melbourne airport in southeast Gippsland, between Bass Strait and the Strzelecki ranges. According to Bek, starting and operating from a regional location is an advantage: "We weren't locked into city rents so our startup and expansion costs were lower. Storage of our moulds would have been expensive in the city. Our town is reliably serviced by Australia Post and other transport services that are critical for our online model." Bek added that their rural locale makes it easier to control the work-life balance.

The couple has plans to upgrade their fabrication practices to include closed moulding for popular parts as well as introducing carbon fibre as an option. They are also working with the local TAFE College to appoint an apprentice later in the year.

Fitting fibreglass front and rear flares, front spoiler, rear spoiler, dash and vents to a Holden Torana A9X

JUC Surf
Surf Coast, Victoria

Written by Kerryn Caulfield, Executive Director, Composites Australia Inc.

The surfcraft industry has always been a strong advocate for sustainability and the environment. Concerns over wastage of carbon fibre spurred fellow surfers and aerospace engineers Dr Filip Stojcevski and Andreas Hendlmeier, along with organic chemist James Randall – all Deakin University graduates – to combine their knowledge of composites, electrochemistry and material interfaces to develop a surf board made from recycled carbon fibre. Named after Jan Juc, a village between Bells Beach and Torquay in Victoria's surf coast, JUC Surf is the team's startup vehicle for repurposing high value industrial carbon fibre waste that would otherwise be sent to landfill.

The choice of surf board design and input materials is a complex trade-off between board strength, flexibility (flex) and weight "Carbon fibre surfboards have been done in the past and the criticism is that they're always too stiff. The techniques and understandings to use carbon fibre aren't the same as glass. But we have that knowledge base and we've brought that to surfing," said Filip.

Conventional surfboards have a stringer which is a backbone made from wood that controls the flex and rigidity of the board. The JUC Surf board is a "stringerless" construction and uses woven and non-woven carbon fabrics which compensate for the stiffness characteristics of carbon fibre.

Filip explained that carbon fibre is an inert surface and doesn't readily bond. "We've used our scientific knowledge to promote and complement the carbon interface to its supporting resin. This is something that is overlooked in the surfing industry, particularly with carbon fibres which come with many surface treatments some of which are non-complimentary to resins like polyesters and epoxy. By emphasising the importance of fibre to matrix adhesion, recycled and waste fibres can be used to make great surfboards and solve a waste problem. They ensure that no waste is left behind by taking the carbon fibre in various forms, and creating a specific use for each type. Non-woven chopped carbon fibre is used as the fabric reinforcement, milled carbon fibre is added to the resin to toughen it up, and reclaimed carbon fibre is incorporated in specific spots to strengthen the piece."

Carbon fibre in fabric form comes in many different filament counts and weaves, not all of which are suitable for surf boards. "Different materials and how they are placed on a board will affect the strength and board shape alters the hydrodynamic function. But when you're working with recycled materials, the materials may not be perfectly to spec, so we developed a novel solution like a home-made loom to create recycled fabrics that give us the strength properties we needed," said Filip.

For their core material, the team at JUC Surf chose Kerdyn™ Green, the recyclable thermoplastic PET foam developed by Gurit to meet the growing need for a more sustainable structural core material. According to Filip, Kerdyn™ has good resin uptake performance with a good balance of mechanical properties, temperature resistance and density. It can also be processed at high temperatures, withstanding high exotherms. JUC Surf is also currently using the accredited bio-based epoxy, AMPRO™ Bio.

According to Filip, the JUC Surf board has a character all its own. It has a high buoyancy line and, being made of carbon fibre, the boards are 'ding' resistant.

"After many years of developing, innovating and testing our processes, we were transitioning into the commercialisation phase. Once the ABC aired an interview with us on the 6 pm news during the height of COVID, we went viral and started receiving enquiries and orders from all over the world and we realised we had a business," said Filip.

True to the tradition of startup pioneers of the surf coast such and Quicksilver and Rip Curl, JUC Surf is building boards from local sheds but hopes to move into more industrial premises as the company grows.

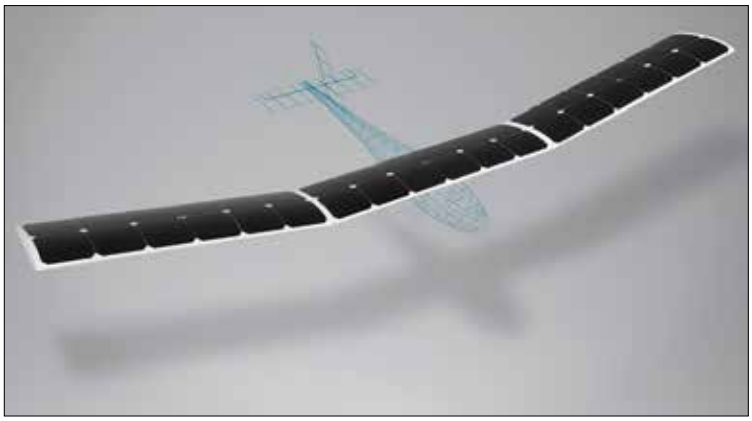
"After many years of developing, innovating and testing our processes, we were transitioning into the commercialisation phase. Once the ABC aired an interview with us on the 6 pm news during the height of COVID, we went viral and started receiving enquiries and orders from all over the world and we realised we had a business,"

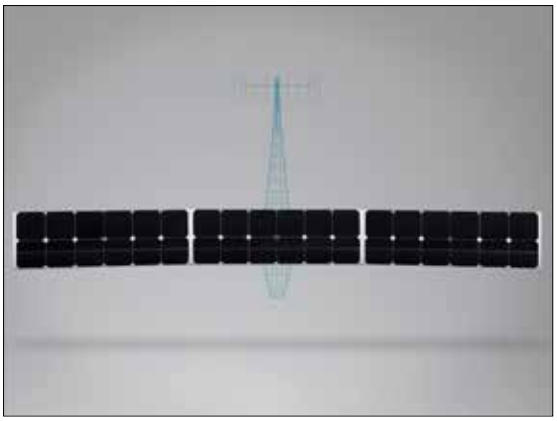
L to R. Gabriel Raposo, Filip Stojcevski, James Randall, Catherine Fraser, Andreas Hendlmeier, Jack Buckley, Lucas Rosson

Praxis Aeronautics
Royal Park, South Adelaide

Written by Kerryn Caulfield, Executive Director of Composites Australia Inc.

The Adelaide based startup Praxis Aeronautics specialises in the design and manufacture of Solar Energy Harvesting Composite structures, using a process that directly encapsulates solar cells inside composite material and the first structural solar cell encapsulation system on the market.





Above and Left. Solar-powered UAV wing featuring the first proprietary structural solar cell encapsulation technology.

Solar-powered Unmanned Aerial Vehicles (UAV), commonly known as drones, are traditionally made using prefabricated solar panels fixed or adhered to the wings or body of the structure. The panels add weight to the aerodynamically sensitive structure and the quantity of solar panels is dictated by the vehicle or wingspan rather than the required power. The shape and size of the pre-made solar panels also influence the design of the UAV. So while the solar panels power the vehicle's energy system, they also limit its functionality and design.

Cameron Donaldson, Founder and Director of Innovation and Manufacturing of Praxis, reasoned that incorporating solar cells into the vehicle's structure would solve these limitations by offsetting the weight of the cells, enabling an increase in power without a weight or aerodynamic penalty. Applying his knowledge of composite materials gained during a 20 year career as a boat builder, Cameron invented the first proprietary structural solar cell encapsulation technology.

In 2016, Cameron tested his idea in the Australian eChallenge, the competitive entrepreneurial program run by the University of Adelaide and won his category. A grant from the South Australian Government provided the means to test the concept's technical and manufacturing feasibility and practical potential. Through further research and experimentation, Praxis made design improvements and weight savings that can increase the flying time of a UAV by up to 200-300 per cent more than non-solar variants.

Based in Adelaide, South Australia, Praxis Aeronautics is a technology and manufacturing company that specialises in using composites to harvest energy from the sun for air, land and sea applications. Cameron's sister, Katie Donaldson, joined the company in 2018 as business partner and Managing Director. Cameron and Katie have since built a team of professionals with wide ranging technical and business skills including composite design and manufacturing, aeronautical and structural engineering and electronic and software engineering.

XTEK staff undertaking first flight test of the XTEK Puma Solar Wing Mk1. Left to right: Joe Nixon (XTEK Chief Controller), Mark Mathews (Project Manager), Rik Heslehurst (Chief Engineering), Tibor Fekete (Head SUAS Business Unit) and Mark Allen (Chief UAV Pilot)

"While we're confident that our Praxis Technology heralds a step-change in solar-powered drones, the journey from idea to commercial outcomes has presented lots of challenges"

Together they have refined the Praxis process to structurally integrate solar cell chemistry into a shaped composite component that is aerodynamically efficient and waterproof, while also developing custom electronics to complement the power management of the solar arrays. "While we're confident that our Praxis Technology heralds a step-change in solar-powered drones, the journey from idea to commercial outcomes has presented lots of challenges"; explained Katie. "In the process of proving and refining our technology, we've collaborated with a number of organisations including Gurit which has a key focus on innovation in sustainability and solar technology."

Praxis was also contracted by XTEK Ltd, the listed ballistic armour and advanced composites manufacturing company that provides acquisition and in-service support to the Department of Defence Small Unmanned Aerial Systems (SUAS) section. The XTEK Logistics team provided engineering and technical support on the structural integrity of the SUAS and conducted the flight performance trials that led to the Praxis solar wing system certification.

"With drones fast becoming the autonomous workhorses of the air and sea, our ultimate goal is to create multifunctional autonomous vehicles that can operate in daylight for an unlimited number of hours while the batteries kept at their highest charge state and optimum performance for longer and solar composites, allow us to do this," advises Katie.

Praxis has a number of transformative commercial and defence contracts under consideration.

Kinetic NRG
Southport, Queensland

Written by Kerryn Caulfield, Executive Director of Composites Australia Inc.

Founded in 2016 by the late Paul Camilleri, Kinetic NRG is a startup with a mission to provide communities across the globe with the technology to generate clean energy in decentralised locations without the need for heavy machinery and expensive infrastructure.

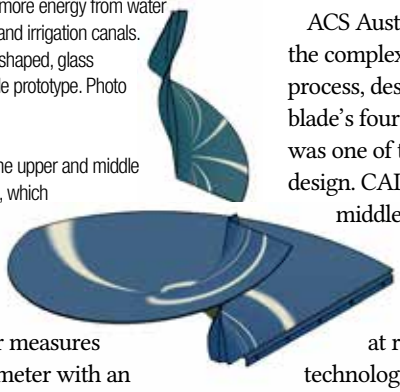
The Hydro-kinetic Energy Generator modular unit built and assembled by Marky Industries

Through private funds, the company has invented and patented a micro hydro-kinetic energy generator which is capable of providing constant base load electrical power generation using untapped kinetic energy flows from small waterways.

Hydro-electric power is a major source of renewable energy in Australia. More than 120 operating power stations were built across the country in the 20th century, the largest of which is the Tumut 3 Hydro-electric Power Station on the Tumut River in New South Wales which is part of the massive Snowy Mountain Scheme. Electricity is produced by using falling or fast-running water to spin a turbine connected to a generator that produces electricity. While hydro-electric power relies on huge dams and water systems and equally large turbine systems, hydro-kinetic energy conversion (HEC) uses the velocity of smaller water systems including rivers, streams or irrigation channels to generate electrical power.

Above. Kinetic NRG set out to design a modular hydroelectric turbine able to capture more energy from water sources such as rivers and irrigation canals. The result is this spiral-shaped, glass fibre/epoxy turbine blade prototype. Photo credit, ACS-A

Right. CAD files show the upper and middle sections of the part tool, which was manufactured by ACS-A.



Kinetic NRG's hydro-kinetic energy generator measures 1.5 metres in diameter with an output of up to 30 kilowatts (kW) from water flows of 2.0 metres per second. It is part of a kit that uses an environmentally friendly turbine blade to produce more power from low velocity water flow (1.5 m/s) within a given waterway. It is a modular designed transportable structure powered by a smart technology power management system. The spiral-shaped turbine blade which combined with the nacelle increases water pressure available for capture, extracting more energy than previously thought possible, which is the systems defining feature.

Darren Wren, Managing Director of Kinetic NRG, explains, "Conventionally turbines are forged from metal, which after trials proved unsuitable for our innovative spiral blade model. Alternative manufacturing techniques and materials including nylon, ceramics and 3D printing also proved unsuitable."

During 2020, the Victorian specialist composites design and manufacturing organisation, Advanced Composite Structures Australia (ACS Australia), was engaged by Kinetic NRG to design and manufacture the hydro-electric turbine. The primary material for the turbine blade is a non-crimp glass fibre epoxy resin composite which is finished with an anticorrosive, marine-grade paint before installation.

ACS Australia says that in addition to the complex manufacturing and assembly process, designing the tooling for the blade's four interlocking subcomponents was one of the challenging aspects of the design. CAD files show the upper and middle sections of the tool, which was manufactured by Sykes Australia in Geelong.

"We are currently looking at refining the fabrication technology which may require a higher-speed process depending on the shape and volumes," says Paul Falzon, General Manager of ACS Australia. "We are also evaluating converting other metallic components of the system into composites, to cut down on overall weight of the assembly. Cost and performance will determine the material system that will eventually be utilised." Falzon says.

As a technology company, Kinetic NRG will be forming manufacturing partnerships to scale up to commercial volumes.

Lorimer Composites
Port Melbourne, Victoria

Lorimer Composites (LC) is a startup that is specialising in developing innovative ideas into market-ready products and services. It is wholly owned by the composites design and manufacturing organisation, Advanced Composites Structures Australia (ACS Australia), and operates from its industrial premises in Port Melbourne in Victoria, Australia.

Composite materials have been introduced into almost every industrial sector in some form, creating new markets and adding new dimensions to mature ones. But the breadth of skills, equipment and infrastructure required to bring new composite products to market can stymie the best ideas. For this reason, Lorimer Composites was recently established to enable and advance the commercialisation of great cutting-edge ideas. LC circumvents traditional avenues of early-stage investment, in that the company will consider an equity arrangement in exchange for design, engineering, prototype and commercialisation services.

ACS Australia morphed from the Cooperative Research Centre for Advanced Composites Structures (CRC-ACS) that operated from 1991 to 2015. Over 24 years of industry, university and government laboratory collaboration produced highly practical and valuable technology and capability outcomes that helped Australia's composites industry to move forward competitively. At its core, the CRC-ACS showed that coordinated teamwork was a productive approach for Australia's composites industry, helping it to achieve international market share and prominence. In addition to state-of-the-art manufacturing facilities and world-class engineers all under the one roof, Lorimer Composites has the unequalled pedigree of the ACS Australia experts from whom the innovators can draw.

"We know that advanced composites technology is a fertile medium for new products. We are confident that the need for stronger and lighter structures offering low maintenance will continue to inspire the development of new composite products. We believe the market is ready to capitalise on our legacy of tried and tested innovation management processes to bring an idea to commercialisation" says Paul Falzon, General Manager of ACS Australia.

Lorimer Composites is open to pitches from engineers, inventors, designers or anyone with a need to realise a great idea using advanced composites technology – contact them at info@lorimercomposites.com.

Some early examples of innovative composite products that LC participants are exploring include, consumer products, high-end furniture and advanced material technology.

Carbon fibre composites enable ultra-thin minimalist "floating in air" lamp for modern interiors.

From concept to commercialisation, the 'carbon fibre bike cup holder' made in-house at Lorimer Composites in Port Melbourne. Now available at coffeenride.com

Veitch Boats
Bairnsdale, Victoria

Written by Kerryn Caulfield, Executive Director, Composites Australia Inc.

'Get real – get rural' is the advice from Roger Veitch, founder and Managing Director of startup Veitch Boats based in Bairnsdale, southeast Victoria.

Roger already had considerable experience building composite racing boats, V8 parts and skis when he recognised an opening in the market for a locally designed and made trailerable fishing boat. He set his mind to the challenge and, after six years in development, the result was the "Veitch 27" - a fully trailerable, resin-infused, composite game fishing boat. "A standard full licence allows you to operate a vehicle with a GVM (Gross Vehicle Mass) of 4.5 tonnes. So I designed a boat that could fit a trailer just inside the legal width for towing. It is a fast boat with buoyancy at the top section to keep the bow up when diving into big Bass Strait swells," said Roger.

From a startup in 2017, Veitch Boats soon attracted an equity partner in 2018 and now employs around 17 local people and six apprentices in technical boat building roles. The company operates from a 12,000 metre site overlooking wetlands and a wildlife reserve, both part of the environmentally significant Gippsland Lakes.

The company's purpose-built boatbuilding facility includes three sheds – soon to be four - with ceiling heights of 10.5m. The factory is fitted out with three 3 axis CNC machines, five spray booths and three overhead cranes capable of lifting 10 tonnes.

"The build started at the beginning of 2020 just as the pandemic was breaking. The teams worked frantically to finish the job which was completed in record time – we were all freaking out that the world was going to end," said Roger.

A standard full licence allows you to operate a vehicle with a GVM (Gross Vehicle Mass) of 4.5 tonnes. So I designed a boat that could fit a trailer just inside the legal width for towing.

The base model Veitch 27 can be bought for around $250,000, but optioned up the price can double. Roger likens his boats to high-tech drones: "Options include gyroscopic stabilisers that reduce rolling by sensing and automatically stabilizing orientation. The C-Zone switching system manages all things digital including autopilot, night vision systems, radar and even running operations with pre-set modes dialled in for cruising or fishing. Later this year, we're launching a 23-footer using the same concepts."

Spending on aquatic recreational endeavours and assets has exploded during the COVID-19 era. According to Roger, game fishing has attracted much of the spending and Veitch can't keep up with the demand. Waiting time for delivery of a Veitch 27 has now stretched out to 18 months.

Roger sees no downside in operating his business in a regional location. "As a startup we could afford to buy our land and build a production facility that is fit for purpose. We have a ready pool of willing workers. Some have done a tree change and relocated from the city, others have knocked on our door keen to build boats. As a young company, most of our marketing communication is done through social media – we don't need flashy showrooms," advises Roger.

Boats such as the Veitch 27 and upcoming Veitch 23 are in high demand and the economy of Bairnsdale is growing in parallel.

The "Veitch 27" - a fully trailerable, resin infused, composite game fishing boat diving into big Bass Strait swells.

Partington CC
Waurn Ponds, Victoria

Written by Kerryn Caulfield, Executive Director, Composites Australia Inc.

Founded in 2015 by Jon Partington, Partington CC specialises in designing and making high performance carbon fibre wheels.

A cycling enthusiast, Jon drew on his knowledge of automotive design and carbon fibre gained early in his career working in the UK's automotive and motorsport industries and supplemented with a mechanical engineering degree from Deakin University. This knowledge and experience allowed him to apply frontier engineering disciplines to the design and manufacture of exceptional light-weight high performance bicycle wheels.

Partington wheels are produced as a single unit. The unique carbon fibre spoke design is bonded under tension to two points of the rim and wraps around the aluminium hubshell. A high density, aerospace grade "PMI" (polymethacrylimide) foam core supports the fine carbon fibre wall.

Ned Volk, R&D Engineer preparing a development rim for test and evaluation measurements as part of the ongoing evolution of the Partington CC product portfolio. Photo by Ron Not

The rim has high stiffness-to-weight and strength-to-weight characteristics. Carbon fibre pre-preg and towpreg feature as well as titanium, aluminium and plastic. The spokes are made from unidirectional carbon fibres that can have a stiffness-to-weight ratio of >12 times that of steel. Partington has developed a number of proprietary manufacturing processes as well as its own tooling.

At close to $8,000 for a wheelset, Partington's high-performance carbon fibre wheels are in the upper tier for discretionary cycling investments. According to Jason Steinwedel, CEO of Partington, there is no shortage of cycling enthusiasts willing to pay for high tech equipment.

Every aspect of a Partington wheel has been developed from a concept put forward in-house, from ideation, detailed design, analysis, materials characterisation, tooling design and manufacture, component manufacture and testing. Every process, material and test result is analysed in order to refine and redesign, and to capitalise on the material properties.

Partingtons' wheels have been verified by the UCI (The Union Cycliste Internationale), the world governing body for sports cycling that oversees international competitive cycling events and technical regulations.

"We've moved beyond the startup phase and well into the next growth phase. Structures are now in place to rapidly grow our capacity and throughout. We have an R&D team and administration support, Business Development, Sales and Marketing, and recently appointed a Manufacturing Operations Manager.

We're investing heavily in tooling plant equipment and scaling up production to become a much larger player. We will have automated half our processes by the end of the year, which will be ongoing into 2022, and we're developing more prototypes with the aim of having 16 products in the field," said Jason.

For the time being, demand is exceeding production capacity. "We're sold out until end of year and only taking expressions of interest beyond that. The scale-up will increase our production capacity to 4,000 wheel sets per annum," advises Jason.

Investors have been keen to buy into the company with a vision of being part of one of the world's premium light-weight high performance bicycle wheel manufactures. A second fund raising round will open soon.

Jon Partington, CTO and founder, explaining the process of design iteration with respect to the internal commentary of the Partington CC R-Series wheels. Photo by Ron Not

"We're sold out until end of year and only taking expressions of interest beyond that."

Carbonix
Artarmon, NSW

Carbonix is a company that specialises in high quality, fully integrated RPAS (Remotely Piloted Aircraft Systems) and Unmanned Aerial Vehicles (UAVs) – commercial drones – which are manufactured from its purpose built site in Artarmon on the lower North Shore of Sydney.

Carbonix Domani airframe made entirely of prepreg carbon fibre composites. Aerodynamic optimisation is visible in the wing root blends and shaping of the nose and motor pods.

Commencing as a hands-on boat builder, Dario Valenza, Founder and Chief Technology Officer of Carbonix, later studied as a Mechanical Engineer. He gained early experience as part of several America's Cup teams and pioneered full hydrofoiling in A-Class catamarans at World Championship winning levels.

This involvement and technical experience conditioned Dario to question and push technological boundaries. He founded Carbonix in 2011 as a consulting company specialising in the design and construction management of high-performance racing sailboats. Among a number of stellar achievements, the company developed and supplied advanced control systems for Moth customers, including Australian Olympic sailing team Gold Medal winners.

As Dario explains: "Drawing on aeronautics and aerodynamics and next-generation composite materials and technologies, we were able to make high performance yachts fly. The hull being out of the water drastically reduces drag and immediately increases the speed of the yacht allowing speeds of more than 70 kilometres per hour for some classes. From a production perspective, it was all learning; we pushed the edge of what could be done at any given time – like doing large hulls out of carbon fibre and managing the resin flow and the cure and core bonding to minimise weight and maximise stiffness."

In 2014, Carbonix produced the Volanti Vertical Take-Off and Landing (VTOL) UAV. Volanti is an evolution of Cometa, that had been developed in partnership with Spain based D3 Applied Technologies. Being able to dramatically improve the performance and practicality of commercial UAVs defined a new direction for Carbonix.

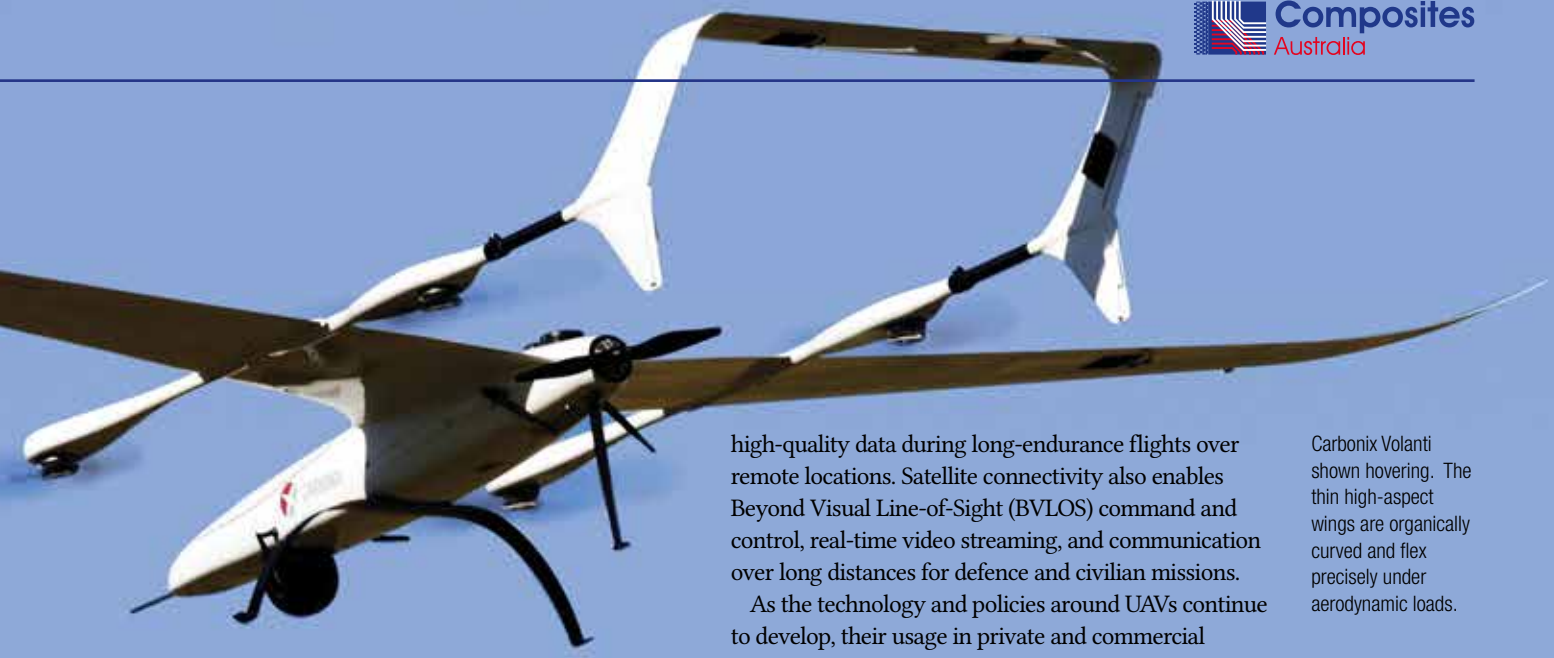
Aeroelasticity is the interaction between aerodynamic forces and non-rigid structures. "Designing and engineering for aeroelastic behaviour is fundamental to maximising the performance of hydrodynamic and aerodynamic craft. Using advanced materials and technology, aeroelastic behaviour can be modelled and tuned. This specialisation led me to build yachts, planes, and cars," Dario said.

Production is all done on site where they engineer the tooling and composite construction, mainly using carbon fibre prepregs, vacuum bagging and oven technology. But as the Carbonix team developed lighter, stronger and more efficient composites airframes, the company found that the avionics systems weren't advancing at the same rate. "The market wanted a fully operational UAV. But we realised that available electronics stymied reliability, endurance and range. We then had to develop the capabilities in-house and invent some of the core components of the systems ourselves," advised Dario.

The company's two main fixed-wing VTOL Power Lift vehicles are the Volanti and the Domani. The Volanti has a wingspan of 3.6 metres, while the Domani has a wingspan of 4.5 metres. Volanti is all-electric whilst Domani uses a petrol hybrid system which gives it the ability to carry as much as 5kg for up to 10 hours. Both vehicles are capable of executing automated aerial surveys over very large areas and operate from difficult terrain. They are fitted with proprietary avionics with a range of sophisticated sensors that can be customised to end-use applications.

Carbonix also offers a design consultancy and

Carbonix Volanti carrying a gimbal camera payload for ISR (Intelligence, Surveillance, Reconnaissance) missions. The ball hangs under the payload bay of the aircraft and is able to swivel through 360 degrees. It can track objects and measure range to target.



Carbonix Volanti shown hovering. The thin high-aspect wings are organically curved and flex precisely under aerodynamic loads.

engineering service as well as custom manufacturing of prototypes and productisation of customer projects. It has extended its services to include training, maintenance and customisation and now offers cost effective leasing arrangements for its UAVs.

A memorandum of understanding (MOU) was recently signed between Carbonix and the global industrial conglomerate, Honeywell International Inc. The partnership will see the Carbonix vehicles fitted with Honeywell's brand new Small UAV SATCOM systems. Weighing only one kilogram, Honeywell's technology can enable connectivity in remote areas far away from the drone's Ground Control Station. This takes away dependency on ground-based communication networks, freeing the user to capture high-quality data during long-endurance flights over remote locations. Satellite connectivity also enables Beyond Visual Line-of-Sight (BVLOS) command and control, real-time video streaming, and communication over long distances for defence and civilian missions.

As the technology and policies around UAVs continue to develop, their usage in private and commercial applications multiplies beyond surveillance and reconnaissance. Utility sectors, as well as construction and mining are increasingly using drones. So too are community safety services such as firefighting and search and rescue. Urban air mobility and the use of drones for delivery services are said to be the new frontiers in aviation. Dario's view is that the next step-change will rely on the interface between avionics, payload, endurance and range enabled by advanced performance materials and production systems such as composites.

Carbonix works with final year students and PhD candidates at Macquarie University and the Universities of Sydney and New South Wales. Its team of 20 is set to expand with new appointments in the near future.

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