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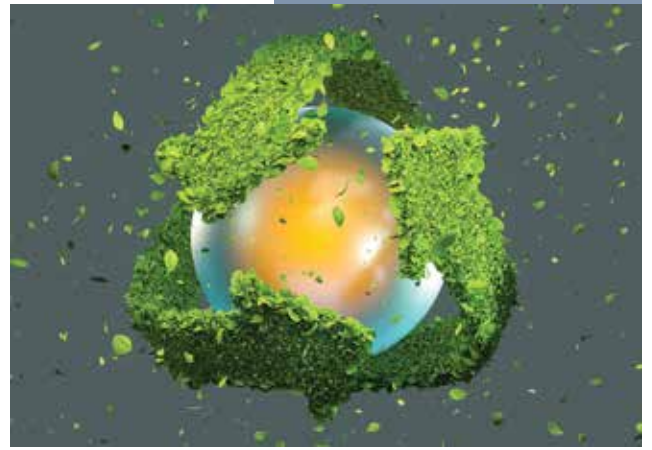
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THE GROWING DEMAND FOR SUSTAINABILITY

Put simply, sustainability is the ability to maintain or support a process continuously over time, in other words preventing the depletion of natural or physical resources. If a product or activity is sustainable it can be reused, recycled or repeated in some way because it has not exhausted all the resources or energy required to create it.

Sustainable construction involves using renewable and recyclable materials on building projects, while reducing or eliminating energy consumption and waste of any kind. The primary goal is to decrease the industry's impact on the environment and the world's finite resources.

However, the construction industry, by its very nature, is one of the main consumers of minerals and natural resources, responsible for approximately 50 percent of the worldwide consumption of raw materials. It is also a significant waste producer. As a result, the pressure on construction companies to reduce their environmental impact is growing, largely from their clients who want to be at least seen to be 'doing their bit'. There is still plenty of 'low hanging fruit' such as changing outdated construction practices and employing more efficient equipment.

SUSTAINABILITY IN THE LIFTING SECTOR

Sustainability in the lifting equipment sector has taken a while but is now a discipline in its own right with an increasing number of companies even appointing sustainability directors. Cargotec - the parent company of Hiab and Kalmar - was one of the first appointing Päivi Koivisto as its first

vice president of sustainability at the end of 2019. Plenty of companies, such as United Rentals in the USA, are also including the subject in the remit of a senior executive, such as vice president of health & safety, environment and sustainability.

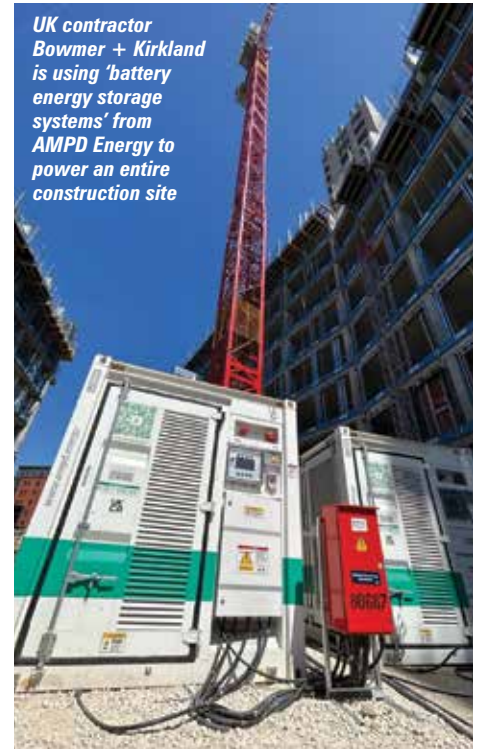
The growing importance of sustainability is also creeping into finance. A prime example of this is Dutch international access and telehandler rental group Rival which in July agreed a €300 million revolving credit facility with an interest rate dependent on its year on year improvement in its sustainability performance.

The indicators are linked to Rival's key elements in its 'Sustainability 2025' strategy, which includes increasing the number of sustainable products, reducing solid waste, increasing the company's Ecovadis score from Silver to Platinum level and reducing its overall carbon footprint.

SITE BATTERY POWER

The feature on mastclimbers and hoists on page 36 shows how UK contractor Bowmer + Kirkland is using three 'battery energy storage systems' from AMPD Energy to power, not just the tower cranes, hoists and mastclimbers but an entire construction site. The company has also used Punch Flybrid flywheel technology to halve the size of generators, slashing its fuel usage and emissions. In the past 12 months alone, it claims

UK contractor Bowmer + Kirkland is using 'battery energy storage systems' from AMPD Energy to power an entire construction site



to have reduced its carbon output by 1,270 tonnes and saved 488,000 litres of fuel, all of which has saved it hundreds of thousands of pounds. And it is still early days with many more sites to convert and initiatives to implement. The advantage it will gain over more sluggish competitors is incalculable.

According to the European Parliament E-waste (electronic and electrical waste) - which includes everything from old washing machines to computers - is one of the fastest growing waste streams with less than 40 percent being recycled. This is in danger of becoming an obstacle to reducing its ecological footprint.

Last November members of the European Parliament called for new measures to promote a culture of repair and reuse and support second hand businesses and local repairers by making it easier and cheaper for consumers to have products repaired.

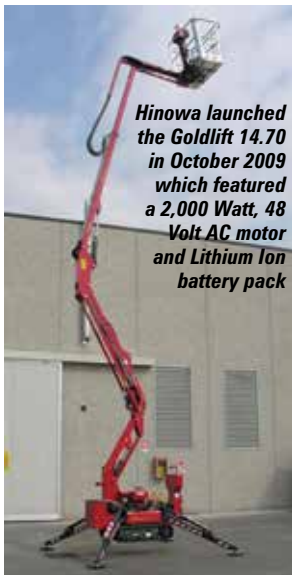
In our industry manufacturers of electronic equipment such as radio remote controls which are now used on a majority of new equipment, are continually developing and improving their products, but the downside is that it can obsolete equipment that might otherwise still have a useful life. Several radio remote control manufacturers are now offering software and other updates to older controllers in an effort to extend their working life, rather than throwing away when they malfunction or appear obsolete. Some parts suppliers have of course been offering service exchange programmes for items such as joysticks for many years, however the faster pace of development and 'unrepairability' can make this more difficult.

LIFTING EQUIPMENT REDUCES EMISSIONS

Construction equipment has been getting cleaner, initially to meet ever more stringent engine emission regulations which has seen a 95 percent reduction in the emission of particulates and other noxious gases from diesel engines since the Stage I regulations came into force in 1999.

At times the changing engine emission standards have caused havoc for equipment manufacturers with most having to redesign chassis and engine compartments to accommodate bulkier and heavier engines which included emission reducing 'add-ons'. The regulations have provided an incentive to seek alternatives for equipment previously considered too power hungry to switch to battery power, while the emerging lithium technology was seen as too expensive.

Italian spider lift manufacturer Hinowa was the first to introduce Lithium Ion battery power as far back as 2009 when it launched the Goldlift 14.70 with a 2,000 Watt, 48 Volt AC motor and Lithium Ion battery pack. It pioneered the technology and in the 14 years since has seen few, if any replacements. Today almost



Hinowa launched the Goldlift 14.70 in October 2009 which featured a 2,000 Watt, 48 Volt AC motor and Lithium Ion battery pack

every aerial lift manufacturer has lithium battery powered equipment in their range and while small scissors have always been battery powered, Lithium technology has made it more practical for battery power to be applied on larger scissor and boom lifts.

When it comes to larger and heavier equipment especially machines that travel on the road such as van and truck mounted lifts and mobile cranes, it can be far more challenging, often leading more to a hybrid approach. However companies including Palfinger, Sogage, Klubb, Multitel and Versalift all now have all-electric vehicle mounted lifts although the price of the chassis can be discouraging. These will be covered in a future issue.

JCB has taken the view that battery power is unfeasible to power larger equipment, especially those involved with cycle work, as the size of batteries would be far too big and heavy to include in the design. Perhaps because of its diesel engines - it manufactured 80,000 engines in 2018 and has expanded since then - it has chosen to develop hydrogen engines and recently unveiled a hydrogen powered telehandler, although the debate then moves to what type of Hydrogen? Green, Blue, Grey hydrogen or even Turquoise. More on this later.



JCB has taken the view that battery power is unfeasible to power larger equipment

RENEWABLE DIESEL

There have been several efforts to find an alternative for diesel particularly with stricter regulations being introduced. HVO - Hydrotreated Vegetable Oil - is one alternative increasingly



Alternatives to diesel such as Renewable Diesel is needed because of increasingly strict regulations

used in cranes and delivery trucks. Possibly the most recent is Renewable Diesel which has a very similar chemical and structural composition to petroleum diesel, though it is made from fats and oils such as animal waste fats, wasted fish products, used cooking oil, vegetable oil residues which is fully sustainable or tall oil pitch - made from tree resin - crude palm oil and rapeseed oil which is grown for the purpose and may well generate additional emissions and chemical usage, while possibly leading to more deforestation. However, what sets renewable diesel apart from counterparts such as petroleum diesel and biodiesel is its higher energy density said to be in the region of five percent.

These alternatives to diesel are being sought because of the increasingly strict regulations being introduced such as one introduced last November and coming into force this January.

The California Air Resources Board (CARB) approved amendments to its off-road regulation aimed at further reductions in emissions. In amending the In Use Off-Road Diesel Fuelled Fleets Regulation (Off-Road Regulation), CARB requires fleets to phase out the use of the oldest and highest polluting off-road diesel powered vehicles in California, prohibit the addition of high emitting vehicles to a fleet and require the use of R99 or R100 renewable diesel in off-road diesel vehicles, coming into force at the start of October its requirements begin to phase in from the start of 2024. It claims that the programme will yield more than \$5 billion in health benefits over the next 14 years.

With regulations such as this coming into play consumption of renewable diesel is likely to rise significantly. According to the U.S. Energy Information Administration, U.S. renewable diesel production is expected to more than double over the next two years to meet the growing demand.

ELECTRIC CRANES

Dutch mobile self-erecting tower crane manufacturer Spierings introduced its first all-electric crane - rather than a hybrid - in 2010 when it announced its 'all electric' City Boy crane. However, it would take the company a further seven years to perfect the system before a production version arrived - the three axle, seven tonne capacity SK487-AT3. It was another three years before the first models were delivered to customers in 2020. The crane can be operated as a full battery electric machine as well as used as a plug in hybrid model with a low emission diesel engine.

Spierings introduced the first all-electric crane in 2010 but the first models - the SK487-AT3 - were not delivered to customers until 2020



Spierings is way ahead of the game with the City Boy concept, several years passed before other crane manufacturers began announcing equipment with plug-in mains powered superstructures, mounted on the diesel chassis. In late 2020 Liebherr unveiled its first battery electric crawler cranes with the 200 tonne LR 1200.1 Unplugged and 250 tonne LR 1250.1 Unplugged lattice boom models, with the first units delivered in 2021.

The cranes have the same performance and same structural elements as the regular LR 1200.1 and LR 1250.1 but the diesel power unit is replaced with a large lithium ion battery pack, with electric motors driving the hydraulic pumps. The rest of the crane remains the same as the regular models. The battery pack is designed for four hours of typical lifting operations and can be recharged on a conventional 32 or 63 Amp electrical supply in around 4.5 hours or just 2.25 hours with a 125 Amp supply and can be operated while plugged into the mains.

The first LR 1250-1 Unplugged has been purchased by Kynningsrud Nordic Crane, with UK based Select Plant Hire taking the second unit. More recently units have been delivered to customers in Asia and North America, as well as most European markets.

At the time Eirik Kynningsrud of Kynningsrud/ Nordic Crane said: "Kynningsrud Nordic Crane is green in every sense. We are aware that we are part of society and therefore we are investing in a green future. When we invest, we think green and

new machines meet the market environmental requirements. Our main market in Norway is Oslo, in 2019 the EU declared the city as the environmental capital which stands as a role model for green solutions. Oslo intends to be a fossil free city by 2030 so it is very relevant."

LIEBHERR HYBRID AT

A year later Liebherr unveiled one of the first plug in hybrids - a version of its 50 tonne LTC 1050-3.1 City type All Terrain crane, the LTC 1050-3.1E. The crane features an electric motor alongside the standard diesel engine. The two power units use the same hydraulic pumps, and the operator can switch between diesel and electric power for crane functions. Once on site, it ideally plugs into a 125 Amp mains power supply in order to match the full performance of the diesel, but it also operates well enough on a 63 Amp supply. Alternatively, it can be plugged into a standalone remote battery pack.



The first Liebherr plug-in hybrid was the 50 tonne LTC 1050-3.1E

TADANO GREEN SOLUTIONS

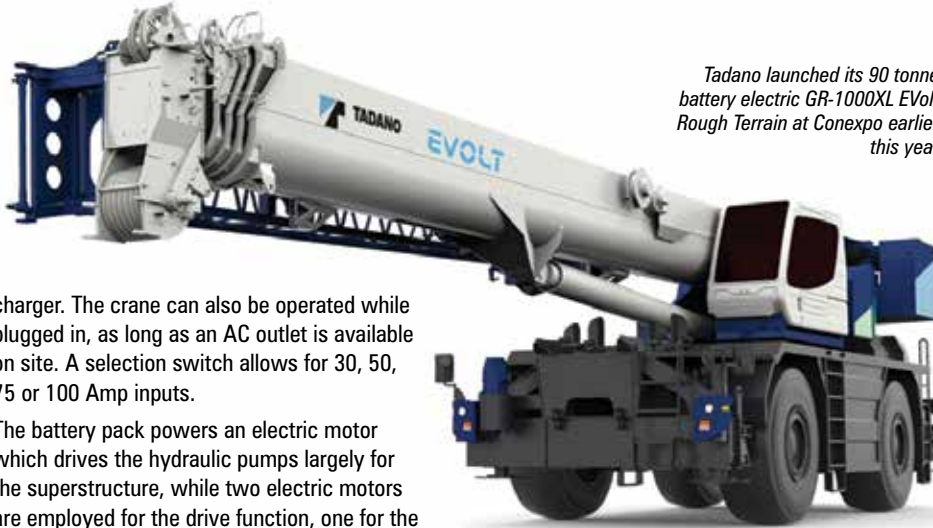
The LTC 1050 was probably introduced as a response to Tadano's E-pack electric power pack which allows its cranes to operate on site without using the diesel engine. The E-pack was part of Tadano Green Solutions 'long term environmental targets', aiming to reduce CO2 emissions from its business activities by 25 percent and a 35 percent reduction from product use by 2030, leading to achieving net zero carbon emissions by 2050.

ALL ELECTRIC RTS

Tadano launched its long trialed battery electric Rough Terrain at Conexpo earlier this year - the 90 tonne GR-1000XL EVolt - which will initially be offered in North America. The superstructure is essentially the same as on the standard GR-1000XL however where the new EVolt differs is the chassis and the driveline, with a lithium ion battery pack that is said to be sufficient for around a typical nine hour work day. It can be recharged in seven hours with the standard onboard system, or in two hours with a Tesla fast



US rental company Sims Crane & Equipment added a Liebherr LR 1250.1 Unplugged to its fleet in earlier this year



Tadano launched its 90 tonne battery electric GR-1000XL EVolt Rough Terrain at Conexpo earlier this year

charger. The crane can also be operated while plugged in, as long as an AC outlet is available on site. A selection switch allows for 30, 50, 75 or 100 Amp inputs.

The battery pack powers an electric motor which drives the hydraulic pumps largely for the superstructure, while two electric motors are employed for the drive function, one for the front and one for the rear axle. This format was chosen to simplify the drivetrain and reduce the number of shafts required while creating more space within the chassis. The crane can travel an average of 12.5 miles on a single charge, although it is equipped with regenerative braking. Top speed is 11 mph (18kph), the same as the diesel model. While emissions are important the company said that one of the growing driving forces for such a machine is the noise. The Evolt is almost silent, with most of the noise coming from the hydraulics. The next step will be to eliminate all hydraulic motors, leaving the pump purely for the hydraulic cylinders.



The GR-1000XL EVolt RT features

Tadano also launched a smaller version of the Evolt in Japan - the 25 tonne GR-250N Evolt Rough Terrain/city type crane. The crane will again be the same as the diesel version but with electric power.

Chief executive Toshiaki Ujiie said: "In the spirit of greater harmony, we have set aggressive goals for lowering both operational and product emissions, and we will partner with industry leading companies to attain those goals. In conjunction with previous product innovations to lower CO2 emissions, we are excited to introduce the first battery/electric Rough Terrain crane, which will be a key driver for our goal of 35 percent reduction in product CO2 emissions by 2030."

THE RISE OF HYDROGEN

As mentioned earlier several major companies are investing in Hydrogen power as a long-term solution. Speedy Hire in the UK has started taking delivery of Niftylift's 50ft HR17 H2 Hydrogen-Electric boom lift with fuel cell technology, having successfully completed extensive field trials

with key customers, especially those looking to improve their 'Environmental, Social, and Governance' (ESG) ratings or working in ultra-low emission areas. Its initial order for 100 machines includes both the HR17H2 and its smaller brother the 43ft HR15H2 Hydrogen-Electric.



Speedy Hire in the UK has started taking delivery of Niftylift's 50ft HR17 H2 Hydrogen-Electric boom lift with fuel cell technology

The new models start with the latest versions of the manufacturer's standard all-electric, two wheel drive boom lifts, which incorporate direct electric wheel motor drive and AGM maintenance free batteries, with a lithium-ion battery option. As straight electric machines, the new lifts are said to be capable of four to five days between recharges when working in typical applications. The H2 models are equipped with a hydrogen fuel cell, fed by a standard



A lightweight G-20 hydrogen gas cylinder

G20 hydrogen gas cylinder, which produces electricity to top up the battery pack if and when necessary. It is possible to set the system to constantly top up the batteries or only when the state of charge drops to a preset level.

Assuming a standard AC electrical source is available on site, the batteries can also be topped up by plugging in like an ordinary electric, thus reducing hydrogen consumption. However, for sites where there is no power, a single hydrogen cylinder should enable the machine to run for more than 12 working days of typical usage before requiring a cylinder change. The system can also alert the operator when the gas level in the cylinder falls below a preset point, so that they are prepared for a replacement.

Speedy's chief executive, Dan Evans, said: "Our sustainable growth strategy, Velocity, sets out a clear direction for the business to deliver long term benefits to our customers, our people and our investors and this is a strong example of Velocity in action. Our investment and collaboration with Niftylift enables us to accelerate the sustainable and technological evolution in the sectors where we operate and supports our ambitious plan to become a net-zero business by 2040, 10 years ahead of the Government's target, whilst also enduring commercial sustainability against traditional alternatives for our customers."

The hydrogen cylinder/fuel cell concept looks like an optimal solution for mid-sized equipment such as boom lifts. The machines are clean, quiet and powerful as well as being low maintenance and capable of running for two or three weeks or more on a single hydrogen cylinder, which can then be quickly and easily changed. Whether or not it is better than the alternative hydrogen/internal combustion solution remains to be seen. To be truly environmentally friendly both hydrogen formats require a plentiful supply of 'green' hydrogen produced from sources such as wind, solar or hydroelectric power.

HAULOTTE HYDROGEN SCISSOR

Haulotte has also been trialling hydrogen powered options in partnership with Bouygues Energies & Services and has installed a Bouygues Hyvision hydrogen fuel cell system in one of its Pulseo HS 18 Pro full size Rough Terrain scissor lifts.



The hydrogen range extender version of the Haulotte HS18 Pro



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Liebherr LR 1160.1



Tadano CC 38.650-1



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Manitou's hydrogen prototypes are based on a standard 14 metre model



Manitou has equipped its R&D test centre with a green hydrogen station, making it easier for testing of its prototype hydrogen telehandlers

We understand that it is also testing a hydrogen combustion version of its Range extender diesel generator. Introduced earlier this year the prototypes are on test with Bouygues contractors evaluating the ease of use of each format and how easy it is to refuel.

MANITOU KEEPING OPTIONS OPEN

Manitou has equipped its R&D test centre with a green hydrogen station, making it easier for testing of its prototype hydrogen telehandlers. The test prototype is a slightly modified version of the company's existing 14 metre model.

[The test programme involves testing and evaluating two types of hydrogen technology, the first a modified diesel engine and the second with fuel cell. The first prototype on the test bed utilises a hydrogen fuel cell working - one assumes with an electric power train. The company says that as tests proceed it will choose the solution that best meets the needs of its customers. It aims to complete the test programme in time to send units to construction sites for field testing by the end of this year. If all goes well the company will have a hydrogen telehandler of one format or the other ready to sell and start delivering in 2026. The company is also working on options for its 360 degree models, and already offers plug in models.

Chief executive Michel Denis said: "We are studying all the hydrogen related technologies based on what users need. These prototypes are only a first step. There are many benefits of green hydrogen with production possible using wind power that has no greenhouse gas emissions at all. This fits in perfectly with our low-carbon trajectory."



Cadman's net zero journey

WHAT COLOUR IS YOUR HYDROGEN?

When it comes to hydrogen there has been much talk about Green, Blue and Grey hydrogen, with only Green or at a stretch Blue being desirable. However, do a little digging and a whole spectrum of colours emerges.

For hydrogen to be fully environmentally friendly and sustainable it needs to be Green - in other words produced by wind or solar power. Although Blue hydrogen in which production includes carbon capture, might be a practical alternative. Just in case you wondered, the other colours include Turquoise, Brown, Yellow, Black, White and Pink hydrogen. Yes Pink - apparently produced with nuclear power.

ACHIEVING THE END RESULT

With all the work being carried out on green products within the lifting sector it is actually seeing it work in the real world that will make the difference. In the UK rental company Cadman cranes says it is on course to become net zero by 2025, well ahead of any legal targets. The company has now completed the transition of its fleet to HVO diesel, having started in 2020 and has now converted all of its vehicles, including vans, support and transport to HVO which it says represents a 97 percent reduction in its footprint, saving 570 tonnes of CO2 per year.

The HVO fuel it is using is a renewable, sustainable and 100 percent biodegradable and emits only 0.036kg of CO2 per litre, in stark contrast to diesel which emits 2.51kg of CO2 per litre. The storage life of the fuel can also be up to 10 years, while switching to HVO requires no infrastructure changes or additional capital expenditure.

In order to reach its 2025 target, Cadman has also formulated detailed plans which include the imminent installation of solar panels and heat pump at its Essex base, improvements in waste disposal methods, the adoption of sustainable workwear and an audit of its supply chain. ■



The colours of hydrogen

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