EDISON

Riber

Strategy update

Key enabler of compound semiconductors

Tech hardware & equipment

Demand for Riber's molecular beam epitaxy (MBE) is supported by exposure to key structural trends such as demand for faster data, next-generation displays and the proliferation and evolution of sensors to support greater automation and intelligence (Industry 4.0). We expect that management's focus on growing revenues from services to the large installed base will support profit recovery in FY21. A relaxation in export controls or a major evaporator order would potentially represent upside to our estimates and could drive share price appreciation.

Year end	Revenue (€m)	PBT* (€m)	EPS* (€)	DPS (€)	P/E (x)	Yield (%)
12/19	33.5	0.9	0.03	0.03	53.3	1.9
12/20	30.2	0.7	0.02	0.03	80.0	1.9
12/21e	29.1	0.9	0.03	0.03	52.9	1.9
12/22e	32.8	1.8	0.06	0.05	24.7	3.1

Note: *PBT and EPS are normalised, excluding amortisation of acquired intangibles, exceptional items and share-based payments.

MBE preferred to MOCVD for critical applications

MBE is used to deposit the very thin layers of material forming compound semiconductor materials. MBE systems are used in research on new materials such as UV-diodes used to kill viruses and bacteria, micro-LEDs, power transistors, IR sensors and magnetic memory. They can fabricate a much broader range of materials than metal organic chemical vapour deposition (MOCVD) techniques. Larger MBE systems are used for volume production of electronic and optoelectronic devices used in applications including 5G communications chips, fibre-optic networks, LiDAR and night vision sensors. While MBE technology does not have the throughput of MOCVD, this is partly offset by its superior yield, making it the preferred technology for devices with many thin epitaxial layers.

Service revenues incremental to system sales

Demand from the applications noted above is predicted to support global MBE market growth from US$101.2m in 2019 to US$123.2m by 2025, a CAGR of 5.0% (Zeal Insider). Riber has the dominant market share and is investing in new system variants to maintain this position, putting it in a good place to benefit from the predicted market growth. It is also developing sales of services, creating a source of recurring revenues and growth incremental to the market and boosting margin.

Valuation: Trading at a discount to peers

At current levels, the shares are trading at a discount to the mean of its peers (Aixtron and Veeco) with respect to prospective EV/sales and EV/EBITDA multiples (eg year one EV/EBITDA 13.9x vs 19.3x). We believe that this level of discount is justified given Riber's smaller market capitalisation and lower margins. However, we see scope for share price appreciation if higher than anticipated numbers of MBE system orders, which could be catalysed by a relaxation of export controls, or receipt of a major evaporator order drive estimate and margin upgrades.

25 June 2021

Price	**€1.60**
Market cap	**€34m**

Net debt (€m) at end December 2020 (excluding IFRS 16 lease liabilities)	0.3
Shares in issue, excluding treasury shares	21.0m
Free float	50.0%
Code	ALRIB
Primary exchange	Euronext Growth Paris
Secondary exchange	N/A

Share price performance

%	1m	3m	12m
Abs	(4.3)	(0.5)	3.7
Rel (local)	(7.4)	(9.9)	(23.5)
52-week high/low		€2.18	€1.28

Business description

Riber designs and produces molecular beam epitaxy (MBE) systems and evaporator sources and cells for the semiconductor industry. This equipment is essential for the manufacturing of compound semiconductor materials that are used in numerous high-growth applications.

Next events

AGM	25 June 2021
H121 results	30 September 2021

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Edison profile page

Riber is a research client of Edison Investment Research Limited

Investment summary

Company description: Global number one in MBE

Riber has the dominant share of the global MBE market. MBE is a versatile and precise technique for depositing controlled amounts of material onto substrates that is used to create innovative semiconductor structures deployed in many novel devices, including high-frequency 4G and 5G communications chips, transmit/receive devices for fibre-optic networks and 3D sensing chips for autonomous vehicles. Riber also supplies high-quality material evaporators that are used to make inexpensive thin-film solar cells and displays for organic light-emitting diode (OLED) TVs.

Financials: FY20 sales affected by export licence issues

FY20 revenues were €3.3m lower year-on-year at €30.2m, reflecting fewer MBE system deliveries, minimal evaporator sales and a 24% jump in service revenues. Management notes that total revenues would have been over €31m had the French government not refused export licences for R&D systems and certain types of spares to China. Adjusted operating profit reduced by only €0.2m to €0.7m. Riber moved from €5.7m net cash at the end of FY19 to €0.3m net debt at end FY20, primarily because of an increase in working capital related to the preparation of two systems for delivery in FY21. At €14.4m, the FY20 year-end order book was €14.3m lower than a year previously. Management attributed this to the government's refusal to grant export licences worth around €13m. In addition, while enquiry levels were high throughout FY20, customers were slow to sign contracts given the economic uncertainty. The FY20 year-end order book contained only two MBE systems. Since the year end, Riber has received orders for two production systems, each priced at several million euros, and an R&D system. This underpins our FY21 estimates, though we expect system deliveries to be H2 weighted.

Valuation: Trading at a discount to peers

Riber's share price has dropped back from the €2.18 high reached in April following the news that a customer in Asia had placed an order for its fifth production system. At current levels, the shares are trading at a discount to the mean of its peers (Aixtron and Veeco) with respect to prospective EV/sales and EV/EBITDA multiples (eg year one EV/EBITDA 13.9x vs 19.3x). We believe that this level of discount is justified given Riber's smaller market capitalisation and lower margins. However, we see scope for share price appreciation if higher than anticipated numbers of MBE system orders, which could be catalysed by a relaxation of export controls, or receipt of a major evaporator order drive estimate and margin upgrades.

Sensitivities: Prospects affected by export licence issues

The key sensitivities as we see them are lumpiness of earnings, the ability to secure export licences to China, market cycles, dependence on key suppliers and customers and foreign exchange exposure. The first three are the most significant. Since a single production MBE system can cost €2.2–3.5m, depending on configuration (an R&D system is typically <€1m), and 90% of revenue is recognised on delivery, turnover can fluctuate substantially from quarter to quarter and the final outcome each year is very dependent on Riber meeting its delivery schedule for individual units. As noted above, the French government's decision not to grant licences for the export of R&D systems and certain spare parts to China adversely affected both FY20 revenues and the year-end order book. Demand for evaporators is linked to the OLED and solar equipment cycles. Demand for MBE equipment is less dependent on individual cycles because it is deployed in more markets, each following different phasing.

Enabling critical compound semiconductor materials

Riber develops and manufactures MBE systems that are used in the manufacture of semiconductors. It is the global market leader for MBE equipment, with the largest installed base of MBE machines in operation (c 750) and has the dominant market share at between 40–50%. The company's MBE portfolio includes both smaller research reactors and substantially larger production machines. Over 80% of its installed MBE base is deployed in universities, research institutes and the research labs of major global corporations where it is used to develop new materials for applications such as UV-diodes used to kill viruses and bacteria, micro-LEDs, power transistors, IR sensors and magnetic memory. The remainder of Riber's installed base is deployed in the production facilities of electronic component manufacturers and providers of epitaxial wafers. Volume applications include high-frequency 4G and 5G communications chips, terrestrial and submarine fibre-optic networks, light detection and ranging (LiDAR) and night vision sensors. Zeal Insider predicts that demand for the photonics components needed for these applications is predicted to support global MBE market growth from US$101.2m in 2019 to US$123.2m by 2025, a CAGR of 5.0%.

Riber has adapted its expertise in depositing ultra-thin layers of complex materials to make evaporators. These are integrated into equipment for processing thin-film solar cells, OLED displays for smartphones and tablets and OLED lighting. The evaporators are sold either to the equipment integrator or direct to the end-user. Segmental sales are highly dependent on investment cycles in the solar cell and OLED markets.

Riber also derives revenues from providing training, consultancy, retro-fit sales of hardware and software, on-site upgrades, in-factory component repairs and refurbishments and preventative or remedial operations at customer sites to its large installed base of clients. It also supports MBE users with systems from competitors. These services provide a source of high-margin recurring revenues that is less dependent on the overall level of investment in compound semi-conductor, OLED display or solar cell-manufacturing equipment. Management's stated objective is to increase service revenues to more than 40% of the group total (28% FY19 and 39% in FY20, although system revenue sales were depressed in FY20), thus providing a substantial proportion of annual fixed costs and potentially enabling growth that is faster than the market for equipment.

More than 90% of Riber's revenues are generated from exports to customers elsewhere in Europe and in the United States, Canada, Mexico, Japan, China and South Korea.

Exhibit 1: Customer base

	Clients	Operational units	Sample customers
MBE for R&D	324	c 630	Argonne National Laboratory (USA), Chinese Academy of Sciences, Dongguk University (South Korea), Fraunhofer Institute, IMEC, Indian Institute of Technology Bombay, Russian Academy of Sciences, UCLA, The University of Tokyo, US Naval Research Laboratory
MBE for production	44	c 120	II-VI, II-V Lab, 3SP Technologies, Acken Optoelectronics, Aledia, Asahi Kasei, Aselsan, Coherent, IntelliEPI, IQE, Northrop Grumman, Phillips Photonics, QDLaser, Raytheon, Teledyne Technologies, Trumpf
Evaporators	9	2,000+	Canon Tokki, First Solar, Heliatek, Singulus Technologies

Source: Riber

Riber's headquarters are in Bezons in the suburbs of Paris, where it owns a 3,500m^2 facility, including a 1,000m^2 clean room with the capacity to output 25 MBE machines annually. The company designs and assembles equipment in Bezons, outsourcing the manufacture of individual non-key components. It has subsidiaries in China (opened 2018) and the United States, and a network of around 10 agents and distributors. The group also holds a 2% stake in the Institut Photovoltaïque d'Île-de-France, a research institute specialising in the field of photovoltaic solar energy. It currently employs around 120 people.

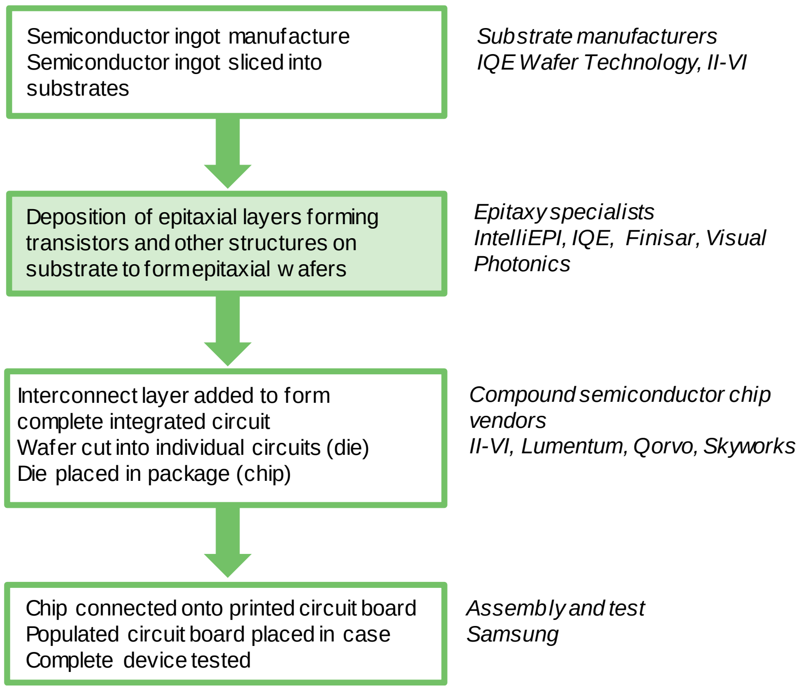
Serving multiple growth markets

MBE systems for volume production of electronic components

Key enabler of high-performance photonics

Riber's larger MBE systems are deployed in the production facilities of electronic component manufacturers and providers of epitaxial wafers. The equipment is used by companies manufacturing epitaxial wafers such as IntelliEPI to deposit the vital layers that convert electricity to light in optical components (see Exhibit 2). The wafers then go through additional processing steps to make individual electronic chips such as laser diodes. Since Riber's MBE equipment is used to manufacture a wide range of compound semiconductor materials, it is deployed in many markets that have different profiles. This reduces the company's exposure to any single market but makes it more difficult to predict overall demand beyond the period or around six months covered by the order book. Typical applications are 5G/4G/Wi-Fi communications, satellite transceivers, fibre-to-the-home (FTTH), local area network (LAN) and submarine fibre-optic networks, laser cutting, laser passivation, LiDAR systems; infra-red (IR) and ultra-violet (UV) detectors used in night vision systems, thermography, medical diagnosis and vegetation mapping and magnetic sensors used in vehicles to detect position, distance and speed, for example in air-bag controls and anti-lock braking systems.

Exhibit 2: Compound semiconductor supply chain



Source: Edison Investment Research

VCSELs a key growth area

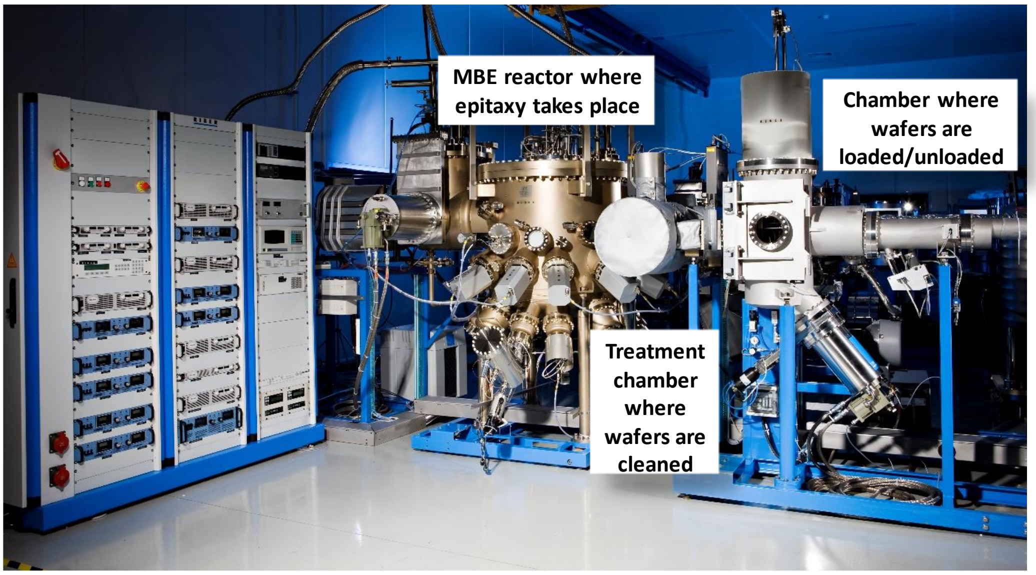
Among the diversity of markets serviced, we single out vertical cavity surface emitting lasers (VCSELs) for a special mention because Riber recently delivered a high throughput MBE system to IntelliEPI for VCESL production. Unlike edge-emitting lasers, which emit light from a cut edge perpendicular to the surface of the device, VCSELs emit light from their surface. This means that the laser diodes do not have to be split up in order to emit light, so they can be fabricated into devices with high density arrays of emitters.

Until 2017, the VCSEL market was driven by datacom applications, with photonics devices being used in links of up to 500m in data centres, enterprise and campus networks. Since 2017, 3D sensing has become the dominant driver, especially since Apple began to use Face ID in the iPhone X. Yole Développement's report on the VCSEL market published in October 2020 noted that mobile 3D sensing will represent around 75% of overall VCSEL revenues in 2020. Fixed telecommunications and infrastructure represent most of the remaining 25%. Yole Développement's report predicts that the global VCSEL market will grow from more than US$1bn in 2020 to US$2.7bn in 2025, a CAGR of 18.3%. It observes that other applications such as driver monitoring systems and LiDAR-based pedestrian detection, collision avoidance and parking assistance in cars could emerge in the medium to long term.

Passivation of edge emitting lasers limits future defect generation

Passivation is a key step for commercial edge-emitting lasers, where Riber's ultra-high vacuum solutions are used to deposit films that protect the cut edges where the light emerges, preventing unwanted oxidation, which damages the surface and stops light from escaping efficiently. This is important because trapped light heats the surface, causing a degradation in optical performance over time. Another approach to passivation developed by Riber's partner Comptek Solutions, which is based on epitaxial oxides, is also applicable to the manufacture of transistors used in radio-frequency and power electronic applications and multi-junction concentrated photovoltaic cells. Riber has developed an MBE system variant for third-parties who want to license Comptek's passivation process.

Exhibit 3: Riber MBE equipment



Source: Riber

Riber has dominant market position

US-listed Veeco is the only other company offering high-capacity/high-throughput MBE production tools for manufacturing. Management estimates that over the last five years, Riber's share of the production systems segment has averaged 80%. Management believes that this dominant position is attributable to the production output, yield and total lifetime cost of ownership afforded by the equipment as well as the services and maintenance provided. The technical barriers to entry are extremely high, deterring new market entrants. Moreover, given the relatively small size of the market globally compared to the MOCVD market, we believe it is unlikely that an equipment manufacturer would regard the return as economically worthwhile. Demand for production equipment is similar to the semiconductor cycle, though linked to the various types of compound semiconductor devices discussed above rather than microprocessors or memory chips. Management notes that the global requirement is typically three to five systems each year.

Strategy: Developing presence in China and the United States

Riber is focusing its sales resource on mainland Europe, where there is a lot of activity in the opto-electronics market, and in China, where the government is developing its own semiconductor industry so it is not dependent on products from companies such as Qorvo or Skyworks. In 2009 Riber opened a sales office in China, followed in 2018 with the opening of a subsidiary there that is able to provide sales support, aftersales service and the supply of spares from stock held on site. Riber is less active in the United States because there is a lot of spare MBE capacity in the country, for example at one of IQE's sites. Nevertheless, in 2019 Riber acquired US-based SemiPro, which specialises in the maintenance and renovation of MBE systems, to support existing customers in the region. (See Exhibit 1 for an analysis of the customer base.) We note that Riber experienced difficulty in gaining export licences to China for MBE systems during FY20.

Strategy: Improving individual system throughput

In April 2021 Riber announced that it had delivered the world's largest MBE, the MBE 8000 system to long-standing customer IntelliEPI. This machine has capacity to grow up to eight 150mm wafers simultaneously and offers the possibility of transitioning to 200mm wafers. The new system will augment IntelliEPI's installed base of 15 MBE systems, all from Riber, helping IntelliEPI address the expected increase in demand for VCSELs (see above) and other gallium arsenide (GaAs) devices. As discussed in our December Outlook note on IQE, the switch to larger 150mm substrates increased MOCVD throughout, reducing the cost of VCSELs and encouraging mass adoption of the devices. Being able to process multiple 150mm wafers using an MBE system will improve the cost-effectiveness of MBE technology as well.

MBE systems for research into novel materials

A wide range of applications

Over 80% of Riber's installed MBE base is deployed in universities, research institutes and the research labs of major global corporations where it is used to develop new materials, primarily, but not exclusively, for photonics related applications. These include:

- **UV LEDs:** the dominant application for UV LEDs used to be UV curing, which includes printing, adhesives and coatings, but UV is increasingly being used to kill viruses and bacteria in disinfection and purification systems. Most LEDs are manufactured using MOCVD technology, but this does not produce very efficient devices at UV wavelengths. Riber is working with the Centre de Recherches sur l'HétéroEpitaxie et ses Applications (CRHEA), part of the Université Côte d'Azur, to make demonstration UV LED wafers for evaluation by a potential commercial customer interested in using UV light to purify water. The UV LED wafers are based on layers of aluminium gallium nitride (AlGaN) on a sapphire substrate with AlGaN quantum dots forming the active region where electrical energy is converted to light of precisely the required wavelength. As discussed later in the note, MBE gives much more control over the structure that is being deposited than MOCVD.
- **Micro-LEDs:** micro-LEDs are very small LEDs that are used in flat panel displays to give enhanced colour contrast, colour saturation and response time. They are also used in smart watches, smart phones and augmented reality or virtual reality headsets where their lower power consumption extends the time between battery charges and their higher brightness enables users to see the screen even in bright sunlight. Currently, red and green LEDs are made by adding a phosphor to a standard blue LED to convert the blue light to green or red. This approach does not work for very small pixels where the minimum phosphor size is greater

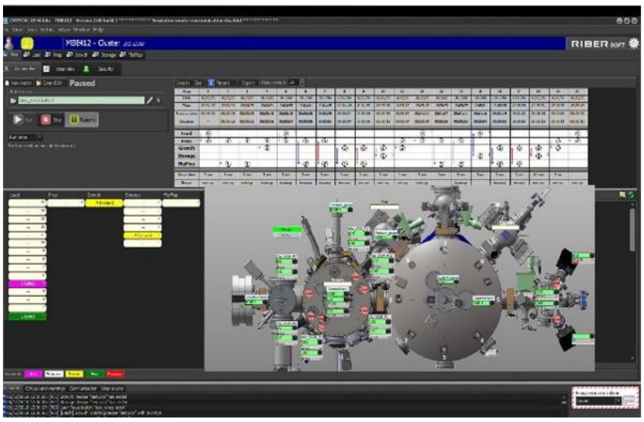
than the pixel size. Riber is working with CRHEA on the fabrication of red and green coloured micro-LEDs where the longer wavelengths are achieved by adding high levels of dopant to the region where electricity is converted to light. (Doping is when small quantities of another element are added when an epitaxial layer is being deposited, which changes the electrical or optical properties of that layer.) The highly doped active layers are processed using MBE, the others using MOCVD. CRHEA has installed MBE equipment from Riber that is capable of handling the 8” wafers commonly used in MOCVD processes to give high throughput.

- **IR sensors:** MBE can be used to make the epitaxy for older mercury cadmium telluride (CdHgTe) sensors because this technique enables the deposition of different layers, each able to detect a specific wavelength. MBE can also be used to make newer detectors based on aluminium gallium arsenide (AlGaAs) or antimonide structures. Unlike CdHgTe sensors, which need to be cooled to temperatures near that of liquid nitrogen, these newer sensors work at room temperature so are less expensive and can be used for gas sensing, medical applications and automotive or consumer electronics, not just military projects. In January 2021 Riber delivered an MBE system to Teledyne Imaging Sensors for the fabrication of high-performance infrared imaging sensors. These infrared sensors are used in NASA missions, such as the Hubble Space Telescope, and European Space Agency missions, such as the Euclid dark energy project.

Exhibit 4: Refurbishing MBE equipment

Source: Riber

Exhibit 5: Riber’s software for real-time control of MBE process



Source: Riber

- **Power transistors**: compound semiconductors such as GaN are better materials for manufacturing power transistors than silicon because they can conduct higher current densities with lower losses when on and handle larger voltages when off. However, depositing GaN transistors on a GaN substrate is prohibitively expensive. Depositing GaN on silicon carbide substrates gives good results, but the substrate is expensive and only manufactured in the US so its export is restricted. Depositing GaN transistors directly on top of an inexpensive silicon substrate gives poor results because the crystal structures do not match up. One solution for addressing this is to deposit an aluminium nitride (AlN) buffer layer between the two materials. In June 2020 GaN-on-silicon start-up EasyGaN, which is a spin-out from CRHEA, announced that it had fabricated the world’s first AlN pseudo-substrates deposited on top of 200mm silicon wafers using a Riber reactor at CRHEA and an ammonia-based MBE process. The ability to deposit epitaxial layers on 200mm silicon wafers is significant because these give greatly increased throughput.
- **Functional oxides:** Riber continues to work with Institut des Nanotechnologies de Lyon (CNRS-INL) on using MBE technology to deposit the oxygen atoms in precisely controlled strontium titanate oxide (STO) films. These films are typically produced by pulsed laser deposition or sputtering. MBE technology gives better control over the individual layers within a

film and the interface between the layers. INL is working on oxide-based integrated devices for energy harvesting and advanced photonics. We note that other research bodies working on STO films are investigating applications related to quantum computing and nanoelectronics.

Riber has dominant market position

While industry commentator Zeal Insider predicts that the global MBE market will grow at a CAGR of 5% between 2020 and 2025, management notes that demand for R&D equipment is generally stable with total global sales of 10–15 units each year. Purchases are driven by new projects instigated in response to technological challenges. For example, a requirement to shift to larger diameter substrates or renewal of equipment originally purchased in the 1980s or 1990s. There is also demand from economies such as China and India, which are seeking to develop their own compound semiconductor capability.

There are around 10 other manufacturers globally offering R&D or pilot-production systems. These include CreaTec Fischer (Germany), DCA Instruments (Finland), Dr Eberl MBE-Komponenten (Germany), Eiko (Japan), EpiQuest (Japan), Pascal (Japan), Scienta Omicron (Germany), SVT Associates (US) and Veeco. Management estimates that over the last five years, Riber's share of the R&D systems segment has averaged 45%. Management believes that the company commands the dominant position in this segment because it supports production of the widest range of alloys including III-V and II-VI compound semiconductors, gallium nitrides, mercury cadmium telluride, films for passivation and oxide alloys. As in the production segment, the technical barriers to entry are extremely high, deterring new market entrants.

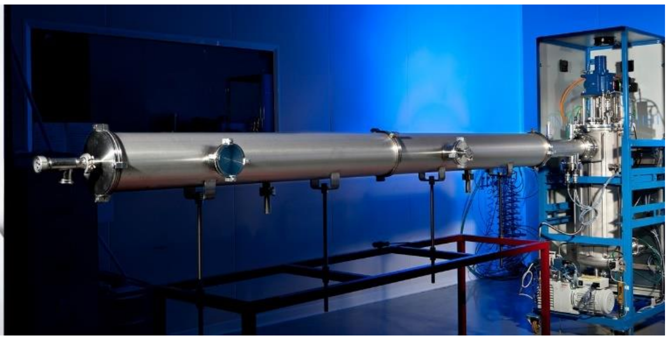
Strategy: Staying close to projects moving to volume production

Management's objective in this segment is to maintain Riber's global market share above c 60%. Securing R&D sales is not only important in its own right, it also ensures that Riber stays close to projects that progress to volume production so it is well placed to sell production equipment with the appropriate enhancements. We note that it typically takes seven to 10 years for an initial idea to pass into volume production. The company's strategy for maintaining its position in the R&D segment is to invest in innovation, typically making relatively small adjustments to components and accessories to support novel processes.

Evaporator activity takes Riber into additional markets

Entry into OLED and solar markets

Exhibit 6: Spot evaporators (left) and linear evaporator (right)



Source: Riber

Riber has adapted the effusion cells used to generate streams of material inside MBE systems so that they can be used to deposit highly uniform, ultra-thin films of material such as selenium on much larger substrates. Arrays of point source evaporators are used to deposit the aluminium forming electrical contracts in OLED displays and lights. Riber sells evaporators to systems integrator Canon Tokki, which serves OLED manufacturers in South Korea and China. It also sells linear evaporators for copper indium gallium selenide (CIGS) thin-film solar cell processes to systems integrator Singulus Technologies, primarily for deployment in China. Linear evaporators allow material to be deposited on moving plates that are several metres away from the evaporators.

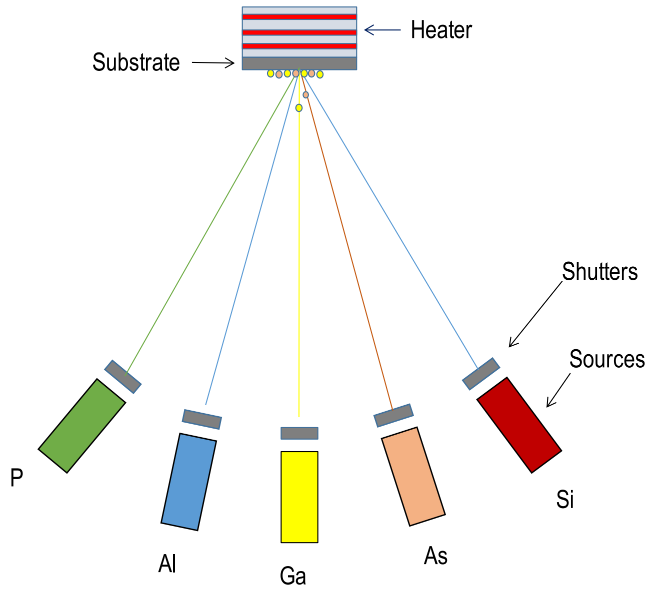
OLED market currently at trough of investment cycle

Management estimates that the market size is several thousand-point source evaporators per year depending on investment cycles in the OLED and solar industries and the emergence of new applications. The linear evaporator market is much smaller at around 10 units per year. The market is dominated by two larger Asian-based competitors. Management estimates that Riber's share is around 1%. However, it believes that Riber's point source evaporators deposit films that are more uniform with respect to thickness and exhibit a lower number of defects than films deposited by competitive equipment and that Riber is the only manufacturer to have developed a high-precision linear evaporator for depositing the selenium used in CIGS type solar cells. Riber's revenues from evaporators were modest in FY19 and FY20, reflecting a pause in investment in the OLED screen industry, though revenues were €14.4m in FY17 and €11.6m in FY18. While management has maintained contact with its customers for evaporators, we treat a resumption of substantial evaporator orders as upside to our estimates (see below).

Technology

MBE is a key tool for creating multi-layer structures

Exhibit 7: MBE process



Source: Edison Investment Research

Semiconductor devices consist of very thin films of compound semiconductor materials with differing electronic and optical properties stacked up like a many-layered cake. The behaviour of a device is determined by how electrons move through each layer. For example, a transistor acts as a switch by only allowing electrons to pass through a stack when a voltage is applied across the top and bottom layers of the stack. Alternatively, different structures where electrons are converted to light energy as they pass through specific layers form LEDs and lasers. Varying the composition of the layer where electricity to light conversion takes place causes a different colour of light, including

UV or IR wavelengths, to be produced. These complex structures cannot be realised using standard silicon chip fabrication technology. Specialist equipment such as MBE or MOCVD (for a comparison with MBE see below) reactors are required.

Device performance depends on achieving very precise control over the thickness and composition of each layer. MBE achieves this by generating individual streams of molecules by heating solid or gaseous materials, directing these beams onto a substrate material and turning the stream on and off with a computer-controlled shutter or valve with a very quick response time (typically 0.6 seconds). For example, a layer of gallium arsenide is created by directing beams of gallium (Ga) and arsenic (As) onto the substrate. When the atoms arrive on the substrate, they combine to form GaAs. Small amounts of other elements may be added to the mixture. For example, adding aluminium (Al) results in the formation of a layer of gallium aluminium arsenide (GaAlAs). The entire process takes place in an ultra-high vacuum to ensure very high levels of purity of the individual layers.

MOCVD and MBE compared

The main alternative to MBE for creating epitaxial layers is MOCVD. In this technique gases are injected into a chamber containing the substrate, which is heated. When the mixture of gases meets the surface of the hot substrate it reacts, depositing a thin layer of the desired alloy on the substrate. For example, a layer of GaN is formed by reacting an organometallic compound containing gallium with ammonia (NH_3), which is a combination of nitrogen and hydrogen atoms. We note the following key differences between the two techniques:

- **Throughput**: MOCVD can deposit material more quickly than MBE, so for structures such as LEDs, which are composed of relatively thick layers of materials, it is the preferred technology.
- **Uniformity**: the MBE technique results in the deposition of a much more uniform layer across the surface of a single wafer or multiple wafers being processed simultaneously. This in turn gives superior yield, which to some extent compensates for the lower wafer throughput.
- **Precision**: as the MBE technique enables a reactor to switch between source materials more cleanly than MOCVD it is more suitable for devices with thin and alternating layers, for example pseudomorphic high electron mobility transistors (PHEMTs). Additionally, since MBE takes place at a lower temperature than MOCVD, there is less movement of dopants either from one layer to another at an interface, giving more precise control of the final structure, or within a layer, giving improved uniformity. This is attractive for higher-performance device structures such as 850nm VCSELs for data communications and 940nm VCSELs for high-power applications. It is also important for longer wavelength micro-LEDs, enabling the higher levels of indium doping required to create green and red devices from GaN. Manufacturing GaN laser diodes using MOCVD techniques is not ideal because the temperatures involved have to be kept relatively low to avoid unwanted movement of dopants, but at this temperature the concentration of nitrogen atoms formed from splitting the ammonia is too low to form uniform films.
- **Material range**: MBE enables a wider range of elements to be deposited since the stream of molecules is created by simply heating a sample of the material (eg indium or phosphorus) that is to be deposited. In the MOCVD technique, the active elements (indium and phosphorus) need to be converted into a gas containing other elements (hydrogen and carbon). This is not always possible. For example, it is very difficult to get stable antimonide gases for making antimonide-based IR detectors. Additionally, the hydrogen involved in the MOCVD process for manufacturing GaN material reacts with the magnesium doping forming p-GaN layers. It has to be driven off in an extra step to activate the dopants, a process that is difficult for large area laser diodes and impossible for buried structures such as tunnel junctions.

- **Cost:** MBE reactors are larger and more expensive than MOCVD reactors because the former operate in an ultra-low vacuum. However, this is partly offset by the more rigorous safety measures required for MOCVD because of the toxic and flammable nature of the gases used.

We note that a high proportion of Riber's MBE reactors are sold for R&D purposes, reflecting the wider range of materials that may be deposited using this technique and the higher levels of control over the deposition process. Within the production environment, the higher throughput of MOCVD reactors has obvious attractions. However, this is offset to some extent by the superior quality of deposited semiconductor films offered by MBE, which results in better optical and electrical device performance. Moreover, as discussed above, MOCVD is not suitable for all types of epitaxy. We note that reactors being installed for the first phase of IQE's Newport facility are for volume VCSEL production and use MOCVD technology for VCSEL (opto-electronic) epitaxy, while MBE reactors are deployed at some of IQE's other locations where they are used for a variety of applications including IQE's emerging technologies. One of these emerging applications, cREO, uses a combination of MBE and MOCVD capabilities. As discussed above, Riber is addressing throughput issues by developing the MBE 8000 production system.

ASX-listed BluGlass has developed a variant of the MOCVD process for manufacturing critical layers in GaN devices. This patented remote plasma chemical vapour deposition (RPCVD) process takes place at a lower temperature than conventional MOCVD processes and avoids the problems caused when hydrogen reacts with the dopants forming p-GaN layers. This process is showing promise for the development of high-performance laser diodes, high-brightness LEDs and long-wavelength micro-LEDs. However, it is only suitable for GaN devices and is deployed in conjunction with conventional MOCVD reactors.

Management

The composition of the executive board has evolved over the last two years, as **Michel Picault** stepped down from his position as chairman of the board in June 2019, while remaining an executive director, and then retired from the board in December 2020. **Philippe Ley,** who re-joined Riber in 2018 as CEO and board director, took over as chairman of the board in June 2019. **Laurent Pollet** was CFO and board director between June 2019 and February 2021. **Stéphane Berterretche** became CFO in March 2021. **Emmanuel Routier** joined the board in December 2020, having been appointed as Riber's production director in June 2020. The executive board currently consists of Philippe Ley and Emmanuel Routier.

Sensitivities: Export licences an issue

The key sensitivities as we see them are:

- **Export licences:** China is an important geographical market for Riber, accounting for almost 50% of FY19 revenues. Riber needs to obtain export licences from the French government for systems and spares to China because of concerns that MBE equipment, particularly R&D systems where the end-usage may not be clearly defined, could potentially be used to make materials used in nuclear weapons. The government's decision not to award licences for MBE systems and certain types of spares to China resulted in actual FY20 revenues being around €1m lower and the order book at the FY20 year-end being at least €10m lower. Management notes that it has become harder to secure export licences to China since US/China relations soured during the Trump era.
- **Lumpiness of earnings:** since a single production MBE system can cost €2.2–3.5m depending on configuration and 90% of revenue is recognised on delivery, turnover can

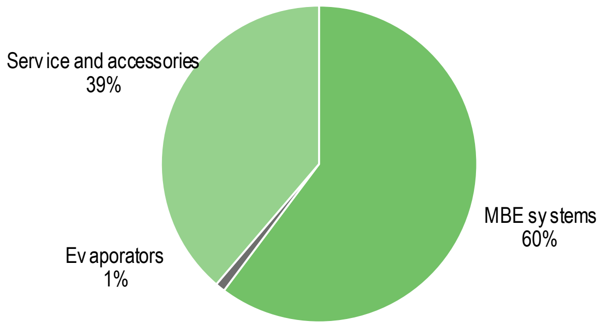
fluctuate substantially from quarter to quarter and the final outcome each year is very dependent on Riber meeting its delivery schedule for individual units. The high cost of a single MBE production system also means the proportion of revenues attributable to individual customers in any one year is material, but the customers involved will change from one year to the next.

- **Market cycles:** as noted above, demand for evaporators is linked to the OLED and solar equipment cycles. Demand for MBE equipment is less affected by individual market cycles because it is deployed in more markets, each with different phasing.
- **Dependence on individual customers:** since Riber works with only a handful of companies integrating evaporators into their manufacturing systems, evaporator sales also depend on the ability of individual systems integrators to secure market share.
- **Dependence on key suppliers:** Riber carries out machining and welding of R&D systems in-house but does not have the ability to execute these steps for larger production systems. These are outsourced to a specialist that is able to clean the surface of completed chambers so they are suitable for ultra-high vacuum deployment.
- **Foreign exchange exposure:** Riber prices sales contracts in euros, except for customers in the US, who are billed in US dollars. This is partly balanced by some materials purchases that are denominated in US dollars.

Financials

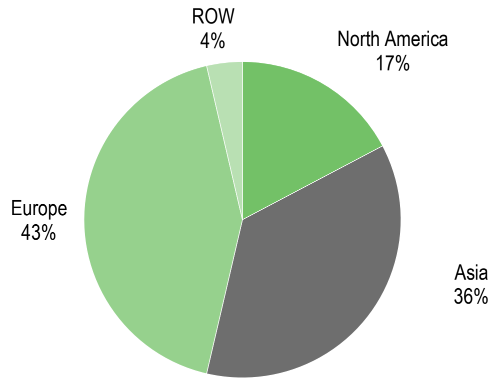
FY20 systems revenues adversely affected by Chinese export bans

Exhibit 8: FY20 revenues by segment



Source: Riber

Exhibit 9: FY20 revenues by geography



Source: Riber

FY20 revenues were €3.3 m lower year-on-year at €30.2m as FY19 performance was flattered by the delivery of two MBE systems had slipped into Q119 and the lull in investment in the OLED screen industry continued. This was partly offset by strong growth in sales of services and accessories, reflecting management's stated strategy of growing this activity. Total revenues would have been over €31m had the French government not refused export licences for R&D systems and certain types of spares to China. China is an important geographical market for Riber, accounting for almost 50% of FY19 revenues. Adjusted operating profit reduced by only €0.2m to €0.7m, in part because of lower travel costs associated with COVID restrictions and the capitalisation of a higher proportion of R&D costs. Financial charges increased from zero to €0.5m (non-cash charge, which we treat as an exceptional) because of the effect of the devaluation of the US dollar against the euro on receivables denominated in US dollars. Adjusted profit before tax fell by €0.2m to €0.7m. Management has proposed a cash payout of €0.03/share for FY20, which will be paid in July 2021 (€0.03/share in the previous year). For more detail, please refer to our May update note.

Liquidity benefits from €8.0m government-backed loans

Riber moved from €5.7m net cash at the end of FY19 to €0.3m net debt (excluding IFRS 16 lease liabilities) at end FY20. The key factors behind this were a €5.3m increase in working capital, €0.8m capitalised R&D (€0.7m in FY19), €0.8m capital expenditure (€0.9m in FY19) and €0.6m dividend payments. The increase in working capital is primarily linked to the preparation of two systems for which firm orders were received in H121. In addition, there was a reduction in customer prepayments for systems reflecting the low order intake (only three systems) during FY20. Despite the cash outflow during the period, cash at the end of December 2020 was €8.0m, higher than the €5.9m at the end of December 2019. This is because Riber obtained two loans backed by the French government totalling €8.0m and repayable over a four-year period from FY22 onwards to ensure it could maintain investment in R&D despite cash flow being affected by the delay in orders.

Outlook: Uncertainty affecting systems order book

Exhibit 10: Revenue analysis

	2018	2019	2020	2021e	2022e
Number of industrial MBE systems	4	7	4	3	4
Number of R&D MBE systems	3	5	5	4	6
Revenue MBE systems (€m)	9.6	23.0	18.2	15.3	17.6
Revenue – Evaporators (€m)	11.6	1.0	0.3	0.3	0.3
Revenue – Accessories, components and services (€m)	10.1	9.4	11.7	13.5	14.9
Total revenues (€m)	31.3	33.5	30.2	29.1	32.8

Source: Riber, Edison Investment Research

Riber's manufacturing facility remained operational throughout the coronavirus pandemic and moved to split-shift working so capacity was not affected. Because its MBE systems are used in research on new materials and for the production of electronic and opto-electronic devices used in communications networks and 3D sensing applications, enquiry levels remain high. However, at €14.4m, the FY20 year-end order book was €14.3m lower than a year previously. Management attributed this to the government's refusal to grant export licences worth around €13m. In addition, while enquiry levels were high throughout FY20, customers were slow to sign contracts given the economic uncertainty. The FY20 year-end order book contained only two MBE systems, both for R&D activity. One was from a European customer for research into opto-electronics components, probably LiDAR, for the automotive industry, the other an Asian customer. In January 2021, Riber received an order from an Asian customer for use in research including telecom lasers for fibre-optical networks. In March the company received an order from an Asian customer for its second multi-wafer production system, taking the total to €17.3m. In April it received an order from another Asian customer for its fifth multi-wafer production system, which will be used to manufacture electronic and opto-electronic devices. In June Riber announced an order for a research system from a research institute in Italy, Istituto Nanoscienze, which will be used to develop new types of solid-state lasers. Each of the production systems is priced at several million euros. All six of the systems on order are scheduled for delivery in FY21.

Q121 revenues were down €2.1m year-on-year at €3.2m and consisted entirely of service revenues, which were 4% higher than a year previously. The difference was that Q120 benefited from the delivery of a production machine. Management has not provided formal guidance for FY21. It expects that the services and accessories business will continue to progress and aims to improve the group's profitability compared with FY20. Management expects to benefit from some of its customers shifting production from China to Singapore or Taiwan so they can continue to participate in US-centric supply chains. It also expects to benefit from the French government's investment in R&D centres.

Our estimates model a year-on-year reduction in the number of MBE systems for delivery in FY21 to reflect the delays Riber experienced in closing orders during FY20 followed by a modest recovery in FY22. We treat a potential recovery in evaporator revenues linked to the OLED and solar panel investment cycles as upside. The change in product mix to a higher proportion of service revenues automatically increases the gross margin applied in FY21 and leads to a small rise in operating profit. Given Riber's leveraged operating model, the year-on-year revenue growth predicted for FY22 results in a meaningful improvement in operating margin. (Please refer to our May update note for the other assumptions supporting our estimates because the numbers are unchanged from this update.)

Valuation: Exports all clear would benefit share price

We base our valuation on a peer multiples approach. We restrict our sample to the two listed companies that are involved in developing equipment for manufacturing compound semiconductors because they benefit from similar growth trends to Riber, rather than the wider semiconductor industry.

Exhibit 11: Compound semiconductor manufacturing equipment peer multiples

Name	Market cap (€m)	EV/sales 1FY (x)	EV/sales 2FY (x)	EV/EBITDA 1FY (x)	EV/EBITDA 2FY (x)	P/E 1FY (x)	P/E 2FY (x)	Gross margin 2FY (%)	EBITDA margin 2FY (%)
Aixtron	2,513	5.6	5.0	24.6	20.0	36.1	31.0	41.6	25.0
Veeco Instruments	983	2.1	2.0	14.1	10.4	20.0	15.3	43.1	18.9
Mean		**3.8**	**3.5**	**19.3**	**15.2**	**28.1**	**23.1**		
Riber	34	1.2	1.0	13.9	9.9	52.9	24.7	35.0	10.4

Source: Refinitiv, Edison Investment Research. Note: Priced at 24 June 2021.

Riber's share price has dropped back from the €2.18 high reached in April following the news that a customer in Asia had placed an order for its fifth production system. At current levels the shares are trading at a discount to the mean of its peers with respect to prospective EV/sales and EV/EBITDA multiples. We believe that this level of discount is justified given Riber's smaller market capitalisation and lower margins. However, we see scope for share price appreciation if higher than anticipated numbers of MBE system orders, which could be catalysed by a relaxation of export controls, or receipt of a major evaporator order drive estimate upgrades. Given Riber's leveraged operating model, revenue incremental to our estimates would also lead to improved operating margins.

Exhibit 12: Financial summary

€m	2019	2020	2021e	2022e
Year end 31 December	IFRS	IFRS	IFRS	IFRS
INCOME STATEMENT				
Revenue	33.5	30.2	29.1	32.8
Cost of Sales	(23.6)	(21.2)	(18.9)	(21.3)
Gross Profit	9.9	9.1	10.2	11.4
EBITDA	1.7	2.1	2.4	3.4
Operating Profit (before amort. and except.)	0.9	0.7	0.9	1.9
Amortisation of acquired intangibles	0.0	(0.0)	0.0	0.0
Exceptionals	0.0	0.0	0.0	0.0
Share-based payments	0.0	0.0	0.0	0.0
Reported operating profit	0.9	0.7	0.9	1.9
Net Interest	(0.0)	(0.0)	(0.1)	(0.1)
Profit Before Tax (norm)	0.9	0.7	0.9	1.8
Profit Before Tax (reported)	1.0	0.2	0.9	1.8
Reported tax	0.1	0.0	0.0	0.0
Profit After Tax (norm)	0.6	0.5	0.6	1.4
Profit After Tax (reported)	1.1	0.3	0.9	1.8
Average Number of Shares Outstanding (m)	20.8	20.8	21.0	21.0
EPS - normalised (c)	3.07	2.49	3.03	6.48
Dividend (c)	3.00	3.00	3.00	4.93
Revenue growth (%)	7.0	-9.7	-3.8	12.6
Gross Margin (%)	29.6	30.1	35.2	35.0
EBITDA Margin (%)	5.0	7.0	8.4	10.4
Normalised Operating Margin	2.7	2.4	3.2	5.9
BALANCE SHEET				
Fixed Assets	11.4	11.3	11.4	11.4
Intangible Assets	2.6	2.9	3.2	3.5
Tangible Assets	5.4	5.3	5.1	4.8
Investments & other	3.4	3.1	3.1	3.1
Current Assets	26.8	29.1	30.4	32.7
Stocks	11.5	14.3	13.5	13.5
Debtors	8.0	5.1	6.4	7.2
Cash & cash equivalents	5.9	8.0	8.9	10.4
Other	1.3	1.7	1.7	1.7
Current Liabilities	(17.3)	(11.4)	(12.3)	(13.4)
Creditors	(13.0)	(7.9)	(8.8)	(9.9)
Tax and social security	(0.0)	(0.0)	(0.0)	(0.0)
Short term borrowings	(0.1)	(0.1)	(0.1)	(0.1)
Other	(4.2)	(3.5)	(3.5)	(3.5)
Long Term Liabilities	(1.7)	(10.0)	(10.0)	(10.0)
Long term borrowings	(0.2)	(8.2)	(8.2)	(8.2)
Other long-term liabilities	(1.5)	(1.8)	(1.8)	(1.8)
Net Assets	19.2	19.0	19.4	20.7
CASH FLOW				
Op Cash Flow before WC and tax	1.7	2.1	2.4	3.4
Working capital	4.2	(5.3)	0.5	0.3
Exceptional & other	0.6	(0.6)	0.0	0.0
Tax	0.0	(0.0)	0.0	0.0
Net operating cash flow	6.5	(3.8)	2.9	3.7
Capital expenditure and capitalised R&D	(1.6)	(1.5)	(1.6)	(1.6)
Acquisitions/disposals	(0.2)	(0.1)	0.0	0.0
Net interest	(0.0)	(0.0)	0.0	0.0
Equity financing	0.1	(0.1)	0.0	0.0
Dividends	(1.0)	(0.6)	(0.6)	(0.6)
Other	(0.4)	0.5	0.0	0.0
Net Cash Flow	3.3	(5.7)	0.7	1.5
Opening net debt/(cash)	(2.5)	(5.7)	0.3	(0.6)
FX	0.0	(0.1)	0.0	0.0
Other non-cash movements	(0.2)	(0.2)	0.0	0.0
Closing net debt/(cash)	(5.7)	0.3	(0.6)	(2.1)

Source: Riber accounts, Edison Investment Research

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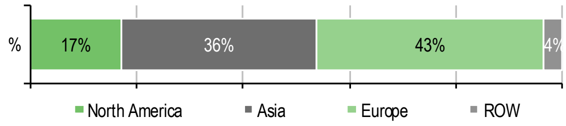
Revenue by geography



Management team

CEO and chairman of the executive board: Philippe Ley

A graduate of Ecole Nationale Supérieure d'Arts et Métiers, Mr Ley started his career at international engineering company ASSYSTEM in 1994. He moved to Renault Automation in 1997 where he occupied different managerial positions and became head of engineering at COMAU France, an industrial automation company, in 2001. He joined Riber in 2007 where he was first production director, then operation director and member of the executive board. He left Riber in 2015 to become managing director at ERCA, which produces equipment for manufacturing containers for dairy food and is part of Italian group IMA. He returned to Riber in June 2018 as chief executive officer and member of the executive board, becoming chairman in June 2019.

Production director and member of the executive board: Emmanuel Routier

Mr Routier began his career at ERCA in 1986. After several years in customer service, he joined the sales team as technical sales representative in charge of Latin America and Oceania. Between 2004 and 2009 he held the position of customer/sales support in the company IMPALSA of the AMCOR group. In 2010 he became deputy director of the ERCA subsidiary dedicated to the overhaul of machines and located in Barcelona. From 2012, he took over the management of the service activity of the company ERCA. He became Riber's production director in June 2020 and a member of the executive board in December 2020.

CFO: Stéphane Berterretche

A graduate of INSEAD, Mr Berterretche's career includes five years as head of finance & operations at Lacoste Footwear, four years as CFO Europe for Lee Cooper and 11 years at Famar Health Services, most recently as CFO. He joined Riber in March 2021.

Principal shareholders	(%)
Ormylia SAS, Jacques Kielwasser (Mr Kielwasser was formerly a member of Riber's supervisory board)	23.5%
ISA Finances, Socodol, Mr and Mrs Raboutet (Mr Raboutet is a member of Riber's supervisory board)	20.8%
Emmanuel Ichbiah	4.6%
Michel Picault	1.1%
La Banque Postale Asset Management1.	1.0%

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