EDISON

Carbios

Annual update

Commercial revenues in 2020

Industrial support services

Carbios's enzyme-based technology for the decomposition of plastic polymers is well placed to exploit the trend for the minimisation of plastic waste. With a strengthened financial position post the recent rights issue and an explicit timetable for the deployment of its technology, Carbios continues its transformation from a research body into a commercial enterprise. Our DCF model indicates a valuation of €13/share.

Year end	Revenue (€m)	PBT* (€m)	EPS* (c)	DPS (c)	P/E (x)	Yield (%)
12/17	1.0	(4.6)	(0.86)	0.0	N/A	N/A
12/18	1.1	(4.3)	(0.67)	0.0	N/A	N/A
12/19e	1.2	(4.8)	(0.60)	0.0	N/A	N/A
12/20e	1.7	(4.0)	(0.42)	0.0	N/A	N/A

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

Macro environment favours Carbios's business model

The macro environment for Carbios's technology and processes remains favourable. Mounting popular and governmental concern as to the environmental impact of plastic production and disposal favours the development of technology to minimise waste. Consumer brand companies are coming under pressure to make their packaging more environmentally friendly and, as a result, have made significant commitments to either reduce the use of plastic, or recycle it. In light of these developments Carbios signed a five-year deal with L'Oréal in October 2017 to bring its recycling technology to market on an industrial scale and in April this year it announced that Nestlé Waters, PepsiCo and Suntory Beverage & Food Europe had joined the consortium.

Commercial revenues from PLA technology in 2020

Carbios is focused on the biodegradation and enzymatic recycling of two polymers, PET and PLA, and has made significant advances towards the commercialisation of its technology in both areas. Carbios has confirmed (at the time of its recent equity issue of €14.5m) that it expects to receive royalty payments from Carbiolice from 2020 and will aim for a first commercial PET plant in 2023. Carbios will target the licensing of one PET plant a year until 2026 and two plants a year in the period 2027–30. Carbios will generate profits from selling its catalyst to PET producers via a tolling arrangement with enzyme producers, as well as upfront licence fees.

Valuation: DCF valuation of €13/share

We have revised our DCF valuation to take account of the increased number of shares in issue as a result of the rights issue (6.9m vs 4.6m) and the latest projections for the commercial deployment of Carbios's technology (provided by Carbios at the time of the equity issue). The timetable expects commercialisation of biodegradation technology in 2020 and enzymatic recycling in 2023. The majority of projected revenue lies well into the future and remains highly uncertain, but our updated financial projections indicate a DCF-based valuation of c €13/share (€15/share before).

30 July 2019

Price	**€6.7**
Market cap	**€46m**

Net cash (€m) as at 31 December 2018	5.2
Shares in issue	6.9m
Free float	72%
Code	ALCRB
Primary exchange	Euronext Growth
Secondary exchange	N/A

Share price performance

%	1m	3m	12m
Abs	(0.9)	(21.0)	0.9
Rel (local)	(2.3)	(21.1)	0.4
52-week high/low		€9.49	€4.30

Business description

Carbios develops enzyme-based processes for biodegradation and bio recycling of plastics, with a long-term aim of displacing current recycling and production processes.

Next events

FY19 interim results	September 2019

Analyst

Graeme Moyse +44 (0)20 3077 5700

industrials@edisongroup.com

Edison profile page

Carbios is a research client of Edison Investment Research Limited

Investment summary

Company description: Plastic lifecycle reinvention

Carbios develops processes for biodegradation, bio recycling and bio production of plastics, based on conversion of polymers into monomers and subsequent re-polymerisation. The processes used by Carbios are based on natural enzymes, which have been improved by enzymatic engineering to fully break down the polymers that make up plastic materials. The bioprocesses under development seek to create fully biodegradable plastics with a controlled lifespan (biodegradation), allow the recycling of plastic waste according to circular economy principles (bio recycling) and produce biopolymers (bio production). The company was founded in 2011 and floated on Euronext in December 2013.

Valuation: Updated for equity issue and rollout assumptions

In the absence of short-term multiples and metrics we use a DCF methodology to provide an indicative valuation for Carbios. Given the high degree of uncertainty surrounding our projections, a high degree of uncertainty also surrounds the valuation projections. Under our central case assumptions, we now obtain a valuation for Carbios of €13/share. However, the valuation remains sensitive to assumptions on discount rates, perpetuity growth rates and long-term margins.

Financials: Enough cash to fund business until 2022

- Revenue – We expect revenue of €1.2m in FY19 and €1.7m in FY20.
- Operating profits – We forecast that Carbios will continue to record operating losses for FY19 (€4.6m) and FY20 (€3.9m)
- Capex - We assume €10m is spent over the next two years FY19 (30%) and FY20 (70%) to finance to the construction of the demonstration PET bio recycling plant.
- Cash flow – We assume Carbios raises a further €5m from a mixture of conditional advances and subsidies in FY20. Carbios claims to have enough cash to fund its business until 2022.

Sensitivities and risks: Commercial competitiveness

- Technical risk – Carbios has yet to deploy its technology on a commercial scale and therefore technological risks remain.
- Financing – Post the recent rights issue Carbios believes it has enough resources to meet its financial obligations over the next 12 months and extend its cash horizon until the fourth quarter of 2022. Beyond this point, Carbios could require additional financing.
- Patent protection – Patent infringement represents a potential risk to Carbios, although the risk is mitigated by the presence of two IP experts internally, a dedicated attorney and a committee for IP.
- Commercial competitiveness – There is no guarantee that Carbios's products will be more cost competitive than other emerging technology.

Exhibit 1: Changes to principal forecasts for FY19 and FY20

	Revenue (€m)			PBT (€m)			EPS (c)		
	Old	New	% chg.	Old	New	% chg.	Old	New	% chg.
2019e	1.2	1.2	N/A	(4.8)	(4.8)	N/A	(74.0)	(60.0)	18.9%
2020e	1.6	1.7	6.3%	(4.2)	(4.0)	4.8%	(64.0)	(42.0)	34.4%

Source: Edison Investment Research

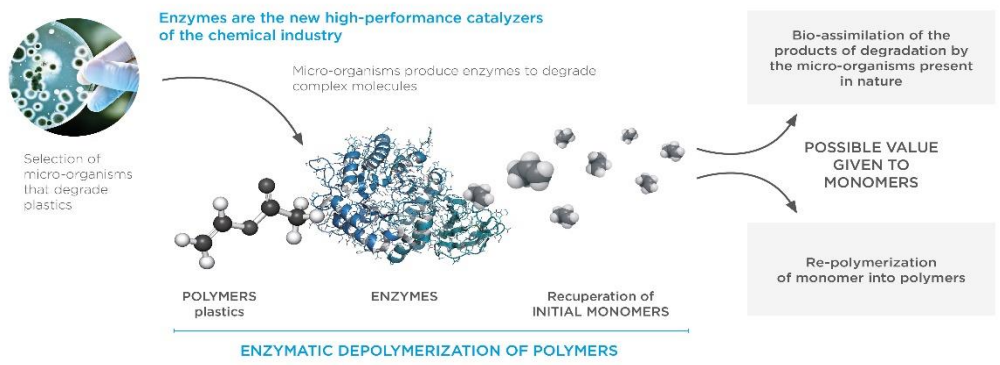
A circular plastic economy

Moulding a new future for plastics

Carbios describes itself as a green chemistry company with a focus on the discovery and development of enzymatic bioprocesses to reinvent the lifecycle of plastics. Carbios's processes are based on the use of enzymes produced by natural micro-organisms, chosen for their ability to degrade the polymers. Carbios is focused, in particular, on two active bioprocesses:

- The creation of a new generation of fully biodegradable plastics with a controlled lifespan (biodegradation).
- Infinite bio recycling of plastic waste enabling the production of new plastics of the same quality as the original product (bio recycling).

Exhibit 2: Carbios' enzymatic process



Source: Carbios

Commercialisation through licensing

Carbios's business model is based on the licensing of its technology and bioprocesses to industrial customers, either directly or via joint ventures. The licences granted will generate revenue in the form of upfront payments, royalties and/or dividends. Carbios signed its first licensing agreement in 2016 with Carbiolice and retains a stake of 56% in the company.

Commercial revenues expected in 2020

Carbios is predominantly focused on the biodegradation and bio recycling of two polymers, PLA and PET, and has made significant advances towards the commercialisation of its technology in both areas. The advances in its PLA business (biodegradation) was confirmed in January of this year when Carbios announced that it had signed a multi-year agreement with Novozymes (a world-leading enzyme producer), under the terms of which Novozymes has committed to become a long-term exclusive supplier of Carbios's proprietary PLA degrading enzymes. At the same time, Carbios confirmed that it expects to receive royalty payments from Carbiolice from 2020. The PET technology is be trialled in a demonstration plant (scheduled to be up and running in early 2021) and Carbios will aim for its first commercial PET plant in 2023. Carbios will aim to license one plant a year until 2026 and two plants a year in the period 2027–30. As well as receiving licensing fees, Carbios will generate profits from selling its catalyst to PET producers via a tolling arrangement with an enzyme producer.

Current plastic production

According to figures used by Carbios derived from a range of sources, plastic production totalled 348m metric tons in 2017, with waste of 125m metric tons. European production has remained flat in recent years (at c 60m tonnes, global market share c 20%), although Europe remains the second largest producer of plastics in the world (China is the global leader with 26% of global plastic production in 2014). The largest proportion of plastics in Europe (39.5%) is used for packaging, with a further 20.1% used in the building and construction industry.

Today, the manufacturing of plastics requires fossil feedstocks, water and energy, with the production process contributing to greenhouse gas emissions. Hydrocarbons are heated to a high temperature, which breaks down hydrocarbon molecules into smaller molecules that are combined to make (in the case of plastic bottles) PET resin. The PET resin can then be melted and injected into moulds to make plastic bottles. Each 500ml plastic bottle has a carbon footprint of c 83g.

Plastic pollution, recycling and disposal

In addition to the negative environmental implications of the production process, the disposal of used plastic also raises environmental issues. Much of the plastic produced finds it way into the environment and it is currently estimated that almost 8m metric tons of plastic ends up in the world's oceans annually.

On land it is believed that some plastic items can take 400 years to break down. While an increasing proportion of plastic waste is recycled and used for energy recovery, according to figures produced by Plastics Europe, less than a third of plastic waste in the EU is recycled. Plastic Europe estimates that 41.6% was used for Energy Recovery purposes, 27.3% was sent to landfill, while 31.1% was recycled. Of the recycled proportion 37% was recycled outside the EU. The picture in the US is even worse; according to the EPA, c 9.1% of plastic material generated in the US municipal solid waste (MSW) stream was recycled in 2015, with 15.5% combusted for energy. The overwhelming majority, 75.4%, was sent to landfills.

The thermomechanical processes currently employed in recycling also suffer from a disadvantage in that they can produce plastic material of diminished quality, which is susceptible to contamination. These processes allow for the re-use of recycled waste only in small proportions for its original purpose.

Governmental ambition

To tackle the problem of plastic waste, in 2014 the European Union set the aim of reducing plastic bag use by 80% by 2019. Such a target requires EU-wide action and a number of countries have already put in place measures to reduce plastic bag use. Denmark introduced a tax on plastic bags in 1994, while Ireland began charging customers in 2002. In 2015 France announced a total ban on plastic bags and in 2016 it followed this up with a ban on plastic cups, plates and cutlery, to be brought in from 2020. In January 2018 the UK government extended the 5p carrier bag charge to all retailers in England. Interestingly, China has had total bans on plastic bags since 1 June 2008.

The EU's most up to date vision for reducing plastic waste was set out in its document 'A European Strategy for Plastics in the circular Economy' (May 2018). The vision aims for all plastic packaging to be reusable or capable of being recycled by 2030 with an overall aspiration that by 2030 more than 50% of plastic waste in Europe could be recycled.

Bio plastics and biodegradable plastics

In addition to the setting of targets for the recycling of plastics and a reduction in single use plastics, there has been a growth in bio plastics and biodegradable plastics to confront the problems associated with traditional plastics. A bio plastic is defined by its production process and is a plastic produced from renewable raw materials rather than from oil-based materials. Biodegradable plastic on the other hand is a plastic that undergoes biodegradation at the end of its useful life from the action of micro-organisms such as bacteria and fungi. Compostable plastic bags represent one such attempt to reduce the amount of plastic leakage into the environment.

The market for biodegradable plastics has been growing quickly in recent years, and is expected to continue to grow at more than 10% pa, but still only accounts for c 1% of the total market. It has been argued that growth rates have been held back by a number of issues, including weak mechanical properties, which prevent biodegradable plastic replacing all types of plastic, and a requirement for a specific set of circumstances (usually industrial compost at 50°C) to facilitate biodegradation.

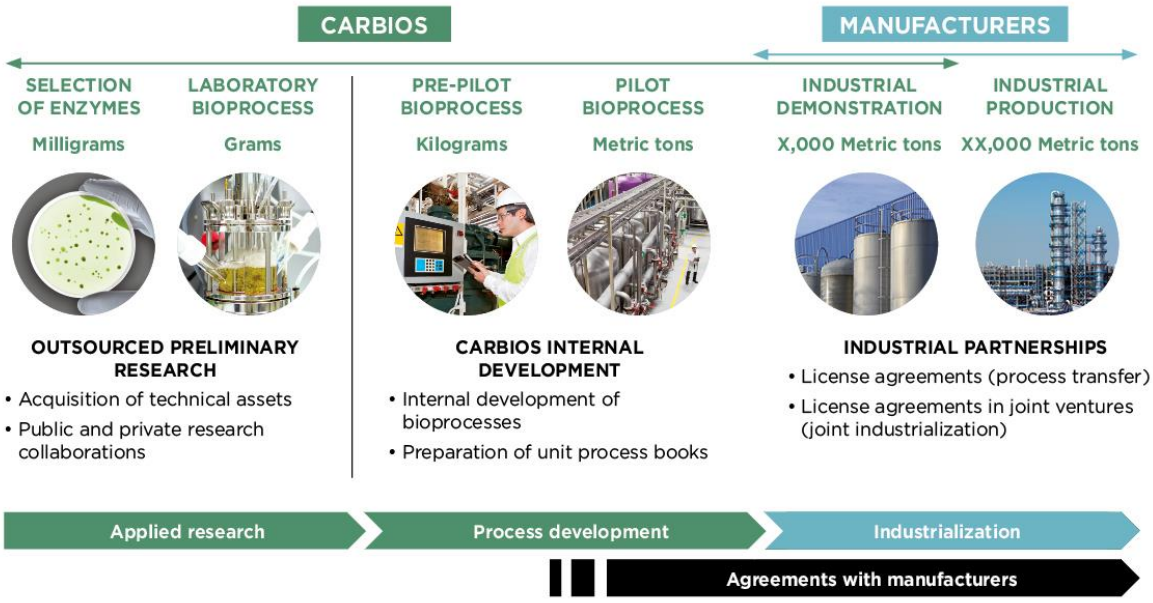
Strategy and business model of Carbios

As we highlighted in a previous report (Commercial revenues in 2020, April 2019), Carbios seeks to utilise enzymes produced by natural micro-organisms to degrade the polymers that make up plastic materials. Carbios is involved in the development of two processes: biodegradation and enzymatic recycling. These bioprocesses are targeted on two polymers: PLA and PET:

- Biodegradation (PLA): the inclusion of an enzyme in a plastic material in order to make fully biodegradable plastics with a controlled lifespan.
- Enzymatic recycling (PET): this process uses highly specific enzymes to fully break down plastic waste. The monomers obtained are then used to produce new plastic of the same quality as the original.

Ultimately Carbios aims to license its technology, either directly or via joint ventures, to other industrial companies. The form of licence revenue will depend upon the terms of the individual agreement, but could take the form of upfront payments, royalties and/or dividends. Carbios signed its first licensing agreement in 2016 with Carbiolice, in which it retains a 56% holding (see below). Carbios received an €8m upfront payment in 2016 and is expecting to receive turnover-related royalties from 2020.

Exhibit 3: Carbios business model



Source: Carbios

At the time of its recent rights issue, Carbios published a table (which we reproduce below) summarising its major technological applications and their stage of development. As can be seen from the table, Carbios indicated that the estimated release dates of the PLA and PET to end-use customers are now 2020 and 2023, respectively. PLA client testing will start in H219 with a view to a commercial launch in 2020. The timing accords well with the French Green Growth Law, which requires single use plastics to be biodegradable and 50% biosourced by 2020. Revenues in advance of these end-customer revenues can be generated from industrial agreements such as that with Carbiolice.

Exhibit 4: Carbios processes, application and stage of development

Processes	Biodegradation			Bio recycling			Bio polymerisation
Polymers	PCL	PLA	PE	PET (plastics)	PET (textiles)	PLA	PLA
Applications	Mulching film and bags	Packaging, mulching films, bags, bag manufacturing, industrial films, disposable tableware	All soft plastics	Rigid packaging (bottles, trays, films)	Clothing, household linens and furnishings (duvets, pillows, etc)	Packaging	Packaging and textiles
Stage of development	Pilot	Demonstration	Approval of concept	Pilot	Laboratory	Pilot	Laboratory
Estimated date of first revenues for the industrial exploitation of the processes developed by Carbios		2016*		2019			
Estimated date of marketing to end customers of processes developed by Carbios		2020		2023			
Industrial development partners		Carbiolice Novozymes		L'Oréal, Nestle Waters, PepsiCo, Suntory Beverage & Food Europe			

Source: Carbios. Note: *Fixed fee of €8m received in 2016 under a patent and know-how licence agreement signed with Carbiolice SAS.

In the following section we examine Carbios's progress in two of its principal polymer markets, PET and PLA.

PET market background

PET is strong and naturally transparent and is one of the most commonly used polymers in the world. The global market for PET is worth c $100bn (c 70m tons) and according to figures used by Carbios the plastic (PET) bottle market (c 24m metric tons) is expected to grow at a rate of 3.4% pa. The larger PET fibres/textiles market (42m metric tons) is expected to grow at 6% pa. The PET market currently suffers from overcapacity with global production capacity of around 90m tonnes.

PET is produced by the polymerisation of ethylene glycol and terephthalic acid and is mainly used to make bottles and textile fibres. Although PET is not biodegradable, it is widely recycled (EU recycling rate 52% according to Euromonitor). With a Chinese ban on the importation of plastic waste, there will be increased pressure to deal with plastic waste locally and, given the problems associated with landfill and the incineration of PET (it is not energy efficient and can produce harmful dioxins), alternative approaches will be required.

Most techniques employed to breakdown and recycle PET rely on chemical processes, however the process developed by Carbios to break down PET is a biological one. Carbios's enzymatic depolymerisation produces purified terephthalic acid (PTA) and monoethylene glycol (MEG) once the PET has been deconstructed. PTA and MEG are the building blocks used to manufacture polyester fibres and PET plastic products. Other chemical degradation techniques produce bishydroxyethyl terephthalate monomer (BHET) or dimethyl terephthalate (DMT). Carbios's process can ultimately create recycled PET, equivalent to virgin PET, which can be used to produce bottles and other forms of plastic packaging. Carbios recently (February 2019) announced that it had used its enzymatic technology to create PET bottles from 100% recycled plastics.

According to Carbios its technology uses highly specific enzymes that can recycle a much broader range of PET plastics (clear, colored, opaque and multilayer) and polyester fibre feedstock than other recycling technologies. Carbios also claims that its patented technology offers the potential to recycle PET plastics repeatedly, enabling new products to be made of 100% recycled PET (as outlined above). Carbios's solution is based upon a 'plug-and-play' unit, which can be attached to the front end of any operational PET production plant to break down plastic waste. As a result, Carbios claims that its technology and process offers advantages in terms of cost and ease of handling. The process (which has received the Solar Impulse Foundation 'Efficient Solution' label) requires limited heat and no pressure or solvents, which improves its environmental impact, and also provides a competitive solution to help increase global plastic recycling rates.

Commercialising Carbios's PET technology

In November 2018 Carbios and KEM ONE signed a letter of intent for the lease and supply of services on KEM ONE's site where Carbios will build its demonstration plant (with the engineering support of Technip) for the enzymatic recycling of PET. In January of this year Carbios and TWB obtained €7.5m in funding from ADEME (Carbios's maximum share is €4.1m) to accelerate the industrialisation of the bio recycling of PET plastic and fibre waste. Approximately 75% of the proceeds of the recent rights issue (see below) will be used to help finance this demonstration plant, which is expected to be up and running in late 2020 or early 2021.

Carbios will aim for its first commercial PET plant in 2023 and will work on the basis of licensing its process at the rate of one plant a year until 2026. From 2027–30, Carbios will aim for two plants a year. The initial plants have a capacity of 100–200k tons pa but will gradually increase in scale to 400k tons pa. Carbios will sell its catalyst to PET producers operating its process through a tolling arrangement with an enzyme producer.

Many brand owners are coming under pressure to make their packaging more environmentally friendly and, as a result, have made significant commitments to either reduce the use of plastic, or recycle it. Evian, for example, has a stated ambition of using 100% recyclable plastic by 2025. Unilever has committed to ensure that all of its plastic will be recyclable, reusable or compostable by 2025. In light of this, Carbios signed a five-year deal with L'Oréal in October 2017 to bring its recycling technology to market on an industrial scale. Recently (April 2019) Carbios announced that Nestlé Waters, PepsiCo and Suntory Beverage & Food Europe are also to join the consortium with L'Oréal. Under the terms of the four-year agreement, the consortium partners' ambition is to bring Carbios's PET-enhanced recycling technology to the market and increase the availability of high-quality recycled plastics to fulfill their sustainability commitments. The collaboration includes technical milestones and support for the efficient supply of consumer-grade, 100% recycled PET plastics for global markets.

The market for the bio recycling of PET remains in its infancy with no dominant market player. Carbios's competitors include Loop and J-Plan. Loop's technology breaks down PET into intermediate organic compounds DMT and MEG, without heat or pressure.

June 2019 rights issue

On 24 June 2019 (after market close) Carbios announced the launch of an accelerated book building process with the aim of raising €13m to finance an industrial PET bio-recycling demonstration plant (75% of the total) and ongoing corporate expenses (25%). The book building closed on the following day (25 June 2019), with Carbios having raised €14.5m via the issue of 2.25m new shares at a price of €6.45/share. The dilution effect of the rights issue was 32.5%. Post the rights issue, Carbios's total issued share capital rose to 6.9m. Carbios stated that it considers it has sufficient financial resources to meet its financial obligations over the next 12 months and has extended its cash horizon until Q422.

PLA market background

Polylactic acid (PLA) is a thermoplastic polymer produced from lactic acid ($C_3H_6O_3$) or lactide monomers, derived primarily from renewable resources like corn starch or sugar cane. PLA is termed a bioplastic as a result of its biomass origins. Although PLA is a fully bio-sourced plastic, it is not biodegradable in normal conditions and requires industrial composting.

Common applications of PLA include plastic films, food packaging, 3D printers and biodegradable medical devices. Currently, bioplastics comprise only a small (but rapidly growing) proportion of all plastics produced on an annual basis and, according to figures produced by European Bioplastics and Nova Institute, total production capacity of bioplastic in 2017 was 2.1m metric tons, of which PLA has a market share of 10.3% of the raw material used for bioplastics production.

Carbios's PLA technology

Carbios claims that by embedding its enzymes into the plastic material, the plastics can fully biodegrade over a controlled lifespan into base molecules without compromising the integrity and performance of the plastic. Carbios's technology can be applied to a variety of plastic products, including bags, disposable tableware and food packaging.

Carbios first demonstrated its ability to depolymerise PLA in 2013 and has now refined the process. Carbios has developed a technology enabling PLA plastics to become 100% biodegradable and 100% compostable. The company has also developed the first biological process producing virgin PLA from lactic acid obtained from the bio recycling of the plastic (PLA).

Given the limited production of PLA (c 275,000 metric tons, the majority produced by Naturworks in the US), the recycling of PLA remains a relatively small but nevertheless emerging market with

strong growth characteristics (15%+). Although work on PLA remains in the development stage, Carbios is discussing the potential licensing of its technology with industrialists.

Carbiolice: Commercialising Carbios's PLA technology

Carbiolice was created in September 2016 and is an industrial and commercial joint venture with Bpifrance and Limagrain Céréales Ingrédients (a global seed producer). Carbiolice is in charge of the PLA biodegradation process developed by Carbios and its partners within THANAPLAST. Carbios currently holds 56% of Carbiolice but does not consolidate Carbiolice according to exemptions under the French Commercial Code. In the short term, Carbiolice generates some revenue from the production of corn-based compounds and biopolymers for plastic manufacturers involved in the production of bags/mulching films. In the longer term, Carbiolice will operate its patented enzymatic biodegradation technology (licensed from Carbios) to produce enzymated pellets (masterbatch). By embedding enzymes into the plastic material, the plastics can fully biodegrade themselves over a controlled life span, into base molecules. According to Carbios, the lactic acid can be assimilated by the micro-organisms in nature but crucially the incorporation of its pellets into the plastic material leaves the performance of the polymers undiminished and does not require any modification to the plastic production facilities.

The progress towards commercial operation was confirmed in January of this year when Carbios announced that it had signed a multi-year agreement with Novozymes, under the terms of which Novozymes has committed to become a long-term exclusive supplier of Carbios's proprietary plastic degrading enzymes. At the same time, Carbios confirmed that it expects to receive royalty payments from Carbiolice from 2020. Carbiolice will operate one industrial plant capable of producing 4,000 metric tons per year (masterbatch) addressing a market size of 80,000 tons a year and will ultimately target a third of the market in the EU for soft biodegradable plastics.

Prior to the generation of commercial revenues, the Carbiolice project is funded by an €18m financing package, including €11m from Bpifrance. The €18m is scheduled to be released in four phases, over four years, on completion of technical and commercial objectives. The three partners of the project invested €4m in 2016 and in July 2018 a second round of financing of €3.35m (€1.1m Carbios) was put in place. It is worth pointing out that on the formation of Carbiolice, Carbios received an upfront payment of €8m, which was converted into shares in the joint venture. Carbios will also have received R&D collaboration revenues of c €2.5m over a four-year period, which will help support the industrial development of Carbiolice and serve as an additional source of income for Carbios.

However, in the longer term, Carbiolice will operate its patented enzymatic biodegradation technology (licensed from Carbios) to produce enzymated pellets (in master batch form).

Management

The Carbios board of directors is comprised of eight members and there is also a scientific advisory board with four members. In December 2018 Carbios appointed Ian Hudson to succeed Jean Falgoux as chairman of Carbios's board of directors, although Mr Falgoux will remain a director of the company. Ian Hudson started his career with ICI and joined du Pont de Nemours in 1998 holding a variety of roles in the company (including 10 years as President of Europe, Middle East & Africa) until he retired in 2016.

There has been no change in the management team (Executive Committee) during the last year. Jean-Claude Lumaret continues as CEO (appointed 2011), while Professor Alain Marty remains chief scientific officer (appointed 2015 following three years as a member of the company's scientific committee and as a scientific consultant for the company). Deputy CEO Martin Stephan joined at the beginning of 2017. Mr Lumaret has a scientific background with a degree in chemical

engineering and considerable experience of the starch industry. However, Mr Lumaret also possesses significant experience as a patent attorney, which will be an important asset for Carbios as it seeks to protect its technology. Professor Marty possesses a wide range of academic and scientific experience in biotechnology, enzymology and bioengineering.

Sensitivities/risks

The key risks facing Carbios are summarised below.

- Technical risk – Carbios has yet to deploy its technology on a commercial scale and therefore technological risks remain. The development of Carbios's technology, even if ultimately successful, could be subject to delays to the envisaged timetable.
- Financing – Since its foundation in 2011, Carbios has, in large part, financed itself via a mixture of subsidies, grants, loans tax credits and equity issues. In the short term we expect Carbios to generate some revenues from the provision of research and technical services to Carbiolice. Carbiolice is expected to provide increasing royalty payments from 2020. Post the recent rights issue, Carbios believes it has enough resources to meet its financial obligations over the next 12 months and it extends its cash horizon until the fourth quarter of 2022. Beyond this point, Carbios could require additional equity financing.
- Patent protection – As we have noted previously, Carbios has filed several patents to protect its intellectual property, and CEO Lumaret has considerable experience as a patent lawyer. Nevertheless, patent infringement represents a potential risk to Carbios.
- Commercial competitiveness – The environmental case for biodegradable plastics and recycling remains strong and as yet the market remains in its infancy. There is no guarantee that Carbios's products will be more cost competitive than other emerging technology.

Valuation

In the absence of short-term multiples and metrics to produce a meaningful valuation guide, we use a DCF methodology to provide an indicative valuation for Carbios. Given the high degree of uncertainty surrounding our projections, a high degree of uncertainty inevitably also surrounds the valuation projections.

Our DCF is based on cash flow projections for the two principal business segments: biodegradation (PET) and bio recycling (PLA). We project cash flows to 2030 and assume, following discussions with the company, a long-term EBIT margin of 40%. We continue to use a discount rate of 15% and perpetuity growth rate of 2%. We have updated our DCF to reflect the increase in the number of shares post the recent rights issue. We assume Carbios records its first operating profit in 2024.

PLA – For Carbiolice we assume the commercial revenues start in 2020, rising to a little over €5m by 2030, based on sales of 6,000 tonnes/year (utilisation rate of 75%) and a selling price of €16.5/kg (Carbios indicates that the current master batch price is c €15/kg) by 2030. We assume the initial installed capacity 4,000t/yr (one plant) will rise to 8,000t/yr (two plants) by 2030 in line with company projections. We also assume Carbiolice can generate c €2m of additional revenue for Carbios from the sale of sub licences by 2030.

PET – The projections for the PET business remain the most important component of our DCF forecasts. In line with the latest guidance, we assume commercial operations begin in 2023. We project that Carbios will generate c €10–12m of revenue from the upfront licensing of its technology by 2030. In total, we expect Carbios will sell 10 licences by 2030. However, this figure is substantially smaller than the revenue that we expect from the sale of enzymes. Carbios will purchase enzymes under an exclusive agreement from an enzyme producer and then sell on the

enzymes to PET producers. We assume that the 10 licences we expect Carbios to have sold by 2030 (company guidance 12), will be equivalent to a total annual demand of c 1,650t/year of pure enzymes (ie a utilisation rate of c 90% given our projected total capacity of 1,850t/year). Based on a formulated enzyme price of €13/kg (slightly less than 10% of the PET price of €1,500/t), we expect 2030 revenue of c €225m.

Under our central case assumptions, we obtain a valuation for Carbios of €13/share. However, the valuation remains sensitive to assumptions on discount rates, perpetuity growth rates and long-term margins (See Exhibit 5).

Exhibit 5: DCF valuations for differing EBIT margin projections 2024–30 and discount rates

Scenario	2024	2025	2026	2027	2028	2029	2030	15% discount rate €/share	20% discount rate €/share
1	40%	50%	60%	60%	60%	60%	60%	22	11
2	40%	50%	50%	50%	50%	50%	50%	18	9
3	35%	40%	45%	45%	45%	45%	45%	15	8
4	**30%**	**35%**	**40%**	**40%**	**40%**	**40%**	**40%**	**13**	**7**
5	30%	35%	35%	35%	35%	35%	35%	11	6
6	30%	30%	30%	30%	30%	30%	30%	8	4

Source: Edison Investment Research

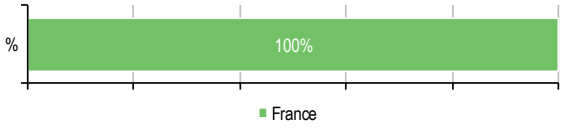
Financials

- Revenue – We continue to expect only modest growth in revenue to €1.2m for FY19 and €1.7m for FY20. Revenue in the short term will be driven by the research service agreement with Carbiolice and complemented by other miscellaneous sources, including revenues from the annual fee from the brand owners of the consortium. We expect a small amount of commercial revenue from Carbiolice in 2020.
- Operating costs and profits – We expect operating costs to remain broadly flat at c €4.7m for both FY19 and FY20. Given our expectations for revenues and costs, we forecast that Carbios will continue to record operating losses for FY19 (€4.6m) and FY20 (€3.9m).
- Capex – We assume €10m is spent over the next two years FY19 (30%) and FY20 (70%) to finance to the construction of the demonstration PET bio recycling plant.
- Cash flow/cash – Following the rights issue, which raised €14.5m, we expect a significant positive uplift in cash resources by the end of FY19 (c €12m). As we have highlighted above, a significant proportion of the cash raised will be spent on the construction of a PET demonstration plant over the next two years. Following the equity issue, Carbios stated that it is capable of meeting its financial obligations over the next 12 months and has extended its cash horizon until 2022.

Exhibit 6: Financial summary

€m	2014	2015	2016	2017	2018	2019e	2020e
Year end December 31	IFRS	IFRS	IFRS	IFRS	IFRS	IFRS	IFRS
INCOME STATEMENT							
Revenue	0.66	0.84	8.87	0.98	1.08	1.22	1.73
Operating Expenses	(3.95)	(4.73)	(5.11)	(5.39)	(5.02)	(5.60)	(5.35)
EBITDA (norm)	(3.28)	(3.90)	3.76	(4.41)	(3.94)	(4.38)	(3.62)
Depreciation	(0.08)	(0.17)	(0.21)	(0.24)	(0.30)	(0.25)	(0.25)
Reported Operating Profit	(3.36)	(4.06)	3.55	(4.65)	(4.24)	(4.63)	(3.87)
Net Interest	0.05	0.08	0.08	0.02	(0.03)	(0.16)	(0.15)
Profit before tax (reported)	(3.32)	(3.98)	3.63	(4.63)	(4.26)	(4.79)	(4.02)
Reported tax	1.09	0.94	1.32	0.70	1.19	1.34	1.12
Profit after tax (reported)	(2.23)	(3.05)	4.95	(3.93)	(3.07)	(3.45)	(2.90)
Extraordinary gain or loss	0.02	(0.02)	(0.03)	(0.01)	(0.04)	0.00	0.00
Net income (reported)	(2.21)	(3.07)	4.92	(3.94)	(3.11)	(3.45)	(2.90)
Basic average number of shares outstanding (m)	3.75	3.78	3.85	4.57	4.62	5.78	6.90
EPS - basic reported (€)	(0.59)	(0.81)	1.28	(0.86)	(0.67)	(0.60)	(0.42)
Dividend (c)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Revenue growth (%)	-26.2%	26.1%	959.7%	-88.9%	10.2%	12.5%	41.7%
Normalized EBITDA Margin (%)	N/A	N/A	42.4%	N/A	N/A	N/A	N/A
Normalized operating margin (%)	N/A	N/A	40.0%	N/A	N/A	N/A	N/A
BALANCE SHEET							
Total Current Liabilities	0.67	0.91	1.17	2.26	3.40	4.58	4.38
Accounts payable	0.20	0.34	0.49	1.43	1.06	1.12	1.02
Other current liabilities	0.47	0.57	0.67	0.83	2.34	3.46	3.36
Total Non-Current Liabilities	1.95	3.01	3.15	3.71	3.71	3.71	8.71
Debt/Repayable advances	1.95	3.01	3.15	3.71	3.71	3.71	8.71
Total Liabilities	2.62	3.92	4.32	5.97	7.11	8.29	13.09
Total Shareholders' Equity	11.12	8.13	13.11	14.55	12.04	23.07	20.17
Common stock / Capital	2.63	2.65	2.68	3.20	3.26	3.26	3.26
Additional paid-in capital / Share premium	13.65	13.70	13.74	18.59	19.13	33.61	33.61
Retained earnings	(2.96)	(5.17)	(8.24)	(3.32)	(7.26)	(10.37)	(13.82)
Other reserves and surplus	(2.21)	(3.05)	4.94	(3.94)	(3.10)	(3.44)	(2.89)
Total liabilities and equity	13.73	12.04	17.44	20.52	19.15	31.36	33.26
Total assets	13.73	12.04	17.44	20.52	19.15	31.36	33.26
Total current assets	12.64	10.38	6.16	9.17	6.69	13.26	5.38
Cash and cash equivalents	11.10	9.01	3.99	7.55	5.15	12.16	4.04
Accounts receivable	1.40	1.22	1.95	1.46	1.48	0.74	0.95
Inventories	0.02	0.01	0.02	0.01	0.02	0.32	0.29
Prepaid expenses	0.12	0.13	0.22	0.15	0.04	0.04	0.10
Total Non-Current Assets	1.09	1.67	11.28	11.35	12.46	18.10	27.88
Property Plant and equipment, net	0.74	1.25	1.21	1.11	0.97	4.34	11.73
Other intangible assets	0.13	0.23	0.37	0.57	0.69	0.76	0.85
Other non-current assets	0.22	0.19	9.70	9.68	10.80	13.00	15.30
CASH FLOW							
Cash Flow from Operations							
Net income (loss)	(2.21)	(3.07)	4.92	(3.94)	(3.11)	(3.45)	(2.90)
Depreciation and Amortization	0.07	0.17	0.22	0.23	0.33	0.25	0.25
Other items	(1.36)	0.39	(0.51)	1.49	(0.29)	1.61	(0.44)
	(3.50)	(2.52)	4.64	(2.22)	(3.08)	(1.59)	(3.09)
Cash Flow from Investing							
Purchases of fixed assets	(0.85)	(0.79)	(0.30)	(0.33)	(0.30)	(3.69)	(7.73)
Other Investing Activities	(0.02)	0.00	(9.53)	0.02	(1.14)	(2.20)	(2.30)
Net cash used in investing activities	(0.87)	(0.79)	(9.83)	(0.31)	(1.44)	(5.89)	(10.03)
Cash Flow from Financing							
Change in Debt	0.15	0.07	(0.04)	(0.05)	1.52	0.00	5.00
Change in Capital Stock	0.17	0.06	0.07	5.38	0.60	14.49	0.00
Other Financing Activities	0.55	1.08	0.14	0.77	0.00	0.00	0.00
	0.87	1.22	0.17	6.09	2.12	14.49	5.00
Net Changes in Cash and Cash Equivalent	(3.50)	(2.09)	(5.02)	3.56	(2.40)	7.01	(8.12)
Effect of Exchange Rates On Cash	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cash and Cash Equivalents - Beginning	14.60	11.10	9.01	3.99	7.55	5.15	12.16
Cash and Cash Equivalents - End	11.10	9.01	3.99	7.55	5.15	12.16	4.04

Source: Carbios accounts, Edison Investment Research

Contact details	Revenue by geography
Biopôle Clermont-Limagne 63360 Saint-Beauzire France +00 33 (0) 4 73 865 176 www.carbios.fr	

Management team

CEO: Jean-Claude Lumaret	Deputy CEO: Martin Stephan
Mr Lumaret has been CEO of Carbios since 2011. He has a degree in chemical engineering and is a French patent and trademark attorney for the EU. Mr Lumaret spent almost 30 years with Roquette Groupe, a leading participant in the French bio industry.	Mr Stephan is a graduate of HEC Paris (École des Hautes Études Commerciales) and has spent his career in the chemical industry with financial and business positions at Elf/Total and DuPont. He joined Carbios in February 2017.
Chief Scientific Officer: Alain Marty	**Chairman**
Professor Marty has been chief scientific officer at Carbios since 2015 after spending three years as a member of the company's scientific committee and scientific consultant. Professor Marty has a doctorate in biomechanical engineering from INSA Toulouse. His areas of interest include biotechnology, biocatalysis, enzymology, molecular engineering of enzymes and metabolic engineering	

Principal shareholders (source Carbios 26/7/19)	(%)
Truffle Capital	17.5%
Copernicus AM	9.0%
BOLD	5.6%
Michelin Ventures	4.5%
Holding Incubatrice Chimie	3.4%

Companies named in this report

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Frankfurt +49 (0)69 78 8076 960
Schumannstrasse 34b
60325 Frankfurt
Germany

London +44 (0)20 3077 5700
280 High Holborn
London, WC1V 7EE
United Kingdom

New York +1 646 653 7026
1,185 Avenue of the Americas
3rd Floor, New York, NY 10036
United States of America

Sydney +61 (0)2 8249 8342
Level 4, Office 1205
95 Pitt Street, Sydney
NSW 2000, Australia