possibly in an exclusive agreement, without carrying out research and development activities on its own – which might not be a core business or even outside the competencies of the company. For the smaller player, usually the technology owner, such partnerships bear the advantage that it has a strong financial partner at its side that enables the scale-up of operations and potentially brings in operational expertise.

1.5 Financing the renewable chemicals industry

For young companies, an initial public offering (IPO) is one of the attractive options when it comes to gathering funds. The rationale behind going public is simple:

1. investors from early financing rounds want to see funds coming in.
2. money paid by investors to a company that is first listing its securities on a public exchange goes directly to the company. This is in contrast to later trade of shares where investors pass money between each other rather than to the company.
3. companies want to tap a wide pool of investors that will provide the funds for working capital, capacity expansion projects, repayment of debt or, more generally, future growth.

In 2010 and 2011, there were several IPOs from companies in the renewable chemicals sector (stock information is provided in the table below). The most interesting figures are given in the column on the far right, which quantify the change in stock value since the launch, based on the settlement price on February 28, 2013. In all six cases, the stock value at the end of February was hovering just above all-time lows. None of the companies considered performed well when measured with stock development. There are, of course, specific reasons for the weak performance of every individual company, but in a nutshell: revenues and corporate development, that is mostly scale-up, are behind target. Another factor that has played a role is the global economic uncertainty that spurs risk aversion. Solazyme fared best – although not well – which is likely rooted in the fact that the company has actually been generating revenue from product sales since 2011 with its tailored algae oils.

<table>
<thead>
<tr>
<th>Company</th>
<th>Launch Date</th>
<th>High Price ($)</th>
<th>High Date</th>
<th>Low Price ($)</th>
<th>Low Date</th>
<th>Current* Price ($)</th>
<th>Change since launch (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solazyme</td>
<td>May 27, 2011</td>
<td>20.71</td>
<td>Jul 12, 2011</td>
<td>27.03</td>
<td>Nov 26, 2011</td>
<td>6.49</td>
<td>-57.8</td>
</tr>
<tr>
<td>Codexis</td>
<td>Apr 22, 2010</td>
<td>13.26</td>
<td>Apr 26, 2010</td>
<td>14.45</td>
<td>Nov 15, 2012</td>
<td>2.03</td>
<td>-84.4</td>
</tr>
</tbody>
</table>

* Feb 28, 2013  All values are settlement prices.
Source: NASDAQ, Toronto Stock Exchange

After a wave of IPOs in the renewable chemicals space could be witnessed until late 2011, it has become fairly quiet in subsequent months. Early in 2012, the pipeline for IPOs was still full, but in the course of the year at least four companies have cancelled their stock market launch, while others have delayed it due to unfavourable market conditions. So not only investors, but also players are in a wait-and-see mode. Several companies have not retracted their IPO filings though, including succinic acid producers BioAmber and Myriant.
To support the transformation of the palm oil sector, the Trade Ministry in September 2011 effectively halved the export duties on refined palm oil to half those then levied on CPO. It lowered the ad-valorem export tax on palm oil in products to 13% from 25%. Additionally, the minimum tax on CPO exports rose to 7.5% from 1.5% while the maximum rate for CPO fell to 22.5% from a previous 25%, effective October 1, 2011. The reference prices for the monthly-set, floating export rates are calculated based on cif Rotterdam prices, Malaysian benchmark and Jakarta futures prices. Previously, the average spot CPO price for Rotterdam in the preceding 30 days was used as a reference price at the meetings between the Trade Ministry and industry officials.

Indonesian coco palm growers partly export their nuts. There are fears from the food industry, which processes the local production, of a decline in supply. Food producers have proposed to the Ministry of Trade the introduction of a 30% coconut export tax or IDR200-300 per coconut.

2.3.5.2 Malaysia

Supply

Malaysia is the second largest palm oil supplier in the world after Indonesia. Until the middle of the last decade, it was the main CPO producer. However, unlike Indonesia, supply expansion in Malaysia mainly depends on yields as the area is limited after some expansion in fertile East Malaysia in the last decade. This means the age profile of Malaysia’s oil palm plantation is the key determinant for the CPO output, while in Indonesia the supply side is able to react to attractive prices with area expansion.

The oleochemical industry in Malaysia started in the early 1980s. The industry comprises both local players and several joint ventures with multinational companies. Since the early eighties, the industry expanded rapidly and today the Malaysian oleochemical industry is one of the largest worldwide, accounting for 20% of the global capacity. It mainly processes indigenous CPO.
criteria and chain of custody are complied with. High standards regarding sustainability and chain of custody cannot be efficiently implemented if appropriate monitoring mechanisms are missing. Governance can be differentiated in the quality of the implementation of a standard and the quality of verification. Standardized reporting requirements prescribed by indicators and checklists, risk management and the integration of different stakeholders in the standard development, for example, evaluate the quality of implementation. The quality of verification is measured by the type, frequency and independence of the audit as well as the education and training of auditors.

3.1.5.3 Certification systems available for chemical materials

In order to evaluate the performance of existing certification systems in the dimensions described above, a panel of eight certification systems has been compiled. The evaluated schemes include the six multi-stakeholder schemes Bonsucro, International Sustainability and Carbon Certification (ISCC), Roundtable on Sustainable Biofuels (RSB), Roundtable for Responsible Soy (RTRS), Roundtable on Sustainable Palm Oil (RSPO) and NTA 8080 as well as the two industry schemes Biomass Biofuels Sustainability voluntary scheme (2BSvs) and REDcert. All evaluated schemes are recognized by the European Commission. Within the panel, the coverage of the EU RED minimum requirements and further environmental and social issues, the type of chain of custody and the mass balance period has been evaluated. As for companies, the market experience and costs of certification are also of importance, additionally the number of scheme users has been included in the evaluation.

For the time being, five multi-stakeholder schemes are available, which are recognized by the Commission. They include agricultural producers, processing industries, traders, research and non-governmental organizations in their standard-setting. Bonsucro is a multi-stakeholder system for sugarcane production. The focus lies especially on South America. 27 of the 32 certificates were issued in Brazil. Until now most of the certificates for the cultivation of raw materials are issued under the Bonsucro EU standard. Thus, it can be assumed that most of the certification is done for raw materials entering the European market. Today, only two certifications under the general Bonsucro production standard were issued in Australia.

The ISCC is a global multi-stakeholder scheme for all kinds of biomass and end uses. It has been operational for several years and the market coverage and acceptance of ISCC is already very high. In the two years to 2012 about 1,800 certificates have been issued in 70 countries. Under ISCC PLUS, raw materials for other applications including chemical applications can also be certified. Until now, twelve ISCC PLUS certificates have been issued, of which five were issued within the bioplastics sector.

The NTA 8080 standard is the result of the Dutch project group “sustainable production of biomass”. It is an international standard; however, with a clear focus on the use of biomass and biofuels for energy. Until now, 20 certificates have been issued to Dutch companies.

The RSB is the second global multi-stakeholder standard for all kinds of biomass, which can be used for biofuel markets and other supply chains. Until now, two certificates were issued, both of them in the biofuels market.
done in the melt or as a solution, where short oligomeric units are combined to give a high molecular weight polymer strand. Even higher molecular weights can be attained by crystallizing the crude polymer from the melt.

The annual production capacity for PLA is about 315,000 tonnes, with one producer in the United States, NatureWorks, operating nearly half of that.

1,4-butanediol (BDO) is a colourless viscous liquid derived from butane by placement of alcohol groups at each end of the chain. It is one of four stable isomers of butanediol. There are several conventional industrial routes to BDO including an acetylene-based process, a multi-step acetylene-free process based on propylene oxide and from maleic acid via hydrogenated methyl maleate ester. Other routes are from butadiene and allyl acetate. In the renewable chemicals industry, BDO can be produced from carbohydrates via fermentation. San Diego-based Genomatica has engineered an *E. coli* to metabolise BDO from sugars. BDO is used as a solvent or in the manufacture of some types of plastics, elastic fibres and polyurethanes.

The bulk of current production volumes come from conventional routes. Genomatica is operating a 13,000 tonnes-per-year plant together with Tate & Lyle in the United States, while global capacity from renewable source can be expected to increase significantly over the coming years with projects in Europe, the Americas and Asia coming on stream. While most of the capacity building is based on first generation feedstocks, a couple of projects do focus on the production of BDO from cellulosic biomass.

Polybutylene succinate (PBS) is one of the most talked about polymers in the renewable chemicals industry. It is synthesised from succinic acid and BDO and can therefore be not bio-based at all or partly bio-based and even completely bio-based, depending on how the precursors are obtained. PBS can be used as a matrix polymer – on its own – or as a modifier, blended with other polymers. It commonly finds application in food packaging, consumer goods, textiles, mulch film, etc. as it is heat resistant and flexible. A few projects are underway to build large scale PBS operations on the basis of renewable feedstocks, although these are first generation feedstocks for the time being.

1,3-propanediol (PDO) is a three-carbon diol. It is a colorless viscous liquid that is miscible with water. PDO is conventionally obtained by the hydration of acrolein or by the hydroformylation of ethylene oxide to give 3-hydroxypropionaldehyde. The aldehyde is hydrogenated to yield PDO. There are, however, also two routes in the renewable chemicals space: first, glycerol can serve as the substrate to which *Clostridium diolis* bacteria and *Enterobacteriaceae* are applied. Second, corn syrup or dextrose can be converted into PDO using a genetically engineered strain of *E. coli*. Today, PDO is used as a building block in the production of polymers such as polytrimethylene terephthalate, but it can also be formulated into a variety of industrial products such as adhesives, solvents, coatings, (co)polymers or antifreeze agents.

Production capacity based on renewables is still small. DuPont Tate & Lyle BioProducts operates a plant in Tennessee, which currently has a capacity of about 64,000 tonnes per year.

Polyhydroxyalkanoates (PHA) are bio-based linear polyesters that are produced through biosynthesis, in particular through bacterial fermentation. The group comprises more than 150 monomers. There is no chemical synthesis involved, which differentiates it from other renewable polymers like PLA. The synthesis of PHA results in one of the two types PHA SCL or PHA MCL. The former is from hydroxy fatty acids with