EDISON

Carbios

Initiation of coverage

Disruptive technology for plastics' end of life

Alternative energy

Carbios leverages proprietary and unique enzyme-based technology for self-destruction and recovery of plastics. It addresses the issue of plastics disposal in the face of growth in demand for plastics driven by major global trends, as well environmental and sustainable solutions via break-through technologies for a circular plastics economy. Our fair value range is €23-37 per share, based on probability-weighted cash flows. Pilot production and licences are key next steps.

Year end	Revenue (€m)	PBT* (€m)	EPS* (c)	DPS (c)	P/E (x)	Yield (%)
12/13	0.9	(3.1)	(57.8)	0.00	N/A	N/A
12/14	0.7	(3.3)	(59.4)	0.00	N/A	N/A
12/15e	0.5	(3.6)	(78.6)	0.00	N/A	N/A
12/16e	0.4	(4.0)	(87.6)	0.00	N/A	N/A

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

New technology at the core of global growth

Carbios focuses on recycling and production of plastics. Its enzyme technology could enable full-time controlled biodegradation, biorecycling of some of the most widely-used plastics and bioproduction. As plastics are central to most sectors, Carbios is exposed to structural growth from some of the most important global mega trends: demographics, emerging markets, urbanisation, lifestyle and consumption patterns, nutrition and the environment. It benefits from tightening regulations for plastics disposal and a trend towards a circular plastic economy.

From research to commercialisation

Carbios develops innovative technology and targets industrial value creation. It looks to license new competitive technologies to industrial stakeholders and is about to enter a pre-industrialisation stage for its first process, a key step towards scale. Its blue-chip industrial partners may help achieve commerciality.

Financials: Pre-revenues

The company is currently at pre-revenue stage, ie its sole revenues derive from subsidies and grant funding. With €11m of cash and a controlled net cash burn of €3-4m, the company should be able to fund its activities until the research stages of its Thanaplast project are concluded in 2017. We note that Carbios needs to execute to that schedule and produce first licence revenues in 2018. Failure to do so would lead to additional funding requirements. If successful, the business model would be high margin and asset light.

Valuation: €23-37 per share

Given the early-stage nature of the company we have looked at different scenarios and used a DCF methodology. We derive a fair value range of €23-37 per share (WACC 20%). The current share price reflects our cash flow forecasts for the most advanced process (polyethylene terephthalate, PET) only, with an 18% chance of success. Pilot production and commercial licences will be key steps that could lead to a re-rating.

3 August 2015

Price	**€12.26**
Market cap	**€46m**

Net cash (€m) at December 2014	11
Shares in issue	3.75m
Free float	20%
Code	ALCRB
Primary exchange	Alternext Paris
Secondary exchange	N/A

Share price performance

%	1m	3m	12m
Abs	(5.3)	(2.2)	(12.4)
Rel (local)	(10.3)	(2.4)	(26.8)

52-week high/low	€14.1	€11.3

Business description

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

Next event

H1 results	September 2015

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Investment summary

Disruptive technology for plastics' end of life

Created in 2011 by Truffle Capital via the Green Chemistry Incubator Holding fund, Carbios raised €13.4m in its 2013 IPO. Carbios leads the Thanaplast consortium, which is made up of academic and industrial partners and has the objective of developing new technology for the biodegradation, biorecycling and bioproduction of plastics. It uses enzyme technology with the ultimate goal of creating a circular economy of infinite recycling of certain plastics and self-destruction of others. Specific enzymes degrade complex molecules and recover the original monomers followed by either biorecycling, bio assimilation of degradation products or the repolymerisation of monomers into new polymers. The company is focusing on four main processes: PET and rigid packaging for biorecycling, and production of plastic bags and mulching films for biodegradation. It is about to enter the pre-industrialisation stage on its first process. With a vast range of potential end-markets in packaging, agriculture and consumer applications, Carbios is positioned at the core of major global mega trends: emerging markets, demographic growth, urbanisation, changing consumer patterns, nutrition and the environment.

Valuation: €23-37 per share

Carbios is a very early-stage company. Its ability to produce the expected research results, scale up to pilot and later industrial production is highly uncertain, as is execution and success in securing commercial licensing deals. We have therefore examined a number of scenarios and applied a DCF methodology with probability-weighted cash flows. This results in a core valuation range of €23-37 per share. A reverse DCF based on our projected cash flows would suggest an 18% chance of success on PET and no value for any other process.

Financials: Funded through pre-revenue stage

The company is at pre-revenue stage. Current revenues are derived from subsidies and grants for the Thanaplast project, while the cost base consists essentially of R&D expenses. The first licence revenues are expected in 2018. Once the company reaches the commercial licensing stage, it should evolve into an asset-light and high-margin business. Carbios had €11m in cash at the end of December 2014, which should fund it through 2017 provided it continues to successfully control cash burn at a rate of no more than €3-4m pa, as targeted by management.

Sensitivities: Technology, execution and macro

As Carbios is developing disruptive technology, there is significant technology risk. This concerns lab success and proof of the technology throughout the processes, but also sensitivity on timing. The latter is crucial for the milestone and subsidies payments and thus the company’s ability to fund its operations. The next steps towards scaling up to pre-pilot and, ultimately, industrial scale are all substantial and entail technology and execution risk. There is also the risk of competing or substitute technology emerging while the company develops its processes. As the company is looking to develop a licensing model, its ability to source commercial deals will be key. Timing and the conditions of commercial agreements constitute significant risk. It will also be exposed to IP risk in this open JV structure. IP protection is at the core of long-term value; we note strong efforts for IP protection. Besides plastic prices, there is a strong sensitivity to the price of crude oil, from which conventional plastics are derived. Furthermore, due to consumer staples and discretionary end-markets, there is a strong correlation to the broader macroeconomic cycle. Regulation is an important sensitivity. Tightening regulations in relation to waste are supportive of the company’s business. The same holds true for broader policies on sustainability and climate change. Broader demographic factors are key and significantly influence the company’s long-term market prospects.

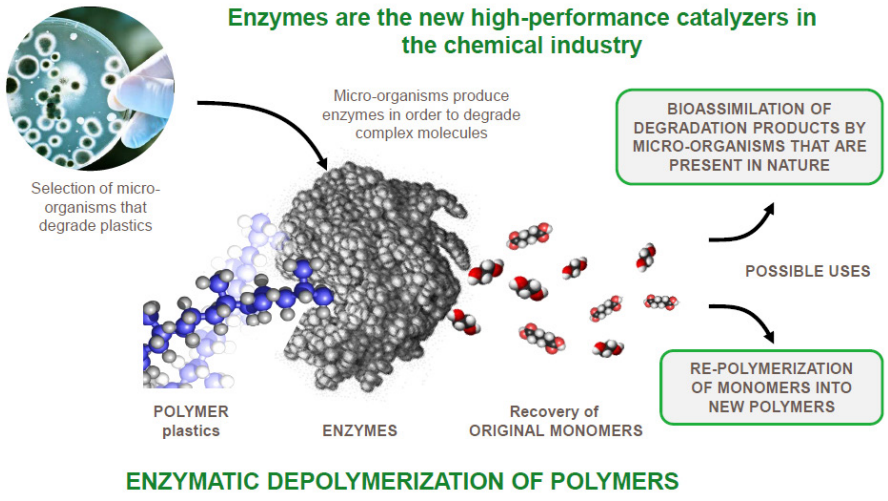
Disruptive technology for plastics' end of life

Carbios is active in value creation in plastics at the end of life. It develops biological processes that focus on the three main areas of biodegradation, bio recycling and biopolymerisation. In each process, its technology is the first of its kind. Carbios was founded in 2011 by Truffle Capital, via the Green Chemistry Incubator Holding fund. It raised €13.4m in its 2013 IPO. It is the leader of the Thanaplast consortium, which was set up as a bridge between research and industrial application. It is made up of Carbios and high-profile academic and industrial partners CNRS (the French National Centre for Scientific Research) and INRA (National Institute of Agricultural Research), as well as Limagrain and Barbier, the largest seed and fourth-largest plastics producer in Europe respectively. The company has also established co-operation with Suez Environnement, a major global environmental company. Thanaplast has the objective of developing biorecycling and biodegradation processes and production of biopolymers. It is scheduled to run from 2012 to 2017.

Linking research and industrial application

Carbios is an intermediary between research and industrial application in the field of plastics biodegradation, biorecycling and bioproduction. Since its IPO, it has built a laboratory and consolidated its business structures. The lab consists of enzyme production process development, and testing of plastics pre-series production. Research teams are in place and proof of concept for Thanaplast at lab stage has been delivered for biodegradation and bio recycling. The company's process is based on depolymerisation and subsequent repolymerisation through an enzyme-based process. Including enzymes as biocatalysts is a significant technological change to current industry standards. Enzymes that can break up complex molecules are selected. As enzymes are very specific, each plastic requires a specific enzyme. This means that plastic degradation and, eventually, reconstitution can be very precise. In the biodegradation process, the degraded products either undergo bio assimilation by natural micro-organisms such that they are absorbed without any impact, or they are repolymerised into new polymers for renewed usage. This is breakthrough technology: the plastics can be programmed to disappear completely after the end of use. Degradation can occur at ambient temperatures, which is another advantage. It is key to note that those monomers will exactly resemble the original virgin monomers in their characteristics. This is a crucial element for recycling, due to the possibility of reintegrating them into industrial processes and thus the viability of recycled plastics as a whole. One of the key targets and ultimate advantages is that the company is looking to offer a degradation process, the time span of which can be controlled. Eventually, this could create a circular economy of plastics.

Exhibit 1: Carbios enzyme technology for plastic degradation and recovery



Source: Carbios

Focus on plastics, an essential material

Plastics – at the centre of global mega trends

Plastics are used across a raft of end-applications and in virtually all industries. The world produces about 290Mt of plastics pa, with the value of the market exceeding US$400bn (source: FMI). Biodegradable plastics account for just 1% of the global total, ie c 665kt. By 2020, the global plastics market could exceed US$650bn, implying 8.5% CAGR. The global bioplastics market is at an embryonic stage and growing stronger, in the region of 28% pa (source: FMI), which could mean a US$43bn global market by 2025. Consumer products, automotive applications, bottling, packaging, food service and disposables are the key end-markets.

Correlation with macroeconomics and structural growth

Demand for plastics is strongly correlated with the macroeconomic climate. The 2008-10 crisis has led to stagnating and in some regions falling plastics volumes, but recovery in demand has been evident since 2013, according to data provided by PlasticsEurope. Through its focus on the plastics lifecycle, Carbios is driven by some of the big global mega trends: emerging markets, demographics and urbanisation – key themes for its applications in consumption as well changing lifestyle patterns, mainly concerning plastic bags and packaging, global food/nutrition (particularly mulching films) and the environment, as well as sustainability of the plastic economy.

Unsatisfactory solutions, tighter regulations favour alternatives

Plastics are characterised by very short usage, but very long length of life after disposal. About 40% of plastic has usage times of less than one year. Degradation can take anywhere between 200 and 400 years under natural conditions. The result is the serious issue of plastic waste disposal. Globally, 100Mt of recyclable waste is disposed of, only c 10% of which is currently recycled (source: PlasticsEurope). Growing volumes, environmental concerns and an increasing focus on sustainability are becoming ever more important challenges to conventional plastic market participants. Biological plastic production and recycling is the single most important aim of the industry as a response. The target is a circular economy whereby plastic is constantly reused and recycled.

Europe alone produces in the order of 2bn tonnes of waste per year. Waste recycling is governed by the EU Waste Directive, under which producers and holders of waste are responsible for management with regard to disposal, safety, recycling and/or recovery. European regulations on waste are constantly tightening. As far as plastics are concerned, the EU Commission is looking to significantly reduce the amounts of what it considers dangerous plastics, namely lightweight bags. At the moment, c 25% of plastic waste in Europe is recycled (Consultic). The rest is incinerated or landfilled. The EU is looking to end landfilling of recyclable and recoverable waste by 2020. By the end of 2015, the EU is expected to present a circular economy package, ie one that considers the economy of reusage and fosters recycling. Among other things, the EU draft proposal contains a recycling target of 80% of packaging waste by 2030, up from the current 50% by 2020.

Positioning at the core of plastics

Through industrial bioprocess based on enzymes, Carbios is active in three areas of plastic recycling and bioplastics production through its Thanaplast project:

- Biodegradation: Carbios develops self-destroying plastics. It believes its key differentiator is the inclusion of biological catalysers. Packaging is the most important application. Current solutions mostly offer only partial degradation and are largely unsatisfactory: Oxo-degradation is on the way to being banned in many places due to the substantial amounts of residual pollution it leaves. Furthermore, there is a requirement for high-temperature industrial composting.

Biomass-based biodegradation is very costly. Lastly, all methods lack an element of control. The company estimates its potential market at about €35bn. There are some major chemicals and biotech names active in the space, notably BASF and Limagrain.

- Biorecycling: the aim is infinite recycling of waste, thus obtaining a circular economy. Carbios targets PLA and PET recycling. It sees enzymatic depolymerisation as its key competitive advantage. Recycling processes that are currently used are expensive, due to sorting and process requirements, ie with regard to purity. There are also issues with toxicity of additives. Furthermore, these processes tend to lead to problems with the output product specification due to difficulties in removing additives as fragments are left. Lastly, it is impossible to recycle complex products made from different polymers. Further recycling, thus a circular economy, is impossible. In this space, the company competes with the major waste management names, eg Veolia Environnment, Suez Environnement, Derichebourg, but also focused plastic companies. Carbios's key differentiator is that the target polymers exactly resemble the original plastic. It believes the market potential could amount to €15bn.
- Bioproduction: the company's processes can lead to chemical-free production of plastics. It chiefly targets PLA, ie plastics production where the current processes are complicated and expensive. This could open a potential market of €2.5bn by 2025. Carbios's one-step bioprocess is the key advance in technology. The competitors active in the space come principally from the environmental industry. Biomass processes, (peripheral competition), lead to additional concerns over sustainability or about competition with nutritional applications. Additionally, biomass is subject to the challenge of scale procurement. Also, the characteristics of biopolymers are different from crude-based polymers and as a result unlikely to serve as a full replacement.

Carbios's process targets the key plastics markets, primarily those plastics with short-use life and a long degradation timespan, as well durable multi-usage plastics:

- **PET** (polyethylene terephthalate) is the most important and advanced near-term prospect. The market is primarily driven by plastic bottles. The world uses 50bn plastic bottles every year.
- **Plastic bags:** connected to global consumption growth, there are more 1tn plastic bags used per year globally (source: saynotoplastics.com). Associated waste volumes have become extremely difficult to manage due to the difficulties related to recycling and even current biodegradation processes. Some countries (eg in Northern Europe) have banned plastic bags altogether, others have imposed taxes. The EU is considering a full ban. However, paper alternatives bring other concerns (eg deforestation). There is currently no sustainable solution to the global plastic bag problem. Carbios is looking to shorten the lifetime of plastic bags and to biodegrade and assimilate them back into nature.
- **Compostable mulching films** are used for crop protection and crop optimisation, thus driven by global population growth and long-term trends in food demand. Global production volume is c 1.1Mt (source: EU DG Environment). Currently, films need to be either disposed of or sent to recycling at an additional cost to farmers.
- **Thermoformed trays and rigid packaging** for food packaging represent global volumes of c 1Mt pa and growth is connected to demographic trends. Carbios targets recycling.
- **PLA** (polylactic acid) is at an early stage, but the most advanced among bioplastics. It might eventually compete with PET. Global PLA production could reach 800kt by 2020, according to Nova-Institute, implying 18% pa growth. The company is developing processes for bioproduction of PLA.

From research to licensing

The company's process incorporates a well-defined sequence of stages. During the preliminary research stage, enzymes are selected and the processes developed to operate in a laboratory. This

is followed by pre-pilot and pilot development, where the company continues to develop and refine the processes. The last stage is industrialisation, whereby the company builds demonstration plants and eventually moves to industrial production with industrial, licensing or joint venture partners.

Carbios is following a partnership model, whereby it is looking for agreements with industrial partners and eventually to a licensing and concessions model. The company is developing all of its workstreams simultaneously, ie they are at development stages that are very similar to each other. This has the advantage of capturing greater synergies. Also, the effects of cross-learning shorten subsequent processes significantly. The company is now embarking on the pre-industrialisation stage and business development.

- Biodegradation has gone through most of the initial research and lab processes and is now entering the pre-pilot stage. Proof of concept has been delivered for an industrial and commercial polyester for a single-use flexible film, in which the speed of biodegradation can be controlled. This was at pilot scale and with an enzyme produced in large quantities. The company has further announced successful biodegradation of two more plastics and a further polymer. Following this success and other results, the company has applied for four new patents. It is now looking to produce first usable products based on the processes, in the first instance focused on packaging. Management expects pre-industrial production by 2016 and industrialisation from 2017.
- Biorecycling has reached the lab stage slightly later than biodegradation, but the time frame is identical, ie the company expects a pilot process by 2016 and industrialisation one year after that. It recently announced that it had achieved depolymerisation of 90% of commercial PLA plastics in a time frame of 48 hours.
- Biopolymers are still in the lab stage. The company expects to enter the pre-pilot production stage this year and a first pilot from 2017.

It is worth noting that the company only relies on collaborative research for biodegradation, whereas it also acquires third-party know-how and patents for the other two processes. There will eventually be a difference in margins achieved, but we see the impact as minor against overall potential growth once the company reaches its later stages. It has the benefit of producing a greater knowledge base, increasing the chance of success and speeding up the research process. The following steps are key for industrialisation: the company is targeting pre-industrial production of biodegradable plastics under time-controlled conditions. It will also drive forward the development of a pre-industrial PLA recycling process. The recent announcement of first success in that process is therefore encouraging. Carbios is also looking to develop a pilot process for enzyme production and to start pilot plastics production at the lab.

Astute management of knowledge and IP

Carbios has a well-constructed model for its research, expansion and financing. It works with partners to maximise results and impact, but keeps its IP very closely to its core. The company has partnerships with academic laboratories. Carbios receives global exclusivity for industrial and commercial uses on any patent achieved. At the end of 2014, the company had 12 active patent applications. The company has chosen high-profile industrial partners, such as Suez Environnement and Deinove. With this approach, it should be able to expand quickly once its processes reach the required maturity. Industrial partners can potentially provide financing support, technical expertise, but also reduction of risk as the company moves from very small scale through the crucial steps of expansion. Last but not least, there is a commercial benefit, in that the company's industrial partners may enhance credibility for later licensing and industrialisation deals, and become instrumental in successful commercialisation.

Capital-light business model through licensing

Carbios is looking to develop a licence-based business model once it reaches the industrialisation stage. It will conclude concession or licensing agreements whereby partners receive exclusive rights for specific areas of an application. Based on typical structures, we see Carbios receiving a lump sum in the order of 5-10% of project NPV, as well as royalties of 3-5% of revenues. Under a different, yet similar model, the company will enter into joint ventures with licensing partners. Again, it will grant exclusivity on specific applications. Additionally, it will receive royalties and a share in operating revenues. One great advantage of Carbios's technology is that it can be integrated into existing industrial processes and does not require new fab build, which should be helpful for commercial success.

Management and governance

The CEO, Jean-Claude Lumaret, has a scientific background in chemical engineering. A chemical engineer, he also has a track record as a patent attorney, in the EU and elsewhere. His experience includes over 30 years in senior functions with Groupe Roquette, one of the leaders in the sector in France. The director of strategy and development, Emmanuel Maille, has a scientific background in biochemistry and is also an entrepreneur with previous start-up experience. His academic background is in biotechnology, enzymology and metabolic engineering. He has worked in the biotechnology sector since 2011. The chief science officer, Alain Marty, is a highly recognised professor in biotechnology, enzymology and bioengineering. He has produced cutting-edge research and combined it with industrial application. He had high profile academic responsibilities, with INSA Toulouse and INRA.

Carbios has a board of advisors and a four-member scientific advisory board. The high-profile members are known for their expertise in the polymers sector. The board comprises former senior managers in the pharma sector, finance and industry, and an award-winning writer turned reporter and sustainability advisor who was an advisor to former President Mitterand. All have held senior positions in blue-chip companies and/or major public institutions. We sense there is a good mix of specific expertise in the pharma, biotech and food sectors, as well as financial knowledge and broader impact on society. There is one woman on the board, who also heads up the scientific advisory board.

Sensitivities

Technology and execution

The company is at a very early stage of developing new and potentially disruptive technology. Technology risk is still high. There are risks around lab success and proof of the technology throughout the processes, and sensitivity on timing. Production of a large quantity of enzymes is a major technological challenge. Later than expected success could lead to delays in milestone or grant payments or other financial support and have a material impact on the company's ability to fund its operations. Beyond pure scientific risk, execution risk must not be underestimated. The company is very close to moving to new scale. The step from lab stage to industrialisation is a substantial one. The organisms with which it deals are very sensitive and taking processes to much greater scale undoubtedly entails risk and requires careful management. Beyond that, the key risks lie in process stability, industrial management and execution of expansion. Once the financing of the Thanaplast project has been concluded in 2017, Carbios may need to find alternative sources of financing, which could lead to interest rate risk and risks related to the availability of financing. The same could occur earlier, if expenses rise above expectations.

Commercial, licensing and IP risk

Carbios's long-term business model is built on a commercial licensing structure, for which management will need to be able to source licensing deals. Its industrial and financial partners should help with credibility and commercial support. We have seen other cases where industrial partners became licensing partners. However, investors should be aware of significant risk relating to the ability to conclude deals, as well as timing of first deals. Last but not least, licence conditions may vary greatly and deviate significantly from initial expectations. Beyond that, the licensing and joint venture/partnership model is a very open structure. IP protection is at the company's core and crucial for long-term value. We note strong effort and active patent filing, but patent enforcement will be just as important. Value could decrease significantly if there is a perception that IP enforcement will be a challenge. Furthermore, although it is a minor consideration at this stage as patents typically last for 20 years and R&D is very active, we note long-term sensitivity to generic competition.

Macro, commodity and regulatory sensitivities

Plastic is a very large global market with various degrees of economic sensitivity but, broadly speaking, long-term revenues will be sensitive to the economic cycle. There is some mitigation from the structural growth in packaging. Nevertheless, as a consumer end-market, packaging is affected by broader macro conditions. As the company widens its applications, it will diversify, but will also increase its sensitivity to cyclical variations. End-product commodity prices, ie plastics prices for new and recycled product, are further sensitivities. These have in the past shown great variability. Recycling will be a growing swing factor and potentially become a market. It is also worth noting that we would expect sensitivity to primary energy commodities, as with all underlying conventional plastics. All of these concern the long term, as the prime value driver is currently operational progress. There could be sensitivity to regulatory measures. In the first instance, there may be a positive impact from stricter waste regulations. Greater focus by policy makers on waste may lead to enhanced incentives for waste recycling, particularly plastic as a result of its strong growth. Demographic factors play a key role in the growth of packaging: We do not see major reversal, but it is worth bearing in mind that lifestyle and consumption patterns have the potential to change.

Competition

The company is engaged in the early stages of very new technologies. At this stage, there is no direct competition, and Carbios has a patent monopoly on the core enzyme technology. It is possible that other competing technologies may emerge, which could become competitors or even full substitutes to Thanaplast. Current granule-based recycling technologies all require sorting. The growth in lower-cost oil and gas resources, primarily in North America, but also elsewhere, is a competitive disadvantage for the bio-based plastics sector. Cheap conversion cost in China has led to the build-up of conventional recycling capacities, which compete on a lower cost base, sometimes even marginal costs. The company will need to ensure it can develop a process that will be competitive in the face of such long-term structural challenges. In bioprocesses, there is oxo-degradation and biomass-based degradation (see above). These processes are currently unsatisfactory. Bioplastics from competitive bio-based feedstocks from Brazil are a very small part of the market, and do not have comparable degradation characteristics. Braskem, the largest Latin American petrochemicals company, Dow Chemical and ADM are active here. Other bacterial processes tend to be focused on the production of olefins (a prime constituent), but not degradation or recycling. Intense focus and scientific progress could lead to renewed competition from such processes, which could come from small participants, as well as the adoption of processes by large global waste management companies. Progress on incineration by traditional operators could be another source of competition.

Valuation

Methodology

We have valued Carbios on the basis of its different potential end-markets, the most important of which are PET and PLA. As it is a very early-stage company, the size as well as the timing of its future earnings and cash flows is highly uncertain. Success in the next stages of development, commercial execution, market adoption and levels of cash flow generation are all important moving targets. We find a DCF methodology the most appropriate method. We note that sizeable cash generation occurs at a late stage in our valuation horizon. We have therefore applied probability weights to the company's long-term cash flows. We model cash flows out to 2030 to reflect reasonable maturity. Our core WACC is 20% (risk free rate of 4.5%, 15% risk premium).

Core valuation range €23-37 per share

We have valued the company based on its market potential for the most advanced processes (ie plastic bags, films, rigid packaging, PET and PLA). For each we have assumed initial licences shortly after the process moves to the industrial stage. We have based the company's market potential on our current view and management's expectations of potential market sizes and achievable market share. After initial sharp acceleration, we model revenues in the most important markets to grow 15-25% on average. Our terminal value includes 5.5% long-term real growth. We apply varying royalty rates, based on management's expectations of 3-5%, the size and concentration of the market, as well as the maturity of the processes and chance of success. Our assumptions are shown in Exhibit 2 below. Using this approach, we derive a core valuation of €33.0 per share.

Exhibit 2: Valuation assumptions

	Global market (Mt)	Market share	Achieved by	Royalties
PET	14	50% of 15% addressable market	2027	5.00%
Plastic bags	12	30% of 10% addressable market	2027	3.50%
Films	1	50% of 50% addressable market	2030	3.80%
Rigid packaging	1	30% of 15% addressable market	2030	2.50%
PLA	0.72	50% of 30% addressable market	2029	2.50%

Source: Edison Investment research

Unsurprisingly, PET and plastic bags account for the largest share of overall value, given that these are the prospects with the highest chances of success in our view.

Exhibit 3: Core DCF valuation at WACC of 20%

Cash flow weights		WACC	20%	EV
Probability weight PET	50%	PV of FCF	€m	68.3
Probability weight Plastic bagsPackaging	5%	PV of TV	€m	48.7
Probability weight Films	25%	EV	€m	117.0
Probability weight Rigid packaging	5%	Net debt (Dec 15)	€m	7.8
Average	21%	MV	€m	124.8
		€/share (3.75m shares)		33.0

Source: Edison Investment research

Because of the early stage and uncertain nature of cash flows, we have flexed the assumptions underlying our long-term cash flows, namely market share and royalty rates. The table below shows the sensitivity of our valuation to changes in these assumptions across the board by the same proportion.

Exhibit 4: Valuation range for key sensitivities (€/share)

Market share avg. vs core assumption	-25%	+25%	Royalty rate vs core assumption	-50%	+50%
WACC 15%	48	69	WACC 15%	38	79
WACC 20%	23	21	WACC 20%	18	37

Source: Edison Investment research

A reverse DCF using our forecast cash flows suggests the share price reflects PET only, at an 18% chance of success. As the company progresses through its development stages and delivers proof of execution, there is the potential for cash flows to de-risk and our valuation to increase. Specifically, evidence of the technology being brought to scale will be key. We see the move to pilot production and progress on first commercial licences as near-term key steps.

Financials

Earnings: Pre-revenue

Carbios is a pre-revenue company. For the next few years while the company is still in the research and development stage, earnings will be characterised by revenues derived from grant funding. The cost base is made up of R&D expenses. As the company progresses through the various stages towards industrialisation, R&D expenses will accelerate. However, we expect the company to deliver a stable level of operating losses as it brings research in-house and continues to have a strong focus on cost control. Carbios benefits from French R&D tax credits, which we expect to remain as a loss-reducing factor until at least the end of the Thanaplast project funding in 2017. When the company eventually reaches the stage of signing commercial licences, it should be characterised by continued R&D expenses – to consolidate its competitive advantage – but most importantly, by an asset-light and high-margin business as revenues should accelerate quickly.

Cash flow – controlled cash burn

Carbios had € 11m of cash at the end of 2014. The company burns about €3-4m per year, with which management expects to be able to fund the next activities through to the end of 2017. For the central case, our forecast supports this outlook. For the end of 2016, we forecast net cash of €4.4m. It is crucial that progress on the research results and execution development through the various stages occurs according to the grant time frame, as otherwise alternative financing requirements would arise. When the company gets to the licensing stage it should be highly cash generative as we expect the bulk of capex to be borne by its industrial and joint venture partners.

Balance sheet

The company's prime source of funding is subsidies and grants for the Thanaplast project. Carbios has obtained reimbursable grant funding from BPI France for a total of €3.7m, payable on the basis of milestones as the project progresses. Investors should note that grant/subsidies funding will finish with the end of the Thanaplast grant schedule in 2017. The company will then need to generate first licence revenues or may require alternative funding. Carbios has committed to reimbursement of €4.5m (at a discount rate of 2.67%) once it has achieved revenues of at least €10m, under a five-year time frame.

Exhibit 5: Thanaplast funding (€000)

Year	2012	2013	2014	2015e	2016e	2017e	Total
Milestone		**First results of collaborative research**	**Transition to lab stage of research**	**Transition to pre-pilot stage**	**Pilot stage**	**Achievement of industrial phase**	
Subsidies	709	923	322	388	300	466	3108
Advance	644	879	860	625	143	566	3707
Total	**1353**	**1802**	**1182**	**1013**	**443**	**1032**	**6815**

Source: Carbios

Exhibit 6: Advance reimbursement schedule (€000)

Year	1	2	3	4	5	Total
Amount reimbursable	300	500	800	975	1,950	**4,525**

Source: Carbios

Exhibit 7: Financial summary

Year end 31 December	€'000s	2013	2014	2015e	2016e
		IFRS	IFRS	IFRS	IFRS
PROFIT & LOSS					
Revenue		900	664	508	410
Cost of Sales		(3,164)	(2,912)	(2,766)	(2,822)
Gross Profit		(2,264)	(2,248)	(2,258)	(2,412)
EBITDA		(3,077)	(3,283)	(3,488)	(3,895)
Operating Profit (before amort. and except.)		(3,116)	(3,364)	(3,577)	(3,993)
Intangible Amortisation		0	0	0	0
Exceptionals		0	0	0	0
Other		0	0	0	0
Operating Profit		(3,116)	(3,364)	(3,577)	(3,993)
Net Interest		(14)	48	0	2
Profit Before Tax (norm)		(3,130)	(3,316)	(3,576)	(3,991)
Profit Before Tax (FRS 3)		(3,130)	(3,316)	(3,576)	(3,991)
Tax		961	1,090	631	704
Profit After Tax (norm)		(2,169)	(2,226)	(2,946)	(3,287)
Profit After Tax (FRS 3)		(2,169)	(2,226)	(2,946)	(3,287)
Average Number of Shares Outstanding (m)		3.8	3.8	3.8	3.8
EPS - normalised fully diluted (c)		(57.8)	(59.4)	(78.6)	(87.6)
EPS - (IFRS) (€)		N/A	(0.6)	(0.8)	(0.9)
Dividend per share (c)		0.0	0.0	0.0	0.0
Gross Margin (%)		N/A	N/A	N/A	N/A
EBITDA Margin (%)		N/A	N/A	N/A	N/A
Operating Margin (before GW and except.) (%)		N/A	N/A	N/A	N/A
BALANCE SHEET					
Fixed Assets		243	1,048	1,337	1,642
Intangible Assets		72	130	130	130
Tangible Assets		14	740	1,029	1,334
Investments		157	178	178	178
Current Assets		16,113	12,684	9,533	5,897
Stocks		0	20	61	116
Debtors		1,401	1,402	1,336	1,063
Cash		14,598	11,099	7,973	4,556
Other		114	163	163	163
Current Liabilities		(1,110)	(196)	(279)	(236)
Creditors		(1,110)	(196)	(279)	(236)
Short term borrowings		0	0	0	0
Long Term Liabilities		(680)	(474)	(474)	(474)
Long term borrowings		(457)	(152)	(152)	(152)
Other long term liabilities		(223)	(322)	(322)	(322)
Net Assets		14,566	13,062	10,116	6,829
CASH FLOW					
Operating Cash Flow		(1,532)	(3,128)	(2,749)	(3,017)
Net Interest		(14)	48	0	2
Tax		0	0	0	0
Capex		(187)	(867)	(378)	(403)
Acquisitions/disposals		0	0	0	0
Financing		13,500	546	0	0
Dividends		0	0	0	0
Net Cash Flow		11,767	(3,401)	(3,126)	(3,417)
Opening net debt/(cash)		(2,374)	(14,141)	(10,947)	(7,821)
HP finance leases initiated		0	0	0	0
Other		0	207	0	0
Closing net debt/(cash)		(14,141)	(10,947)	(7,821)	(4,404)

Source: Carbios accounts, Edison Investment Research

Contact details

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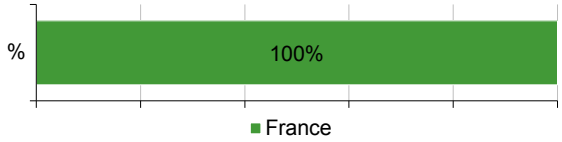
Revenue by geography



Management team

CEO: Jean Claude Lumaret

Mr Lumaret is a scientist and lawyer by background, with particular experience in patent law. He was previously at Metabolic Explorer. His career includes 30 years at Groupe Roquette, a leader in the sector.

Director of strategy and development: Emmauel Maille

Mr Maille has a scientific background in biotechnology and enzymology. He has also been a business development consultant in the biotech sector. He also has experience as an entrepreneur in the sector, as the founder of Proteaxis.

Chief Science Officer: Alain Marty

Dr Marty is a professor of biotechnology and holds a doctorate in bioengineering. His academic background is from INSA Toulouse and INRA.

Principal shareholders	(%)
Truffle Capital/ Green Chemistry Incubator	76.4%
Deinove	2.8%

Companies named in this report

Suez Environnment (SEV.FP), Veolia (VIE.FP), Deinove (ALDEI.FP), Metabolic Explorer (METEX.FP)