

Thin Film Electronics

Game-changing NFC technology

Forecast changes

Tech hardware & equipment

1 July 2014

Price **NOK4.79**

Market cap **NOK2,285m**

NOK6.00/\$

Net cash (NOKm) as at 31 December 2013 266.4

Shares in issue 476.9m

Free float 67%

Code THIN

Primary exchange Oslo

Secondary exchange N/A

Share price performance



% 1m 3m 12m

Abs (13.5) 0.0 89.3

Rel (local) (15.2) (6.2) 50.3

52-week high/low NOK6.5 NOK2.5

Business description

Thin Film Electronics (Thinfilm) commercialises printed electronics and owns key patents for printing rewritable, non-volatile memory and printable NFC circuits. It also licenses technology from others to develop complete printed systems.

Next events

H1 results 15 August 2014

Analysts

Tom Grady +44 (0)20 3077 5767

Katherine Thompson +44 (0)20 3077 5730

tech@edisongroup.com

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In the last 12 months Thinfilm has moved from a company developing its core memory based products to one that has demonstrated wireless temperature sensors and received the first commercial orders for its EAS and brand protection products. This transformation is in part thanks to the acquisition in January of Kovio, whose NFC technology was integrated with Thinfilm's temperature sensor in only four months and whose relationship with Nedap helped generate the first EAS product sales. While these developments mean the company is in a significantly stronger position than at the time of our initiation last year, we have increased the contingency in unit sales to de-risk forecasts and as a result our base case valuation falls from NOK19.10 to NOK17.03.

Year end	Revenue (NOKm)	PBT* (NOKm)	EPS* (NOK)	DPS (NOK)	P/E (x)	Yield (%)
12/12	3.8	(42.0)	(0.13)	0.00	N/A	N/A
12/13	11.5	(63.3)	(0.15)	0.00	N/A	N/A
12/14e	42.1	(93.0)	(0.20)	0.00	N/A	N/A
12/15e	153.8	(100.6)	(0.21)	0.00	N/A	N/A
12/16e	1,080.7	56.8	0.12	0.00	39.9	N/A

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

Two-year acceleration of NFC development

The acquisition of Kovio's printed NFC assets for \$1m shares and \$2.7m cash has accelerated Thinfilm's NFC development roadmap by two years. It provides the company with key IP, which completes the company's platform IP in printed logic and printed memory. We expect NFC to be one of the key differentiators of Thinfilm's products and therefore the integration of Kovio's NFC technology with Thinfilm's temperature sensor in only four months is a big step forward in bringing high-value wireless sensor products to market.

Licensing model allows rapid growth with low capex

The milestone to look out for over the coming six months is the announcement of licencees signing up or joint ventures being formed with manufacturing partners. This is a key requirement for Thinfilm to reach its revenue forecasts as it minimises the capital outlay required and allows more scalable growth, which a single company would struggle to achieve by itself.

Valuation: Significant upside on bull and base case

We have reduced our FY15 revenue forecast from NOK253m to NOK154m, primarily due to a shift in assumed product and licensing mix. Despite this reduction we believe Thinfilm is in a strategically stronger position since our [initiation](#) thanks to its acquisition of Kovio and commercial orders for three product families: Thinfilm Memory, Sensor Labels and Wireless Systems. The base case and slower adoption scenarios (NOK17.03 and NOK7.03 respectively) remain significantly above the current share price. The slower adoption scenario assumes lower unit sales of smart labels and a long-term EBITDA margin of 40% vs 50% in the base case.

Thin Film Electronics is a research client of Edison Investment Research Limited

Investment summary

Company description: Leader in printed electronic systems

Thin Film Electronics (Thinfilm) owns key patents for printing rewritable, non-volatile memory and licenses technology from others to develop complete printed systems. The acquisition of Kovio's NFC assets brings it additional key IP for printed NFC circuits and illustrates its willingness to acquire further IP. The printed systems are intended to provide low-level processing to a wide range of products and applications. Thinfilm is initially targeting the high-volume, low-cost packaging market with brand protection and authentication products followed by smart tags that can be used as a platform for a variety of sensor inputs (up to 20 types of printed sensors are already available from a number of manufacturers). Thinfilm has already demonstrated an NFC-enabled wireless temperature sensor (see video demonstration [here](#)) only four months after acquiring the NFC technology from Kovio. Longer term there is the potential to create a wide range of low-cost intelligent devices for a variety of applications. Thinfilm's strategy is to demonstrate what can be made by establishing in-house production capacity before licensing the technology to customers.

Financials: First licensing revenue expected in FY15

We forecast unit sales of c 35m labels (across all products) in FY14 increasing to c 11bn in FY20. Announcements of JVs or licensing partners are expected in FY14 with first licensing revenues in FY15. Weighted average ASP is expected to increase from 7c per tag in FY14 to 17c per tag in FY20 as more advanced and therefore higher-value tags are produced. Forecasts have been updated to account for the Kovio acquisition and updated product mix assumptions. We have also assumed negative contribution per unit from product sales in 2014 gradually moving to 60% in 2020 compared to our previous forecasts of flat 60% margin to more realistically reflect the cost structure as manufacturing moves to scale volume. The lower unit sales and slower assumed ramp-up of output from licensee facilities means our new licence revenue forecasts for FY15 are 96% lower. Cash balance remains strong with NOK266m (\$45m) as at 31 December 2013, but further funding may be required for extra production facilities depending on the rate of JV formation and licensee sign-up.

Valuation: Base case NOK17.03; slower adoption NOK7.03

We have reconstructed our model to take into account the extended product range and new commercial announcements. The main difference to our previous model is lower unit sales of brand protection products as a result of lower than expected product orders and a shift towards smart labels including NFC. Using WACC of 15% and terminal growth of 3%, our base case DCF produces a valuation of NOK17.03. Our slower adoption scenario produces a valuation of NOK7.03. Base case assumes 3bn smart label sales in FY20 (11bn total); with 50% EBITDA margin slower adoption scenario assumes 1bn smart labels (9bn total) at 40% EBITDA margins.

Sensitivities: Licensing model yet to be proven

Execution risk – given the early stage of development and the fact that Thinfilm is effectively creating its own market, there is a high degree of uncertainty over the unit sales, ASPs and margins that can be achieved and therefore there is a wide margin of error in estimates. **Technology development** – Thinfilm has accomplished significant technical developments over the last nine months, but a significant amount of development work remains and therefore there is a risk that some products may prove to be unviable. **Reliance on partners and suppliers** – the electronic inks that Thinfilm uses are produced externally and while Thinfilm has close relationships with its partners and suppliers it is possible that those partners may withdraw their support or put pressure on margins.

Company description: Printed electronic systems

Thinfilm is the market leader in developing printed electronic systems. The printing techniques used are similar to the traditional processes used to print books, posters, packaging and other types of high-volume items, but special inks with electrical properties are used. These inks can be used to print simple batteries, logic, displays and various other electronic components. Thinfilm owns key patents for printed non-volatile memory and NFC and is developing fully printed systems by licensing other components from third parties. It is the only listed pure-play printed electronics company. It is still at a relatively early stage of development, so most revenue comes from joint development programmes, technology access fees and grants, but product sales are expected to increase significantly over the next year, with first licensing revenues being recognised in FY15.

High-volume, disposable electronics

Thinfilm has production facilities in Linköping, Sweden and Silicon Valley in the US. Production capacity depends on the type of product; Linköping and Inktec have capacity of 200m and 100m brand protection labels respectively (production can be moved to different products if required). The facilities acquired from Kovio in San Jose can currently produce up to 100m EAS or 20m NFC barcodes. However, this capacity could be increased with some capital expenditures and process improvements. The key benefits of the ability to print electronics using traditional printing techniques is the significant reduction in production costs, the very high production volumes that can be achieved and the fast design turnaround time compared to traditional electronics. These advantages enable electronics to be used in a wide range of high-volume, low-cost, disposable applications. As a guide, management has estimated that production capacity of 1bn annual brand protection memory labels (in units) can be constructed for \$9-12m compared to a traditional semiconductor fabrication plant, which would cost \$5bn+. Once production has been optimised, the company plans to license the process to third parties.

Technology and commercial roadmap

The Kovio acquisition has accelerated development of the NFC product by two years and therefore some of the milestones originally targeted for 2016 set out in our [initiation](#) have already been met. All the FY14 technical milestones classified as important in our initiation for FY14 have also been completed. The focus of development shifts as new products are developed and the market matures, therefore some of the lower-priority milestones have been pushed back. The demonstration of wireless temperature sensor accurate to within 1°C is a significant achievement, but work is still required to scale up the process. The first products with smart sensor labels are expected to be launched in 2015.

Exhibit 1: Status of commercial targets set-out in initiation

Description	Date	Comment
Shipments of mass-produced passive array memory to toy customers.	In qualification process	This has been pushed back as a result of stringent regulatory and certification requirements for toys. Products are in the qualification process at the moment.
Delivery of brand protection products.	Completed	Thinfilm announced the first commercial shipments to a luxury product manufacturer at the end of FY13. The products using Thinfilm's solution were used in customer products in Q114.
Produce first samples of printed sensor product.	Completed	Thinfilm demonstrated the first stand-alone printed sensor in October 2013, ahead of schedule.
Pilot manufacturing of sensor product.	Completed	Although the stand alone sensor tag has been demonstrated the process needs to be scaled up for pilot production.
Delivery of smart labels to high-value label manufacturer.	Completed	This was delivered ahead of schedule in Q413. The contract was announced in March 2013 and relates to the prototype printed timer tag that Thinfilm demonstrated in partnership with Brady.
Launch of Bemis product.	2015	This is expected to include Thinfilm's sensor tags. Original expected product launch date at initiation was end of 2014 but it is now not expected until 2015.

Source: Thin Film Electronics

Exhibit 1: Upcoming commercial milestones

Description	Date	Comment
New commercial targets		
Announcement of JV or licensee	2014	Signing up licensing partners is key to achieving long-term revenue growth targets and margins. Thinfilm will either first form a JV to demonstrate the business model or may go straight to licensing the technology to production partners. The first JV or licensee is expected to be announced in 2014 with first licence revenues in 2015.
Scalable software partner for data management	2014	The software that interfaces to smart labels and sensor tags and manages the data is expected to be provided by a third-party software partner. An announcement of a software partner is therefore an important expected milestone for 2014.
Scaled up manufacture of EAS labels	2014	Manufacturing of EAS labels needs to be scaled up to reach the expected order requirements as a result of the Nedap distribution agreement.
Additional sensor applications	2014/2015	Developing new sensor applications is an important milestone to expand the potential customer base and therefore market size.
Source: Thin Film Electronics		

Management

Thinfilm's management has extensive experience in the printed electronics industry and the technology industry generally. Davor Sutija, CEO, served as senior vice president, product marketing at FAST, which acquired Opticom, the original owner of Thin Film Electronics in 2006. Davor is also a member of the board of the Organic Electronics Association (OE-A) and has a PhD in chemical engineering. Dr Christer Karlsson, chief technology officer, was previously deputy research director at the Swedish National Defence Research Establishment. Dr Peter Fischer was previously CTO at Plastic Logic and is on the board of the OE-A. Dr Henrik Sjoberg, SVP of product management previously worked at ACREO, a current partner of Thinfilm and Jennifer Ernst, executive vice president, sales and business development, was director of business development at PARC, which is also a partner and key shareholder of Thinfilm. John Afzelius-Jenevall, CFO, joined Thinfilm in August 2013, before which time he was VP of corporate development at Norwegian conglomerate, Orkla ASA and portfolio manager at Catella Capital Management and Nordea Investment Management. He is a CFA charter holder with a masters in engineering and bachelors in economics.

Printed electronics technology overview

Inorganic vs organic

The materials used in printed electronics can be split into two categories, organic and inorganic. Organic materials are carbon-based polymers that tend to be more flexible and lightweight, and inorganic materials (ie copper, silicon and other non-carbon based materials) tend to have higher performance, but can require higher temperatures in the processing stage, which means they require higher-cost, sometimes metallic substrates. Thinfilm's memory is primarily based on organic inks and Kovio's technology is based on non-organic inks.

Kovio

At the end of January 2014 Thinfilm acquired the printed NFC assets of Kovio Inc for a total of \$3.7m (\$2.7m cash and \$1.0m equity). The assets transferred include over 200 international patents, a 60,000 ft² manufacturing facility including production equipment, Kovio's NFC and EAS product range and 22 of its staff based in Silicon Valley. In our opinion the \$3.7m total consideration was a low price to pay for the significant strategic and technological benefits obtained from the assets transferred. The primary technology acquired is Kovio's printed NFC solution branded as NFC Barcode, which is fully printed and compliant with a subset of the NFC standard. Although it is not compliant with the full NFC standard, Google has introduced functionality into its Android

operating system that enables many Android-based, NFC-enabled phones to read Kovio's NFC Barcode tags. The key limitation of the printed NFC tag at the moment is the limited memory. It currently has up to 256 bits of factory set data that cannot be re-written, but full NFC-compliant tags have at least 384 bits of memory that can be programmed after manufacture. Kovio currently gets around this data limitation by using its cloud-based ENCORE platform (transferred to Thinfilm as part of the acquisition), which redirects the unique codes in the tags to a website or service that can provide additional data as required. If Thinfilm can incorporate its non-volatile, rewriteable memory into Kovio's NFC Barcode, the range of applications could be significantly extended.

Applications

Printed electronics opens up a whole new range of applications that were previously impossible or uneconomic to make using traditional electronics. The printed electronics market in general is expected to grow from its current size of \$2.8bn to \$28.5bn in 2020¹ (including photo-voltaics, OLED displays and e-paper). The four key product groups on which Thinfilm is focused are brand protection and authentication, sensor tags, display tags and NFC tags. In addition, Thinfilm has signed agreements to develop toy-related applications and smart labels, illustrating the wide range of applications for which printed electronics can be used.

Brand protection and authentication

Thinfilm's brand protection product is the use of its Passive Array Memory as an anti-counterfeiting device that is attached to products. A separate hand-held testing device is required to test for authenticity. Following discussions with customers, Thinfilm is now also developing a brand authentication solution that uses the same technology to authenticate product refills automatically. An example of this would be a soap dispenser – the soap refill would contain Thinfilm's brand protection memory product and the dispenser would contain an embedded ASIC (also sold by Thinfilm, but produced by a third party), which would automatically verify whether the soap refill was authentic and consequently allow it to be used in the dispenser. Other potential applications would be air freshener refills, water filter refills or any other product that needs to be supplied with new components or materials. The standard brand protection product provides a similar level of security to chemical tags (c \$1), but at a comparable price to holograms (c 3c). The authentication solution is expected to be sold for c 3-7c per tag and c \$0.75-\$1 for the ASIC that is embedded in the device. The ratio of tag to ASIC will vary significantly depending on the application, but management reports that enquiries have been made for ratios as low as 30:1. In the future NFC could also be integrated into the brand protection memory products to allow consumers to test the authenticity of products through their smartphones. This could help drive adoption, particularly for high-value goods where consumers want to ensure that the good they are purchasing is authentic. The first commercial brand protection products were delivered to a luxury goods manufacturer at the end of FY13. Quantities were small due to the nature of luxury product sales, but it is a positive sign that Thinfilm's technology has been adopted and delivered on schedule. The global anti-counterfeiting market is a fragmented one with different solutions for different products. Authentication of pharmaceuticals is likely to be one of the key target markets and is estimated by VisionGain to be worth \$1.11bn in 2014. We estimate that 31m units of brand protection products will be sold in FY14, which will predominantly be produced at Inktec's facilities in Korea.

Nedap !FaST Electronic Article Surveillance

Electronic Article surveillance is the term used for tags attached to retail products that cause an alarm to trigger if the item is taken out of the store without the tag being disarmed or removed.

¹ IDTechEx – Printed, Organic & Flexible electronics Forecasts, Players & Opportunities 2012 – 2020.

There are many different types of systems, but the one targeted by Thinfilm is wireless labels fitted at source (ie manufactured into the product rather than fitted after manufacture at the store) and deactivated on sale. The current technology can sometimes reactivate itself over time resulting in false alerts but Thinfilm's EAS technology cannot be reactivated and is therefore more reliable. The technology was part of the product portfolio acquired from Kovio, which had a relationship with Nedap Retail that has recently been extended to Thinfilm. The relationship is an important stage in the commercialisation and distribution of the EAS product worldwide and Thinfilm has already received its first orders for EAS products as result, which we understand to be of the order of millions of units. To put the market in context, IBISWorld estimated in 2012 that the market size for EAS products (all types) was \$494m per year Nedap.

Smart sensor tags

Temperature indicators for medical products: Temptime

In March 2014 Thinfilm announced a strategic alliance with Temptime Corporation to collaborate on the development of printed electronic temperature indicators for pharmaceuticals. Temptime is a US-based private company that manufactures chemical-based time- and temperature-sensitive labels. The new labels will include printed thermistors from PST and displays from Acreo. Thinfilm has already demonstrated prototype NFC-enabled temperature sensor labels and timer labels, but development work is needed to integrate and commercialise production. The healthcare market is seen as a big opportunity for temperature sensors and other smart tags because of the strict storage requirements of many medical products and therefore an alliance with Temptime is key to exploiting that market. The agreement also included commercial pre-orders for samples that can be shared with Temptime's customers, which while likely to be relatively small volumes are an important first step in developing the market.

Distribution agreement with Paksense for food suppliers

In April Thinfilm entered a commercial distribution agreement with Paksense for the distribution of Thinfilm Smart Labels, the first of which is expected to be delivered in early 2015. Paksense currently produces traditional silicon-based sensor tags to monitor the storage condition of goods through the distribution chain. It has over 1,500 customers in 70 countries and sees Thinfilm's printed sensor tags as complementary to its current product offering, as it will allow item-level detection of temperature rather than just the current pallet level. It is an important agreement as it puts a key distribution channel in place for when the sensor labels become available in 2015 and could help rapidly accelerate adoption.

Strategic partnership with Bemis – global leader in flexible packaging

Thinfilm has been in partnership with Bemis since July 2012 and has recently announced a two-year extension that gives Bemis access to Thinfilm's brand protection technologies, as well as the intelligent packaging solutions. Bemis produces c 200bn packages a year and generates revenues of c \$5bn, so capturing even a small percentage of these package sales would generate significant revenues. Management has indicated that it expects to start shipping sensor tags to Bemis in late 2014. At its investor briefing in December 2013 Bemis indicated that one of its target growth areas was for smart packaging in the medical and pharmaceutical industries. This is consistent with the target applications of Thinfilm's technology (ie checking the authenticity of medical products and verifying they have been stored under the correct conditions using smart printed sensors) and it is therefore likely to be one of the areas that they will work on together. Medical and pharmaceuticals accounted for over 20% of Bemis's net sales in FY12 and therefore this market alone has significant potential for Thinfilm. The extension of the partnership with Bemis is a positive indicator that product development is progressing well and Bemis still sees potential in printed electronics for high-volume disposable applications. For this application the main risk is that the technology fails to

be commercially attractive due to either not meeting performance requirements or being too expensive to incorporate into disposable products.

Contactless tags and the internet of everything

NFC has been around for almost 10 years with Nokia, Philips and Sony founding the NFC Forum (which Thinfilm joined in March as principal member) in 2004 to help develop and market NFC technology. The uptake so far has been slower than many in the industry expected or hoped, but a key reason for this could be the relatively high cost of producing smart NFC systems. Low-cost static NFC tags are available for 5-10c, but these do not provide any intelligence and simply transmit fixed data to the reader device. Adding additional customised functionality to small, potentially flexible form factors using traditional semiconductors would be very expensive and would not be economic at small scales. However, as new circuit designs can be produced in significantly less time and lower cost with printed electronics, it therefore becomes much more cost effective to create novel smart systems. An increasing number of analysts believe the next generation of iPhone will include an NFC reader that could further accelerate the uptake of NFC. Thinfilm could benefit if this does happen as it is the only company that will be able to provide low-cost, high-volume intelligent, NFC enabled systems.

NFC: The input and output for smart devices

NFC is important to smart devices because it allows transmission of information to and from printed systems. It is this bi-directional communication that is likely to differentiate printed sensor systems from their static silicon counterparts and make NFC tags truly interactive. The range of potential applications is vast, but just looking at Thinfilm's product announcements, NFC could be used to set the period of time for which the timer label is valid, or read information from a sensor label or, as mentioned above, test the authenticity of a product using Thinfilm's brand protection memory.

Wide potential, but development still necessary

The demonstration of NFC-enabled temperature sensors is a good example of how Thinfilm's NFC and sensor technology can provide functionality that could normally only be achieved using more expensive traditional electronics. The speed at which Thinfilm managed to integrate Kovio's NFC technology with Thinfilm's is impressive, but development to commercialise and scale up the process is still required. One of the key areas that needs to be developed is the transistor yield; compared to traditional semiconductors the yield of printed transistors is still low and since the overall system yield falls off exponentially with the number of transistors, the transistor count needs to be kept low. This is one of the reasons Kovio's printed NFC circuit has only 1,000 transistors compared to a traditional silicon NFC chip, which would have tens of thousands of transistors. As processes and materials improve, it is likely that yields and transistor counts will increase, but in the short term printed systems are likely to be limited to simple applications.

IDTechEx estimates that 4bn RFID tags were sold in 2012, 35% up from 2.9bn in 2011, and forecasts this will increase to 16bn tags in 2022. Many of these will be contactless payment cards, which, in the short-term at least, is not a focus of development, but the ability for very low-cost printed NFC systems opens up a wide range of new applications that could boost NFC growth even further.

Sensitivities

Our forecasts and the share price are sensitive to the factors described below.

- **Execution risk:** Given the early stage of development, and the fact that Thinfilm is effectively creating its own market there is a high degree of uncertainty over the unit sales, ASPs and

margins that can be achieved and therefore forecasts are likely to be updated regularly as the market develops and grows into new applications. In particular, the pace of adoption by third parties is difficult to predict and therefore a wide range of potential licensing revenues is possible in the short to medium term.

- **Technology development:** To design complete printed systems, there are some key components that still need to be developed. There is a risk that this development may be delayed or, in a worst-case scenario, the end-product proves to be uneconomic in the targeted applications. Alternatively, competitors may develop solutions that make Thinfilm's technology less competitive or even redundant. Thinfilm's core memory technology and system integration skills, as well as close partnership with its customers, should help mitigate this risk.
- **Reliance on suppliers and partners:** Many different companies own different parts of the IP for printed electronics and key materials such as ink. For example, Thinfilm currently has limited time exclusivity with Polyvera for its inks and while there are other suppliers of electronic inks, losing Polyvera as a supplier would be disruptive to the business. In addition, if the pricing of these inks and materials goes up it could make Thinfilm's target applications commercially unviable.
- **Dependence on technology roadmaps of customers:** As Thinfilm's products are integrated into its customers' products, it is dependent on the development and success of those products. Many of the customer relationships and agreements are confidential, so it is difficult to quantify the financial impact or assess the risks of each one.
- **IP protection:** Thinfilm's technology is protected by patents, but the company may become involved in litigation if its patents are infringed.
- **Competitive environment:** Thinfilm's technology faces competition on a number of fronts; from existing traditional electronics, printed electronics from other manufacturers and alternative methods for providing the same functionality (such as chemical temperature indicators in place of the sensor tag). However, Thinfilm's position in the printed electronics industry appears to be strong, as it is the only company able to produce scalable rewriteable, non-volatile memory and printed NFC, which is a key component of many electronic systems.

Financials

P&L

Thinfilm is still at a relatively early stage of development and given the fact the PE market is immature and Thinfilm is effectively creating the market for some of its products, there is a high degree of variability in forecasts. This is illustrated by the potential expansion of standard brand protection products into the refill market, where it can be used for automated authentication. This application was not envisioned at this time last year. The next 3-5 years of forecasts should therefore be viewed as the mid-point in a wide range of potential values. We have updated our product mix forecasts to reflect the Kovio acquisition, the expansion in the number of products, more clarity in the demand profile of those products and discussions with management. Previously our model was based on an assumed weighted average ASP and unit sales across all products. Our reconstructed model looks at each product line separately and as a result of the extended product range and improved (but still limited) clarity in demand profile for the different products, the forecast weighted average selling price for FY15 has fallen from \$0.22 per tag in our original model to \$0.12. Licensing revenue has also fallen because of this shift in product mix and a more conservative ramp in licensee production output. We still assume that either licensing partners or JVs are formed in FY14 and first revenues recognised in FY15. The net impact on EBITDA from these changes and the additional operating costs from Kovio is a reduction from NOK30m to NOK87m in FY15 and from NOK695m to NOK95m in FY16.

The EAS product acquired from Kovio is the second product group after the memory products to receive commercial orders (announced in May). The first significant revenue from smart labels (both NFC and sensors) is expected in FY15 and is forecast to grow rapidly in FY16. At this point a joint venture, licensing partner or additional capex will be required to meet production capacity (or a mix of all three).

Estimate changes due to product mix and licensing assumptions

Exhibit 3: Changes to estimates

NOK000s	2014e old	2014e new	% change	2015e old	2015e new	% change	2016e old	2016e new	% change
Revenues									
Own production	20,650	15,050	(27%)	220,888	125,912	(43%)	1,112,888	1,040,493	(7%)
Licensing	-	-		26,687	883	(97%)	505,188	13,209	(97%)
Other	27,012	27,012	0%	5,503	27,012	391%	-	27,012	
Total	47,662	42,062	(12%)	253,078	153,807	(39%)	1,618,075	1,080,714	(33%)
Revenue growth									
Staff costs	46,591	72,453	56%	89,492	83,041	-7%	173,121	97,052	(44%)
Premises, supplies	14,183	33,143	134%	105,545	125,656	19%	660,260	804,486	22%
Services	18,990	22,788	20%	20,889	25,066	20%	62,666	62,573	(0%)
Sales & marketing	6,417	6,417	0%	7,058	7,058	0%	21,175	21,764	3%
Other costs	179	1,279	615%	259	1,279	394%	6,014	-	(100%)
EBITDA	(38,698)	(94,017)	143%	29,835	(88,294)	(396%)	694,839	94,838	(86%)
EBITDA margin	N/A	N/A		11.8%	N/A		42.9%	8.8%	
Depreciation	(2,794)	(5,445)	95%	(17,544)	(12,748)	(27%)	(38,194)	(39,034)	2%
Operating profit/(loss)	(41,492)	(99,462)	140%	12,291	(101,041)	(922%)	656,645	55,804	(92%)
Operating margin	N/A	N/A		4.9%	N/A		40.6%	5.2%	
Share-based payments	(5,680)	(10,340)	82%	(5,680)	(11,758)	107%	(5,680)	(13,851)	144%
Reported operating profit/(loss)	(47,172)	(109,802)	133%	6,611	(112,799)	N/A	650,965	41,953	(94%)
Net debt/(cash)	(104,271)	(110,027)	6%	(14,946)	149,879	N/A	(347,898)	529,147	N/A

Source: Edison Investment Research

Exhibit 3 shows the change in estimates due to our assumed change in product mix and the impact of the Kovio acquisition. Estimated staff costs have increased in FY14 due to the accelerated hiring of staff and the 22 Kovio staff that joined in February 2014. Longer-term staff costs have been reduced due to updated average salary and recruitment assumptions. Supply costs have increased primarily as a result of assuming a graduated gross margin progression, increasing from negative margins in 2014 to 40% in 2016 compared to previously assuming a flat 60%. Licensing revenues are expected to be a smaller component of revenues in FY15 due to the licensed products being the lower-value brand protection tags, longer assumed set-up time for licencees to start volume manufacture and a more conservative unit sales assumption. Licencees and/or JVs are still expected to be announced in FY14, but it will take six to 12 months for production to reach scale volume.

Social security tax on share-based payments

Social security costs were a significant contributor to FY13 costs. NOK13.1m of expense was accrued in relation to social security tax on share-based payments. The tax only becomes payable when the options are exercised so although NOK13.1m of expense was recognised, only NOK0.8m was cash. As at 31 December 2013, 20m of subscriptions rights and warrants were outstanding. Current dilutive number of shares represent c 4% of outstanding share capital and there would be an estimated NOK40m tax impact if exercised at the current share price.

Balance sheet and cash flow

We have assumed that internal production facilities are expanded significantly in FY15-17 at a total cost of \$140m (using debt financing) to meet internal production requirements, although it is very likely that a large proportion of this will either be shared with a JV or replaced by licensing agreements. We will update the model as JVs and licensing agreements are announced. We

forecast net cash of NOK110m at the end of FY14. Additional funding may be required in FY16 depending on the production requirements and level of licensing.

Valuation

Thinfilm is the only listed company focused on the development and manufacture of printed electronics and it has very different dynamics to other manufacturers/IP licensors and therefore a multiples-based analysis is not appropriate. We have therefore used a DCF approach to value the business across a range of scenarios. Following the update to the model as described above, our base case valuation has reduced from NOK19.10/share to NOK17.03/share. The main reason for this reduction is increased contingency and de-risking of revenue forecasts and changes in product mix rather than a fundamental change in the business outlook.

Base case: NOK17.03; slower adoption scenario NOK7.03

Exhibit 4: Base case								
Base Case	2013e	2014e	2015e	2016e	2017e	2018e	2019e	2020e
Units Sold								
Memory products (m)	2	24	119	435	901	1,865	3,863	8,000
Authentication ASICs	-	1	2	4	9	19	39	80
Smart labels	-	-	29	396	654	1,083	1,800	3,000
EAS	-	10	32	60	81	110	148	200
NFC Barcodes	-	1	2	6	6	7	7	8
Total units sold	2	35.2	185	901	1,651	3,083	5,857	11,288
% produced by third parties	0%	0%	5%	17%	37%	52%	62%	80%
Revenue from internally produced units	0.0	2.6	21.3	176.4	300.6	517.8	907.7	1041.2
License fee revenue	0.0	0.0	0.1	2.2	9.0	23.5	53.4	172.2
Total Product Revenue (USD)	0.0	2.6	21.5	178.6	309.6	541.2	961.1	1,213.4
(NOK)	0.0	15.1	126.8	1,053.7	1,826.8	3,193.3	5,670.6	7,159.3
Operating Margin	N/A	N/A	N/A	4.0%	16.4%	21.2%	26.9%	32.7%
Operating Profit	(83.3)	(105.2)	(112.8)	42.0	300.5	678.5	1,525.9	2,344.6
Source:								

As described in the sensitivities section, given the early stage of development the market is still very immature and therefore there is a wide margin of error in our unit sales forecasts, and we are reliant on discussions with management to develop our forecasts. With the product mix and growth profile shown in Exhibit 4 the DCF produces a valuation of NOK17.03. Exhibit 5 illustrates the sensitivity of the DCF valuation to long-term EBITDA margin and unit sales of smart labels.

Exhibit 5: Sensitivity analysis						
		2020 EBITDA margin				
		30.0%	35.0%	40.0%	45.0%	50.0%
2020 Smart label units sales (m units)	1,000	4.38	5.71	7.03	8.35	9.68
	3,000	8.41	10.57	12.72	14.88	17.03
	5,000	9.53	11.90	14.27	16.65	19.02
Source: Edison Investment Research						

Using a slower adoption of smart labels and 40% EBITDA margins produces a valuation of NOK7.03. To provide some context to these EBITDA margins, ARM, which also has an IP licensing business model, had operating margins of 49% in FY13 and Ceva, which licenses DSP cores, had adjusted EBITDA margins of 30% in FY13, down from 40% in FY11.

Exhibit 6: Financial summary

	NOK '000s	2011	2012	2013	2014e	2015e	2016e
Year end December		IFRS	IFRS	IFRS	IFRS	IFRS	IFRS
PROFIT & LOSS							
Revenue		1,763	3,774	11,540	42,062	153,807	1,080,714
EBITDA		(35,241)	(41,849)	(63,382)	(89,371)	(88,294)	94,838
Operating Profit (before amort. and except.)		(35,554)	(42,356)	(65,012)	(94,816)	(101,041)	55,804
Intangible Amortisation		0	0	0	0	0	0
Exceptionals		0	0	(13,100)	0	0	0
Share-based payments		(3,012)	(4,369)	(5,154)	(10,340)	(11,758)	(13,851)
Operating Profit		(38,566)	(46,725)	(83,266)	(105,156)	(112,799)	41,953
Net Interest		(125)	320	1,665	1,774	483	960
Profit Before Tax (norm)		(35,679)	(42,036)	(63,347)	(93,042)	(100,558)	56,764
Profit Before Tax (FRS 3)		(38,691)	(46,405)	(81,601)	(103,382)	(112,316)	42,913
Tax		0	0	0	0	0	0
Profit After Tax (norm)		(35,679)	(42,036)	(63,347)	(93,042)	(100,558)	56,764
Profit After Tax (FRS 3)		(38,691)	(46,405)	(81,601)	(103,382)	(112,316)	42,913
Average Number of Shares Outstanding (m)		284.6	330.1	415.4	476.9	476.9	474.2
EPS - normalised (ORE)		(12.5)	(12.7)	(15.3)	(19.5)	(21.1)	12.0
EPS - normalised fully diluted (ORE)		(12.5)	(12.7)	(15.3)	(19.5)	(20.8)	11.8
EPS - (IFRS) (ORE)		(13.6)	(14.1)	(19.6)	(21.7)	(23.6)	9.0
Dividend per share (NOK)		0.0	0.0	0.0	0.0	0.0	0.0
EBITDA Margin (%)		N/A	N/A	N/A	N/A	N/A	8.8
Operating Margin (before GW and except.) (%)		N/A	N/A	N/A	N/A	N/A	5.2
BALANCE SHEET							
Fixed Assets		1,338	2,732	18,927	55,386	53,558	110,786
Intangible Assets		0	0	0	0	0	0
Tangible Assets		1,338	2,732	18,927	55,386	53,558	110,786
Investments		0	0	0	0	0	0
Current Assets		10,366	37,249	274,453	144,890	81,523	498,665
Stocks		0	0	0	4,458	23,996	203,336
Debtors		3,027	4,399	8,018	30,406	30,406	292,476
Cash		7,339	32,850	266,435	110,027	27,121	2,853
Other		0	0	0	0	0	0
Current Liabilities		(7,372)	(9,831)	(35,677)	(25,695)	(227,138)	(784,482)
Creditors		(7,372)	(9,831)	(35,677)	(25,695)	(50,138)	(252,482)
Short term borrowings		0	0	0	0	(177,000)	(532,000)
Long Term Liabilities		0	0	0	0	0	0
Long term borrowings		0	0	0	0	0	0
Other long term liabilities		0	0	0	0	0	0
Net Assets		4,332	30,150	257,703	174,581	(92,057)	(175,031)
CASH FLOW							
Operating Cash Flow		(34,390)	(40,762)	(48,081)	(126,198)	(83,389)	(144,228)
Net Interest		(42)	469	1,422	1,774	483	960
Tax		0	0	0	0	0	0
Capex		(879)	(1,924)	(15,125)	(20,000)	(177,000)	(236,000)
Acquisitions/disposals		0	0	0	(15,984)	0	0
Financing		24,597	67,727	295,367	4,000	0	0
Dividends		0	0	0	0	0	0
Net Cash Flow		(10,714)	25,510	233,583	(156,408)	(259,906)	(379,268)
Opening net debt/(cash)		(18,054)	(7,339)	(32,850)	(266,435)	(110,027)	149,879
HP finance leases initiated		0	0	0	0	0	0
Other		(1)	1	2	0	0	0
Closing net debt/(cash)		(7,339)	(32,850)	(266,435)	(110,027)	149,879	529,147

Source: Edison Investment Research

Contact details	Revenue by geography
Henrik Ibsens gate 100 PO Box 2911 Solli 0230 Oslo Norway +47 23 27 51 59	N/A

www.thinfilm.no

CAGR metrics	Profitability metrics	Balance sheet metrics	Sensitivities evaluation
EPS YY-YYe	N/A ROCE 15e	N/A Gearing 15e	N/A Litigation/regulatory ○
EPS YY-YYe	N/A Avg ROCE 12-16e	N/A Interest cover 15e	N/A Pensions ○
EBITDA YY-YYe	N/A ROE 15e	N/A CA/CL 15e	7.7x Currency ◐
EBITDA YY-YYe	N/A Gross margin 15e	100% Stock days 15e	N/A Stock overhang ◐
Sales 10-16e	408% Operating margin 15e	N/A Debtor days 15e	N/A Interest rates ○
Sales YY-YYe	311% Gr mgn / Op mgn 15e	N/A Creditor days 15%e	N/A Oil/commodity prices ○

Management team

Non-Executive Chairman: Morten Opstad

Served as chairman since October 2006. He is partner and chairman of Norwegian law firm Advokatfirma Røder DA and is also on the board at Idex ASA, Total Sports Online AS, Glommen Eiendom AS, Chaos AS and K-Konsult.

Chief Executive Officer: Dr Davor Sutija

Joined Thinfilm in January 2010 from FAST (a subsidiary of Microsoft). He was elected to the board of the Organic Electronics Association in 2012 and has a PhD in chemical engineering from the University of California.

Chief Financial Officer: John Afzelius-Jenevall

Joined Thinfilm in August 2013. Before that he was VP of corporate development at Orkla ASA and portfolio manager at two investment firms. He is a CFA charter holder, with a masters in engineering and bachelors in economics.

Chief Technology Officer: Dr Christer Karlsson

Joined Thinfilm in 2000 and previously served as deputy research director at the Swedish National Defence Research Establishment. He holds a PhD from Linköping University.

Chief Product Officer: Dr Peter Fischer

Peter was announced as Chief Product Officer in September 2013. He is Thinfilm's technical lead in product marketing and business development. He has a PhD in semiconductor physics and was previously CTO at Plastic Logic.

SVP Product Management: Dr Henrik Sjöberg

Joined Thinfilm in March 2013. He has held a number of Director positions in R&D and Product Management at Micronic. He also previously worked at Acreo (current Thinfilm partner) and has a PhD in physics.

EVP Sales and Business development: Jennifer Ernst

Joined Thinfilm in 2011 and leads global sales and business development. Before that she was Director of business development at Thinfilm's partner and shareholder - PARC (Xerox subsidiary).

Principal shareholders	(%)
Invesco Perpetual High Income Fund	22.2%
Euroclear Bank SA	10.6%
Bank of New York Mellon	9.3%
ASAH AS	5.4%
Simpson Financial Ltd	3.6%
Sundwall Holdings	3.1%
Food International Ltd	3.0%

Companies named in this report

Bemis, Brady, Temptime, PakSense, Nedap, ARM, Ceva

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