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Global power

A handful of manufacturers build large components for conventional power plants. Getting them to their destination, often to power hungry and infrastructure poor countries and then installing them on site requires careful planning and clever technological solutions. Will North reports.

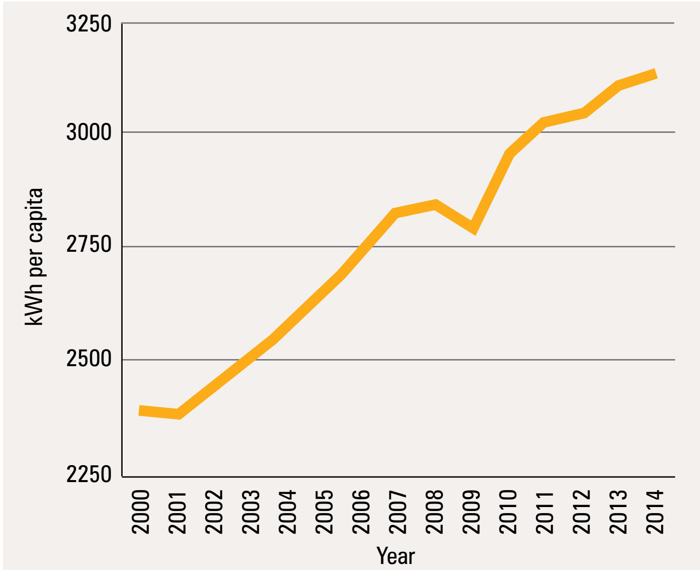
Global energy demand continues to soar. As Chart 1 shows, global electric power use per head increased from 2,386kWh to 3,131kWh in the 14 years to 2014. We all use more electricity every day, whether to charge the growing number of electric cars, phones, laptops, and other devices, or because our home has been connected to the grid for the first time, rather than relying on locally sourced fuels like firewood or diesel generators.

In high income countries, where citizens and state benefit from the luxury of readily available low interest investment capital, the desire for a greener future has seen energy derived from fossil fuels gradually fall (see chart 2). In lower income countries where immediate needs are more urgent than long term environmental concerns, electricity generated from these sources has risen from 75 percent to 89 percent.

No surprise then that low and medium income countries predominate in coal power plant construction. Chart 3, compiled by environmental campaigners Global Energy Monitor, ranks countries by MWh of coal derived electricity coming online between 2017 and the summer of 2020. China leads the field by a long way—although it also leads when it comes to wind and solar power construction. Among the others in the top 10, there are only two highly industrialised nations: Japan and South Korea, while nine of the 10 countries are in Asia, the exception being South Africa.

Mammoet project manager Rutger Beelen says: "Some of the fastest growing economies right now are in sub Saharan Africa, generating greater demand for power there. At the same time Europe is also busy with 'energy transition' as conventional power plants are phased out and replaced by more renewable, sustainable power plants."

Chart 1. Global electric power consumption, per capita



Source: IEA Statistics, OECD/IEA 2014

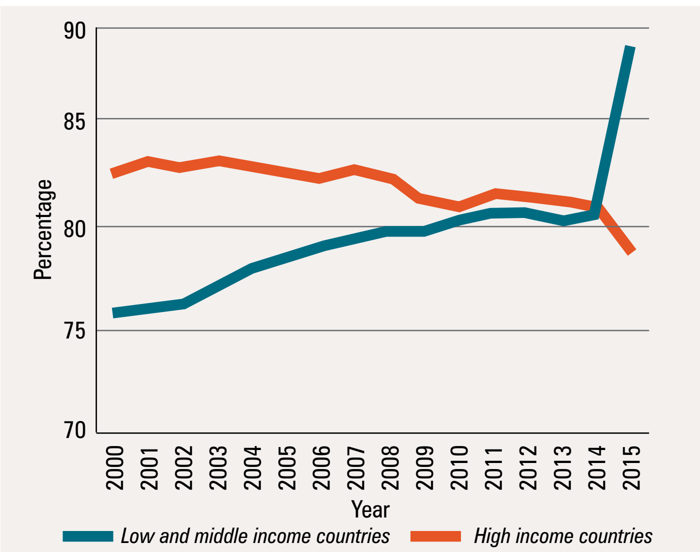
Separation of production and use

The core components of power plants are not built on site and are mostly fabricated by a handful of companies in the world's most industrialised countries, manufacturers such as Siemens, Smit, Wartsila, GE and Hitachi, at plants located in Europe, the United States and Japan. Components are shipped as more or less complete units, often weighing hundreds of tonnes with widths of up to seven metres and a height of five metres.

David Allely director of UK transport specialists Allelys group says: "The generators generally weigh around 250 to 300 tonnes, although Siemens' latest gas turbine–the 8000–weighs 500 tonnes, while Supergrid transformers - used in continental and international transmission networks - weigh up to 200 tonnes and generating transformers up to 350 tonnes."

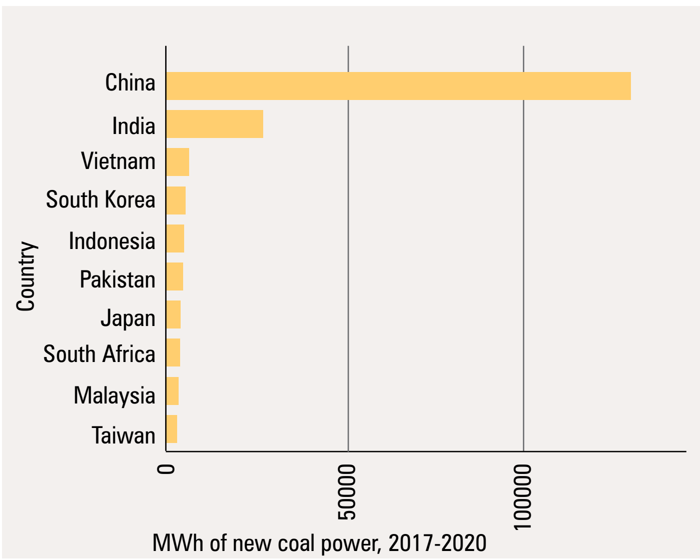
Allely notes that green energy is also employing increasingly large and heavy components. He cites the example of synchronous

Chart 2. Fossil fuels as a percentage of all energy consumption



Source: IEA Statistics, OECD/IEA 2014

Chart 3. New coal power plants, since 2017



Source: Global Energy Monitor

condensers, flywheels and generators, all of which are needed to help maintain the frequency of the AC supply with solar and wind power.

The journey from factory to installation point will largely be by water, but usually involves some land transport, all requiring a combination of barges, temporary port lifting equipment, trailers and transporters. For the biggest components, where the load cannot always be adequately spread with regular trailers and transporters alone, a bridge girder trailer will be required. When the biggest components arrive on site, the structures in which they will be housed are often already built, leaving little space for a suitably large crane. This requires moving the bulky load around and under obstacles, raising them to the installation height, and sliding them into position, typically with SPMTs (Self Propelled Modular Transporters), skidding systems, gantries, and jacks.

Manufacturers of the largest components tend to locate factories near watercourses and equip them for loading big components onto barges or ships. Allely says: "Conventional fossil fuel and nuclear power plants were generally built near water, with purpose built access. However transmission substations are often located inland, moving transformers from the coast can be a challenge as the only way in and out is often by road. Involving two sets of interrelated challenges, the engineering to move the load safely, and the organisational challenge of working with local regulators to ensure the journey can be completed without damaging roads or street furniture."

A shared burden

For components that can be broken down into smaller sections, flexible, modular, transporters and trailers can be used and even combined for larger or heavier loads.

Thomas Fiedler, senior expert of innovation management at Scheuerle and Kamag parent company TII, describes the options his company offers for different components. For jobs where height restrictions are an issue, he recommends the Scheuerle EuroCompact series, for their low loading height. For long distance transport, the UltralightCombi has a low dead weight of 2.2 tonnes an axle and can be combined with other Scheuerle equipment types.

While for loads over 100 tonnes, the company has the modular Scheuerle InterCombi or K25 axle lines, and girder bridges.

Spreading the weight of the largest, indivisible, components - those 350 tonne transformers or 500 tonne generators, for example - require specialised equipment. Girder bridges support the load on steel side beams with a transporter platform at each end, so that the load is divided between the two transporters a good distance apart.

Allelys was the first customer for Goldhofer's Faktor 5 girder bridge, followed by the German manufacturer's upgrade - the Faktor 5.5. Allely says: "We need girder bridges to be lightweight, with very high capacities. The manufacturers achieve this with ultra-high tensile steel, similar to that used in the latest crane booms. In our view, Goldhofer has been the leader in this, since we started working with them in the 1990s. Scheuerle now offers a similar product, but you tend to stick with what you have, especially if you have a large fleet."

The Faktor 5 and Faktor 5.5 take their name from the ratio of its weight to maximum payload: the Faktor 5 carries up to 500 tonnes and the Faktor 5.5 up to 350 tonnes so an equipment weight of 100 and 63 tonnes respectively – depending on configuration. They feature a modular design, allowing them to be converted from use on compact, heavy, loads like those used in the power sector, to longer loads such as petrochemical vessels.

56km Scottish move

The Faktor 5.5 was launched last year and Allelys put the first unit to work in October. The 950MW Moray East wind farm is being installed off the Scottish coast. A substation with three transformers is being built for it inland in New Deer, Aberdeenshire. The 35 mile trip from Peterhead hit its first challenge at the port exit. The route began with a right - left combination and a short steep climb. Thanks to meticulous planning and preparation, the 70 metre convoy overcame the obstacle without a hitch, as well as the following 90 degree bends, roundabouts and bridge barriers. "It proved a big advantage to be able to use the Goldhofer bridge in a short configuration of 10 axles at the front and 10 at the rear, making it more manoeuvrable and above all more economical," says Allely.

The load also had to cross bridges and take in steep sections along the route, with a 1.6 metre vertical lifting stroke and levelling system, the Faktor 5.5 was able to be raised to pass over bridge parapets and levelled to compensate lateral lean on the narrow winding sections of the route.

Allelys used the very first Goldhofer Faktor 5.5 girder bridge to transport a 260 tonne, 12 metre, transformer 35 miles on winding country roads and over small bridges in Aberdeenshire, Scotland

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TII India sold its first locally built girder bridge to local transport specialist JH Parabia

Indian solution

In India, fossil fuels remain an important part of the power mix. The country is exceeded only by China in terms of new conventional power plants brought online over the past three years. TII is meeting this demand with its subsidiary TII India. The division sold its first girder bridge, a 550 tonne capacity TIIGER-STB-550, to local transport and project lift specialist JH Parabia last year. The girder bridge was designed with support from TII's German engineers, and built at its factory in Bawal, near Delhi.

TII India chief executive Jochen Landes says: "It helps us a lot to have a local subsidiary and offer tailor made products for the Indian market and neighbouring regions with similar needs for heavy transport solutions. It is actually the combination of price and proximity that makes our TIIGER brand products so attractive to Indian customers. They want excellent quality at low prices. The expectations of customer service and of a short response time are also very high. In addition to India and selected Asian countries, we see very good market potential in other markets such as the Middle East and Africa."

A proper plan

While modular transporters and specialised equipment can solve most technical challenges, they cannot secure permits or properly plan a route. In addition to owning the right equipment, heavy transport companies need the local expertise to work with regulators.

David Allely says: "There is a lot of work involved in route planning, with knowledge and relationships built up over many years. Capacity on the UK road network has been decreasing, while a lack of maintenance has caused bridges to deteriorate and capacities to be reduced. There has also been a lack of structure as authorities contracted out maintenance and abnormal load services, with contracts changing every few years, with records not passed on, causing a loss of information. There used to be a highway bridge team on every council that understood their assets and kept good records, there are some very good contract companies out there, but also some very bad ones. Ironically, records are for older bridges are often far better than for new ones. Some councils maintain their records very well with the original drawings still available for structures built by the pioneering engineers like Thomas Telford."

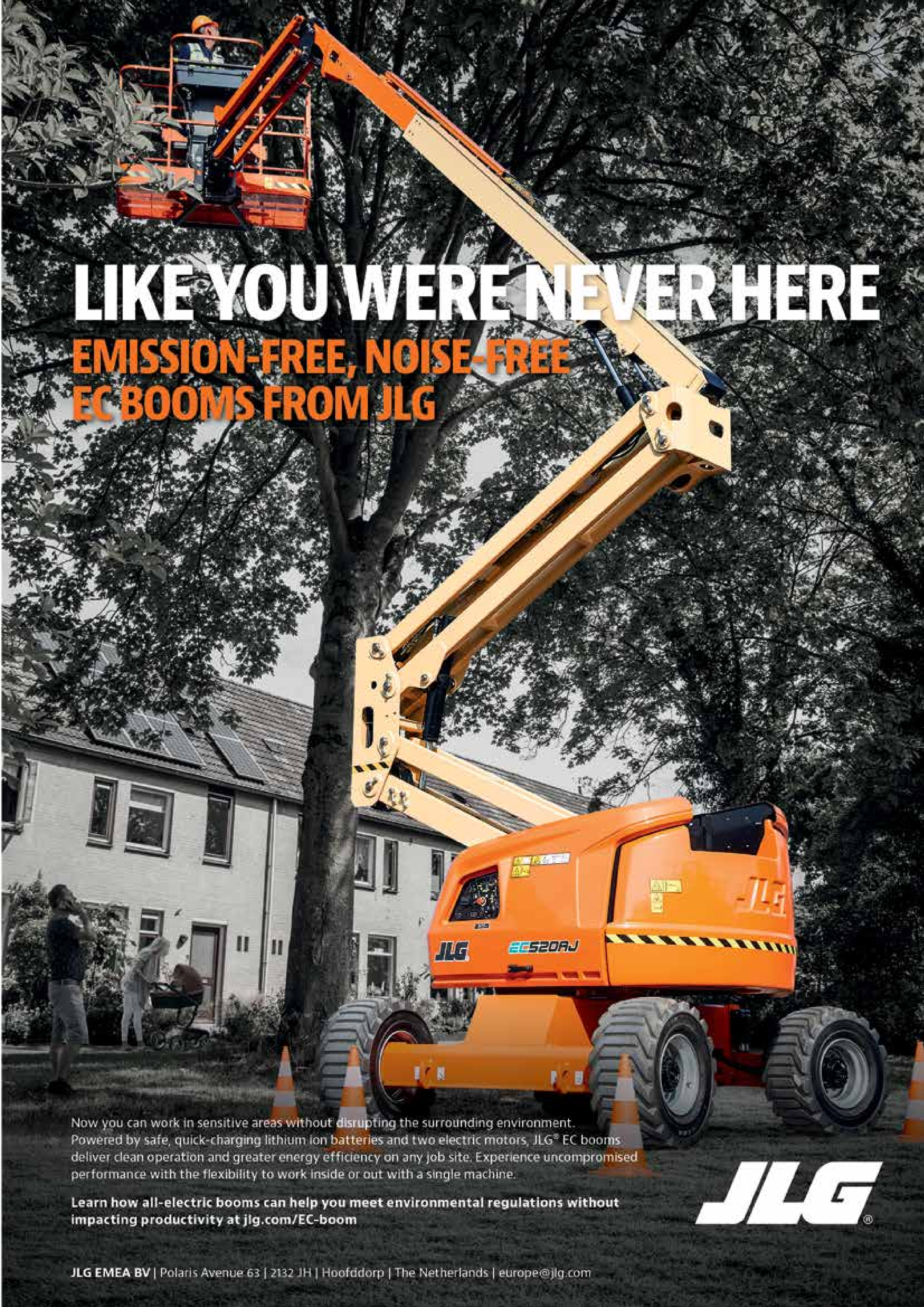
Global businesses need to offer the same level of local expertise on a worldwide basis. Mammoet's Beelen says: "Most of our moves are oversized, requiring a great deal of preparation, including corner widening, bridge crossings, power lines, railways and dealing with trees. In Poland the preparation time for a six kilometre move was 1.5 years! Each country has its own specific rules, regulations and processes we have a team in most countries that is familiar with the local requirements, but which can call on the strong global engineering core to assist them."

"Transport permits usually come with conditions, such as providing an engineering calculation for road strength or a bridge crossing. The local authorities often appoint a university or engineering firm to provide this calculation, but they require input from our engineering department. Having a worldwide network is an advantage, we can pick the item up from the customer's factory and install it, eliminating the interfaces between subcontractors."

Doorstep delivery

Sarens often works with local transport providers for standard loads, while supplying its own solutions for more complex moves with SPMTs and similar equipment.

Large scale global projects can require a clever mix of high tech and local solutions. A good example of this is a recent project Sarens took on in Hong Kong, although its infrastructure is much more developed than the typical location for a new conventional power station, however it is one of the most densely populated cities in the world, and spread over hundreds of islands. Sarens was hired to transport and install components for an extension to a power station on Lamma Island, which has no port and no roads, just a small fishing port and quayside. The company began by trans shipping loads to Lamma with the derrick barges that ply their trade in busy Hong Kong Bay, and involved more than a hundred barge journeys. The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HydraSlide's low profile skidding systems were a vital tool for Swedish firm Jinert on a 25 mile transformer move. On the way, the load had to be skidded under a motorway overpass with only 100mm of clearance

components were unloaded by cranes on the quay and installed using a combination of standard gantries and strand jacks, as well as Sarens Sarskid and Sarlift systems which it developed in house.

The company also uses 'off the shelf' gantries from Enerpac for routine jobs, such as lifting loads from trailers and transporters and simple installation jobs. Stijn Sarens says: "They are very easy and cheap to transport and can be self assembled on site. With four hydraulic cylinders each able to lift 250 tonnes, they can be used for lifts of up to 1,000 tonnes." For other, more complex jobs, Sarens prefers its own purpose built systems.

Swedish Hydra Slide

Hydra-Slide skidding and gantry systems are commonly used on power plant and electrical transmissions jobs, with its low profile XLP150 and LP350 skidding systems aimed at jobs on very tight 'live' sites. The company has also launched an aluminium beam range which is manually portable, while offering good spanning ability and structural support, making assembly quicker and easier, and thus cheaper. A good example of how the systems work involved a job in Sweden, where local company Jinert was contracted to move a 240 tonne transformer 25 miles, from Sundsvall to Nysäter.

Hydra-Slide's low profile system LP350 was used both along the route and at the installation site. Joakim Andersson, of Jinert's heavy project division, said: "The planning survey meant that along the route we had to unload and slide the transformer under a bridge, reload it and continue the journey. The motorway was closed overnight for the job and, due to the cold snowy conditions on the day, salt trucks were called in to prepare the road. The transformer only had 100mm of clearance under the overpass and needed to be skidded 35 metres, while a gradient under the bridge also needed to be taken into account."

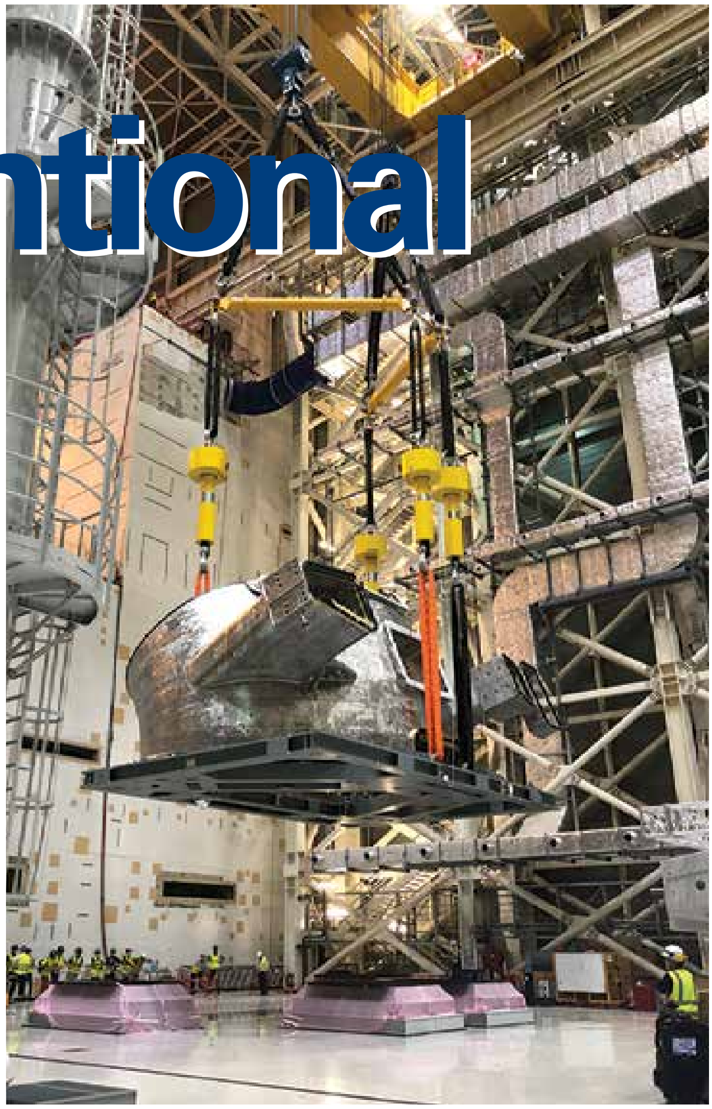
The onsite installation, using skids, gantries and jacks, was easier, as the ground was flat and well prepared, so Jinert needed only to lay skidding tracks, supported by steel plates, and slide the load 12 metres into its final position. Andersson said: "We were very pleased with the system. We have a history stretching back 50 years principally in Sweden, but also internationally, and a hallmark of the company has always been innovation and development of our equipment fleet. The LP350 fits with that overarching theme."

Indeed, while fossil fuels may be a technology on their way out, the tools and skills used to move and place conventional power plant components still demonstrate a forward looking spirit of innovation.

Marine Maroc used its new Enerpac SL400 gantry to install high pressure heaters weighing 130 tonnes at the 2×693 MW Safi coal fired power plant in Southwest Morocco

Unconventional power

Conventional fuels may be the energy source of yesterday, and renewables the innovation of the present, but tomorrow's fuel could well be fusion power. The name of ITER, originally the International Thermonuclear Experimental Reactor, puns on the Latin 'The Way'. The project is supported by the European Union, India, Japan, Korea, Russia and the United States. The global joint venture partners clearly believe fusion power is the way forward.



At the ITER project in Southern France, this international group is building the world's largest tokamak, a magnetic fusion device that has been designed to prove the feasibility of fusion on a large scale, bringing a carbon free source of energy based on the same principle that powers the Sun and stars.

Enerpac SyncHoist lifting systems are being used on the 100 acre site to assist with the assembly of a large vacuum vessel, which will host the fusion reaction, with plasma particles colliding to release energy at very high temperatures, held away from the vessel's walls by magnetic confinement.

The vessel is made up of nine 500 tonne stainless steel sectors, each 13 metres high, 6.5 metres wide and 6.3 metres deep. The SyncHoists are lifting each sector 10 metres into an up-ending tool for vessel assembly by the ITER Sector Sub-Assembly Tool.

Four Enerpac SyncHoist system 225 tonne capacity double acting push pull cylinders were attached to header beams on the assembly hall's overhead crane via heavy web slings, modular spreader beams, with upper adjustment cylinders. As the centre of gravity for each vacuum vessel sector can vary from the theoretical calculations, the SyncHoists units were used to assess this on taking the load, to ensure that they were lifted as close to the plane as possible. The sectors are delivered on rigging platforms, and a SyncHoist cylinder is connected to each of the platform's four lifting points, allowing millimetre control at each corner of the load for the 10 metre lift to the up-ending tool.

"It is essential that we hold the vacuum vessel sector in the plane during lifting," says Jarl Buskop, the ITER assembly engineer. "SyncHoist allows us to know the load at each lifting point and control the lift precisely within a millimetre of accuracy. The SyncHoist is able to cope with variations in the centre of gravity and lift the vessel clear of its transportation frame where there is only 15 to 30mm of clearance."

To meet the project requirements, the one metre stroke hydraulic cylinders were made completely leakproof. The SyncHoist lifting system will also be used to lift toroidal magnet field coils for insertion in the vacuum vessel.