

Thin Film Electronics

Enabling next phase of mobile marketing

Re-initiation of coverage

Tech hardware & equipment

3 July 2018

Price **NOK1.42**

Market cap **NOK1,661m**

NOK8.15US\$

Net cash (\$m) at 31 March 2018
excluding finance lease 87.6

Shares in issue 1.17bn

Free float 95%

Code THIN

Primary exchange Oslo

Secondary exchange OTCQX

Thin Film Electronics (Thinfilm) is benefitting from a renewed interest in NFC (near-field communication) based mobile marketing solutions following Apple's decision to start supporting the standard in June 2017. Its new roll-to-roll (R2R) printed electronics fabrication facility has just started production and should be fully operational in 2019. This will enable Thinfilm to manufacture NFC tags deploying printed electronics in the volumes and at the price point required for the deployment of billions of tags each year, further accelerating NFC adoption. We believe that execution to our estimates would justify a valuation of c NOK3 per share.

Year end	Revenue (\$m)	EBITDA (\$m)	PBT* (\$m)	EPS* (c)	DPS (c)	EV/sales (x)	Yield (%)
12/16	3.8	(36.9)	(42.8)	(6.5)	0.0	30.6	N/A
12/17	5.9	(50.9)	(57.5)	(6.6)	0.0	19.7	N/A
12/18e	8.0	(52.4)	(57.2)	(4.9)	0.0	14.5	N/A
12/19e	100.4	(27.6)	(35.2)	(3.0)	0.0	1.2	N/A

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

Driving demand to meet anticipated supply

Demand for tags is increasing following the launch of Thinfilm's CNECT software platform in Q117. This value-added marketing solution enables brands to directly interact with consumers via NFC tags, increasing customer engagement, retention and understanding. At the end of Q118 there were 487 companies registered on Thinfilm's software platform compared with 80 in Q217. Campaigns are also getting bigger. Recently, Thinfilm announced that active nutrition and weight management supplement company, Iovate Health Sciences International, is using its NFC mobile marketing solution. This campaign is the largest with which Thinfilm has been involved so far and will require over a million tags.

Building blocks in place for an acceleration

Thinfilm's business model is predicated on selling tags in very significant volumes, bringing intelligent connectivity to consumable goods, and we believe the building blocks for an initial inflection are now in place. The R2R manufacturing facility is expected to be in production by Q418 and, after yield ramp, have a capacity of 3bn units by end FY19, while the increase in the number and size of customers should support the estimated doubling in revenues this year and tenfold increase in 2019. We believe that Apple support for Thinfilm's printed tags is required to achieve broad mass adoption, and management has a well-defined plan for achieving this.

Valuation: Substantial upside potential, execution key

Thinfilm is pioneering a new market and is on the cusp of commercialisation. The potential is very significant but, inevitably, the range of potential outcomes is large. Our base case scenario assumes Apple support by end FY19 and our FY20 estimate implies that Thinfilm's tags achieve c 1% of the global NFC market. This returns a DCF valuation of NOK3.01/share. Delays will adversely affect margins and revenue growth. Our scenario analysis presents the potential impact of this.

Share price performance



% 1m 3m 12m

Abs (30.0) (32.5) (64.4)

Rel (local) (30.0) (37.0) (70.9)

52-week high/low NOK4.0 NOK1.4

Business description

Thin Film Electronics is a global leader in NFC mobile marketing and smart-packaging solutions using printed electronics technology. This technology should enable it to offer printed NFC tags at a substantially lower price point than conventional silicon tags.

Next events

Q218 results 17 August 2018

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Investment summary

Company description: Mobile marketing solution provider

With the launch of its CNECT platform and the decision to open up its product range to include conventional silicon tags, Thinfilm has transitioned from tag manufacturer to NFC solutions provider. This is enabling it to build up a customer base and generate sales from third-party silicon NFC tags and its proprietary printed NFC tags, even though Apple is not currently supporting the TTF protocol used in the latter. Nevertheless, we expect the group to put intense efforts into bringing its printed tags into the Apple ecosystem within the next six to 18 months to maximise earnings potential and increase the return on its new R2R printed electronics plant. R2R production of anti-theft tags started in Q218 and production of NFC tags is expected to commence end Q318. The move to high-capacity R2R printing should enable Thinfilm to reduce the cost of printed tags below those of silicon ones, giving it the potential to execute sales across a wide range of verticals.

Q118 points to reaching cash break-even in 2019

The Q1 results show that demand for Thinfilm's NFC solutions is growing. Although total revenue and other income rose by 6% year-on-year in Q118 to US\$1.2m, revenue from sales of tags grew by 35% to US\$0.4m, as 6m electronic article surveillance (EAS) tags were shipped in Q118 compared with 5m in Q117 and shipments of NFC tags more than doubled. Our forecast that this acceleration will continue is predicated on the assumption that the R2R facility reaches high yield and multi-billion unit production by the end of FY19 and that Apple accepts the TTF protocol in the same timescale. We model sales of 21m NFC tags in 2018 (compared with over one million in FY17) which drives an estimated rise in revenues from \$8.0m in FY18 to \$217.0m in FY20. Our base case estimates bring the group to cash-positive at an operational level towards the end of FY19, so this volume ramp-up delivers \$46.7m EBITDA profit in FY20. Further cash will be required to fully equip the R2R facility: we model \$23.5m this year, \$8.0m next, giving a funding gap of \$25.5m, which we model as satisfied through debt.

Valuation: Base case DCF

Assuming no delays to the R2R production ramp-up or Apple's acceptance of the TTF protocol, our DCF analysis gives an indicative valuation of NOK3.01/share. Delays in getting TTF accepted may have a negative impact on revenues in the short term because customers creating marketing campaigns involving Apple device users will select vendors based only on software capability (although Thinfilm's CNECT platform appears to have a strong competitive position) rather than the superior performance of printed NFC tags compared with silicon ones. Longer term, it may have a negative impact on margins if Thinfilm has to redesign its printed tags. Our scenario analysis presents the potential impact of variance on revenue growth on indicative valuation.

Sensitivities: Market and execution risk

- **Thinfilm is pioneering a new market:** the rewards from successful execution should be significant, but the commercialisation process has been protracted and further obstacles could cause further delays. The NFC tag market is still at an early stage of development, having been held back by Apple's reluctance to use the standard except in ApplePay.
- **Compatibility with Apple ecosystem:** our estimates assume Apple will support the TTF protocol by end 2019. Any delay is likely to have an adverse impact on estimated revenues and margins. On the other hand, Apple's decision to support NFC appears to be stimulating demand generally for NFC applications, benefitting Thinfilm if it is able to capture market share.
- **Execution risk:** transition to R2R production presents execution risk during FY18.

Company description: NFC solution provider

Thinfilm is a global leader in NFC mobile marketing and smart-packaging solutions that include NFC tags, cloud-based NFC label management software, reporting and analytics and label/packaging integration services. Distinct to the majority of digital advertising, which is dominated by the global 'walled gardens' Google and Facebook, these elements deliver a powerful one-to-one digital marketing solution through which brands of all sizes can connect directly with consumers, enabling companies to dynamically tailor the marketing to drive maximum customer engagement and, importantly, deriving actionable insights into customer behaviour when a tag is tapped with a smartphone.

Thinfilm has developed a patented additive manufacturing technique for printing NFC and EAS tags on a flexible substrate. These printed dopant polysilicon (PDPS) tags are thinner, more flexible and durable than conventional silicon tags. The NFC tags can be read more quickly than their silicon counterparts. The EAS tags can be easily incorporated into garments, for example bonded under the leather brand labels on jeans, and do not need to be removed after purchase.

Once the R2R-based manufacturing facility is fully operational at the end of FY19, the company should be able to reduce its cost points below those of conventional silicon-based solutions. This presents the potential of incorporating its PDPS tags on billions of everyday disposable items, extending the traditional boundaries of the Internet of Things to the Internet of Everything. At the current stage of its evolution, Thinfilm is focused on increasing revenues from product sales to fill the capacity at the San Jose facility once it comes on line. Longer term, management intends to augment this with licencing deals to be able to meet demand for the tags. It already has experience of this business model, having licenced and sold (subject to a continued licence revenue potential) its printed memory technology to Xerox.

Thinfilm's global headquarters are in Oslo, Norway. The US headquarters are in San Jose, California, where its high-capacity manufacturing site is located. It has sales offices in San Francisco, London, Hamburg, Singapore and Shanghai as well as a smaller R&D facility in Linköping. It employs over 150 people.

Integrated mobile marketing solution

Following the launch of its proprietary CNECT software platform in February 2017, Thinfilm has transitioned from a label producer to a mobile marketing solutions provider.

Direct interaction with customers: Disintermediating the 'walled-gardens'

As smartphone penetration and use continues to increase (over 32% of the global population had a smartphone in 2017 compared with 21.6% in 2014, according to Statista), so does media consumption, particularly amongst key marketing demographics such as millennials.

According to eMarketer, mobile advertising will be worth \$182bn in 2018: 67% of total digital advertising and 29% of the total global advertising market. The vast majority of this is mediated by the global internet giants: Google, Facebook and Tencent. While itself an efficient way to reach the consumer, these 'walled garden' platforms provide little visibility to brands regarding the actual behaviour of their consumers. Furthermore, in passing control of campaigns to intermediaries, as well as adding in a layer of cost, brands lose a degree of control over the distribution of the marketing message.

Much like QR code (two dimensional barcodes), NFC tags present a mechanism for brands to engage directly with consumers both at the point of purchase (supporting customer conversion at the most relevant time in the purchasing decision) and at the point of consumption (supporting

retention and loyalty), presenting an effective complement to a brand's mobile marketing strategy. NFC tags have some distinct advantages over QR codes and barcodes:

- **Functionality** : unlike barcodes or QR codes, each NFC tag has a unique identification number, so it is possible to determine whether this is the first time a consumer has interacted with an individual tag via their mobile or a successive time, and tailor the content accordingly.
- **Usability**: QR codes are fairly unsightly so they tend to be put out of view on products, reducing the take up of any 'call-to-action' to scan the code. Furthermore, QR codes need to be aligned with a mobile, which can lead to a frustrating customer experience.

For example, Spanish wine and sherry producer Barbadillo put neck collars containing Thinfilm's flexible PDPS tags on 126,000 bottles of Castillo de San Diego inviting consumers to 'tap and win' €1,000. This was part of an advertising campaign involving TV and radio ads, banner ads and search engines. When consumers responded to a "call-to-action" and tapped the NFC tag embedded in the neck collar with their mobile phones (NFC technology only works when the device being read and the reader are within 10cm of each other), the NFC reader inside their phone decoded the information stored on the tag. This opened up a web-page enabling them to enter a prize draw.

Use of NFCs so far has been for brand reinforcement or 'brand experience', with c 85% interactions occurring once a consumer has purchased an item. For example, manufacturers of craft beers use the tags to give access to videos of the brewers. In this way tags are used to create a digital persona for physical objects.

The technology is fully compliant with General Data Protection Regulation because the consumer initiated communication by tapping on a tag and no personal data are held, only information about tag taps.

Obtaining actionable insights that drive campaign performance

Because each NFC tag has a unique identification number, each tap provides information on when and where there was consumer interaction with it, each of which is linked to a specific product and/or marketing campaign. This provides brand managers with actionable information across a range of areas, from supply chain management to customer insights. For example, tags linked to a drinks promotion based on a lottery will not start to be tapped until the bottles with the NFC-enabled label or neck-collar are actually on retailers' shelves. This tells brand managers when the optimal time is to schedule any related TV or radio advertising as there no point in spending money on this if the bottles are in a depot awaiting delivery. Tags on boxes of milkshakes intended to support weight loss have a "call-to-action" on the packaging which encourages consumers to tap their mobile onto an embedded tag when they are preparing a shake to download recipes. An analysis of data collected via Thinfiim's CNECT software platform showed that dieters tapping tags typically postponed drinking their 'breakfast' shake until mid-morning and generally did not use a shake a substitute for an evening meal at weekends. These data help brand managers to decide what time of day to promote the shake on other media and identifies a gap in the market for an alternative product for consumption at weekends. Luxury brand Dunhill discovered that a significant proportion of tagged packs of cigarettes sold in the Dubai duty free zone were consumed in Kyrgyzstan, indicating potential for future marketing campaigns targeted at the region.

Proven to drive website traffic

Results from initial campaigns have been impressive. For example, in the Barbadillo campaign the number of consumers engaging via Thinfilm's NFC solution was 10x higher than those participating via social media. Consumers engaging by tapping tags then spent 2.8x longer on Barbadillo's website than those visiting via social media. Overall, 54% of brand engagement was via tapping, which was more than that generated from search engines and banner ads combined.

We note that customers have begun to use Thinfilm's solution for repeat campaigns and the number of companies using the platform increased from 80 in Q217 to 260 by end July 2017, rising to 487 at end Q118. These are drawn from several industry verticals including brewing, wine and spirits, food and cosmetics. Campaigns have grown bigger too. Recently Thinfilm announced that active nutrition and weight-management supplement company, Iovate Health Sciences International, is using its NFC mobile marketing solution to engage with consumers and drive ecommerce. The in-field deployments cover several of Iovate's key brands and feature content based on a custom video from their sponsored athlete and NFL All-Pro tight end, Rob Gronkowski. Products deploying Thinfilm's tags were first distributed through Walmart stores, with plans to follow up with distribution through other national retailers. This campaign is the largest Thinfilm has been involved with so far and will require over a million electronic tags.

Smart packaging solutions

The NFC tags provide a convenient way for consumers to check the product they are purchasing is authentic and can alert suppliers when a product has been tampered with. Obvious use cases are high-value beverages such as Johnnie Walker Blue Label scotch, accessories and diamonds (for Sarine), but the tags are sufficiently inexpensive to be used on boxes of cosmetics (eg Yuni Beauty) and other relatively low value items such as bottles of olive oil. The price point opens up a myriad of use cases in a range of industry verticals. For example, the YpsoMate prototype put Thinfilm's tags on its disposable injector pens used to self-administer medication for the management of chronic conditions. If users are only required to inject medication once or twice each month, it is easy for them to forget, resulting in large healthcare bills. If users tap the pens when they use them, this gives a record that the medication has been taken and a text reminder can be sent if the medication has not been administered at the right time. The NFC tags may also be used to provide more information about a product than can be fitted on a conventional label.

Business to business solutions

The NFC tags can be used to improve logistics, supply chain and infrastructure management. The price point is sufficiently low for tags to be placed on relatively low-value assets. For warehousing applications, this means tags can be placed on individual pallets, cases or individual items. For example, the Korean Red Cross put printed electronic NFC tags on 20,000 relief parcels. Volunteers delivering the parcels tapped on the tag when it was handed over to the recipient, automatically providing a centrally held record of when and where the exchange of each individual parcel had taken place. This replaced a labour-intensive paper process.

NFC solutions

SpeedTap

Before incorporation in a smart label, Thinfilm's NFC tags are pre-programmed with a short url (uniform resource locator) and unique ID. This information cannot be modified subsequently and each tag has a unique identifier. When an NFC-enabled smartphone taps the tag, Thinfilm's CNECT software platform directs it via the cloud to brand curated content.

OpenSense

Thinfilm's OpenSense tags have additional circuitry that is placed across the seal of a bottle or package so the tag also provides information as to whether the seal has been opened. This gives consumers confidence that their purchase has not been tampered with, which is particularly important for food, drink and cosmetics, and offers assurance that a product is not a counterfeit, which is important for high-value beverages and accessories. It also enables brand marketers to

send a consumer different content depending on whether the product is still sealed (point-of-purchase) or has been opened (point-of-consumption).

Third-party silicon

Thinfilm also supplies electronic tags containing silicon chips sourced from conventional semiconductor vendors as these can be read by Apple as well as Android phones. Thinfilm pre-programmes them to work within the CNECT platform alongside PDPS tags.

Software for managing marketing campaigns

CNECT is a multi-tenant cloud-based platform that supports marketing campaigns by managing and tracking the electronic tags in real time and analysing the tapping and consumer behaviour activity to derive actionable insights for improving campaign performance. CNECT will soon be extended to manage the launch of augmented reality experiences and has potential for use when NFC labels act as a trigger mechanism in creating blockchain ledgers (see below).

EAS tags

Thinfilm also uses its printed electronic technology to make EAS tags. These have several advantages over magneto-resistive tags, which are discussed on page 10. The tags were initially used in adult footwear but have since been redesigned so they are a suitable shape to be put in children's shoes and denim apparel as well. The labels may also be put into pouches that are sewn into accessories such as rucksacks. Thinfilm's EAS tags are compatible with the global base of installed 8.2 MHz RF EAS infrastructure, although stores may need to replace equipment for physically removing tags with tag deactivators.

Strategy

Management is focused on three activities: (1) it is enhancing CNECT functionality to support an expanding number of marketing applications; (2) it is commissioning the R2R production facility in San Jose so it can manufacture tags in the volumes and at the price-point required for deployment of billions of units; and (3) it is ensuring that it can provide marketing solutions that are relevant for consumers with Apple devices as well as those using Android or Windows operating systems.

Enhancing CNECT capability

In Q118 Thinfilm announced a partnership with marketing analytics leader Adobe, integrating the capabilities of Adobe Analytics with the CNECT platform. This gives CNECT users the advanced data analysis available with Adobe Analytics, supporting more sophisticated mobile marketing programme management.

In April 2018, Thinfilm released CNECT Cloud Platform 2.0. This has a more intuitive user interface, enhanced tag management capabilities that simplify tag management at scale and streamlined templates to simplify the creation of dynamic NFC-triggered consumer experiences.

Later the same month, Thinfilm launched NFC Blockchain Services to enable product traceability and secure transfer of ownership capabilities through the CNECT Cloud Platform. The solution is built on Ethereum software. It enables tagged items to be tracked as they are transferred along a supply chain. Using the same tag, distributors can verify the authenticity of products as well as location and distribution date, consumers can check how fresh food is and where it has come from and brands can deliver NFC mobile marketing experiences to consumers. This makes it a cost-effective solution for both the supply chain and the consumer-facing parts of a business. The ability to check on the provenance of an item and provide a mechanism for proving that an item has been

shipped, received or returned may encourage more consumers to make purchases from e-commerce sites.

Switching to R2R production

Innovative printed electronics tags

Production of PDPS tags starts by printing a circuit on a very thin, flexible metal substrate. The circuits are pre-programmed by using lasers to blow fuses so each circuit has a unique ID number which is loaded into the CNECT platform. An antenna and other components are connected to the circuit by a third party in the Far East. EAS tags are manufactured in a similar way. Because each EAS tag is the same, no pre-programming is required and fewer processing steps are needed during the print phase. NFC tags based on conventional silicon are produced in a similar back-end process to PDPS tags, substituting the printed circuit with a conventional silicon chip.

Capex for printed electronics substantially less than silicon

One of the key benefits of printing electronics rather than the traditional semiconductor manufacturing process is the low cost of equipment. Thinfilm budgeted c \$32m for its new R2R production facility in San Jose, which will be able to output billions of printed NFC tags each year. Management estimates that an equivalent conventional semiconductor fabrication facility would cost more than \$1,000m to construct.

Shift to R2R brings down unit costs

In June 2017 Thinfilm officially opened the plant. The building was previously owned by silicon chip manufacturer Qualcomm and therefore came with substantial state-of-the-art clean-room facilities, which is a significant part of the cost, so Thinfilm only needed to have the printed electronics equipment installed. Opening this plant was a landmark step for Thinfilm, as historically it has manufactured both EAS and NFC tags by printing each sheet of flexible material individually. The move to R2R production increases batch size by c 600x, ultimately enabling Thinfilm to output NFC and EAS tags at a price point where they can be deployed in their billions on consumer goods, enabling use cases that are not possible with silicon technology.

NFC production remains on track despite delays

Management had intended that production of EAS tags on the R2R process would have started by the end of 2017. However, there were delays shipping the equipment to San Jose. Thinfilm started fully processing EAS tags in the facility at the end of May. Processing printed NFC tags will use all of the EAS R2R equipment plus six additional process tools. At the beginning of May management noted that delivery and installation of the additional equipment would start at the end of Q218, enabling Thinfilm to meet the schedule stated in December 2016 of starting R2R NFC production by the end of Q318. Once product qualification is completed in Q4, the line is expected to have an installed annual capacity of billions of NFC front-end die.

Getting a bite of the Apple

The entrance of Apple into the NFC ecosystem sparked an upswing in interest in NFC marketing from many brands that had been waiting for Apple to endorse NFC before committing to the standard. However, iOS11 can only read the five standard types of NFC tags defined by the NFC Forum so this excludes Thinfilm's PDPS tags, which use a unidirectional device protocol that the company refers to as TTF (tags talk first). Management is taking a range of steps to address this.

Target primarily Android demographics

One option followed by Thinfilm is to target applications where non-compatibility with the Apple ecosystem is not an issue. These include:

- Supply chain/industrial/military customers, where staff use Android/Microsoft handsets or special readers.
- Products whose packaging or labelling process is unsuited to brittle silicon-chip tags, eg spirits producers where 10-15% of silicon-based tags are damaged.
- Products targeted at the European or developing markets, where Android use is over 75%.
- Campaigns aimed at lower income and/or older demographics, particularly outside the US where Android users can be expected to be 90% or more of the market, eg mass-market healthcare products/devices aimed at seniors. For example, a recent marketing campaign for Dunhill based in the Dubai duty free zone and using Thinfilm tags was purely Android based.

However, some brands will question the value of marketing campaigns using labels that cannot be read by both Apple and Android phones. According to Forrester Research, the iPhone has a bigger share of younger, more affluent consumers in the US and Apple is second only to Amazon in the US with regards to e-commerce. According to Smaato data from February 2017, Apple generates 41% of global mobile advertising revenues vs 55% for Android, despite Android handsets outnumbering Apple three to one. Thinfilm's management is therefore deploying other tactics address the issue.

Adding Apple compatible silicon tags to product range

Thinfilm has extended its product range to include its own-branded conventional silicon chip-based tags based on the NFC Forum approved tag type 2, which work on both Apple and Android phones. These tags are programmed, uniquely numbered, locked and integrated into the CNECT platform. Consumers lose the faster read-speeds associated with the TTF protocol, but this is relatively unimportant for applications where people tap their phones on tags. However, this is important for production lines and during tag application, where brands can do a high speed check that tags being shipped into the market function correctly. Once PDPS tags are being produced in sufficient volumes to be lower cost than silicon tags, ie by the end of 2019, Thinfilm will potentially lose margin if it still has to use silicon tags for some campaigns at this point.

Extending NFC standard to include TTF protocol

Thinfilm is working with other companies that use TTF to have the protocol standardised by the NFC Forum, believing this is a step towards having TTF accepted by Apple and remove the restriction on compatibility. It formally submitted the protocol for standardisation at the end of May 2018. We understand that the last tag standard (tag type 5) took two and a half years to approve, although TTF's track record of trouble-free use in the Android space should help speed up the process. Moreover, Thinfilm is a high-profile and highly active member of the NFC Forum, and with one vote per active member with membership consisting of a large base of tag users and producers, we believe there are reasonably good prospects for TTF to be accepted by the NFC Forum and enter the Apple ecosystem by end 2019, which forms the basis of our forecasts. In parallel, Thinfilm and other TTF proponents are promoting deployment of TTF tags more generally, as if there are sufficient TTF users Apple may decide to support the protocol even if it is not an NFC forum standard.

Redesigning PDPS tags to meet existing NFC standard

If lobbying the NFC to extend the standard looks as though it will take an unacceptably lengthy time, Thinfilm could potentially redesign its PDPS tags so they comply with one of the existing five tag types. Management estimates this would take less than six months. As noted above,

consumers would lose the faster read-speeds associated with the TTF protocol, but this is relatively unimportant for applications where people tap their phones on tags. More importantly, the printed area of the resultant tags is likely to be 2.5–5 times larger than existing PDPS tags, eroding the cost advantage of the printed solution and affecting margins.

Market analysis: Smart labels, a growth market

Exhibit 1: Other participants in smart label market

Company	HQ	Notes
Alien Technology	US	UHF (ultra-high frequency) transceiver chips, inlays and labels, fixed and mobile readers.
Avery Dennison Corp	US	Largest radio frequency ID supplier to retail industry. UHF, HF and NFC inlays, tags and labels. Item tagging, retail/apparel, transportation, life sciences.
CCL Industries	US	Acquired Checkpoint Systems, March 2016. Vertically integrated retail solutions provider including NFC tags.
Intermec	US	Acquired by Honeywell in 2013. Hand-held barcode readers.
Invengo Information Technology	China	Complete integrated radio frequency ID (RFID) solutions for ticketing, identify management, supply chain management, authentication, asset management and brand equity. Includes NFC capability.
ParagonID	France	ASK acquired by Paragon Group in 2017 and renamed. Identification solutions in the e-ID, smart cities, transportation, traceability and brand protection sectors. Solutions include NFC tags.
PragmaticIC	UK	Backed by Arm Holdings and Avery Dennison. Partnering with Smartrac. Technology platform for printing RFID and NFC tags.
Sato Holdings	Japan	Global barcode and RFID technology company.
Smartrac	Netherlands	Solutions for engaging with consumers, authenticating products and tracing assets which include NFC tags.
Xerox	US	Conglomerate. Parc division uses technology licence from Thinfilm to print anti-counterfeiting memory labels.
Zebra Technologies	US	Complete supply chain solutions, including NFC readers.

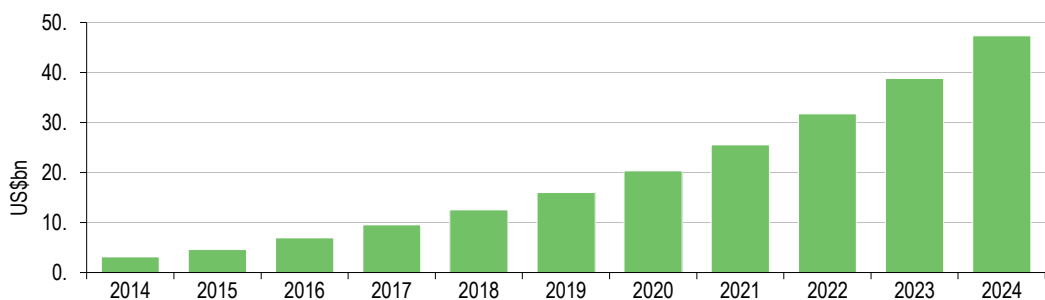
Source: Edison Investment Research

Markets and Markets estimated in April 2016 that the market for smart labels (including EAS, radio frequency ID (RFID), sensor, electronic shelf and NFC labels) will grow from \$4.45bn in 2016 to reach \$10.0bn by 2021, representing a CAGR of 17.6%. The dominant technology in smart labels is RFID silicon chips, which Future Market Insights estimated to account for over 52.8% of the smart label market in 2016.

Thinfilm and PragmaticIC are the only companies in the smart label sector that use printed electronic technology to make NFC tags. PragmaticIC is ramping up production but does not appear to be manufacturing devices in volume yet, or have a complete NFC solution.

NFC tags

Exhibit 2: Global NFC market 2014-24



Source: Statista

IDTechEX forecasts the NFC market will grow at a CAGR of 37% between 2015 and 2020, while Transparency Market Research forecasts the global market for NFC chips, which we see as a proxy for the NFC tag market, to grow at a CAGR of 26.0% to reach \$10.6bn between 2016 and 2024. We see three main drivers of growth: the desire for product differentiation and alternative marketing routes to consumers; rapidly emerging ubiquity in NFC enabled handsets, particularly with the

addition of Apple to the ecosystem; and falling NFC silicon tag prices. Although silicon tags have security drawbacks that may deter brands from using them (see below), their availability should help make consumers very familiar with the concept of tapping NFC tags in a wide variety of situations and drive further implementation. NXP was NFC market leader in 2015 with 55% market share and is the dominant producer of tag type 2 chips, which are the closest competitors to Thinfilm's products.

Exhibit 3: A comparison of printed electronic and silicon tags		
Heading Left	Thinfilm's printed electronic tags	Silicon tags
Robustness	Flexible, conform to shape of bottle	Brittle. 10-15% of tags on bottles get damaged.
Resilience to cloning	ID programming cannot be modified	ID programming can be modified
Speed of reading	TTF protocol is 40x faster than NFC endorsed protocols	NFC endorsed protocols
Wholesale price	12-15c/tag including integration into CNECT	12-15c/tag including integration into CNECT 11-13c/tag without integration

Source: Edison Investment Research

Software platforms

The market appears to be evolving rapidly, so our selection for comparison is not exhaustive. CNECT looks similarly feature-rich to the French Connectthings platform, which is oriented to poster-embedded tags and has a greater focus on Bluetooth and city centre beacons than NFC. It appears to have superior functionality to the independent US platform Qfuse, with a mobile device interface. It also compares well with the 'Smart Cosmos' platform offered by silicon chip-based NFC label producer Smartrac. This does not appear to provide full geolocation and does not have a mobile device interface. With the platforms market developing rapidly, we believe CNECT is a very important tool to build sales and retain customers. Our model assumes customers do not pay upfront for CNECT access and the charge for monitoring each tag with CNECT is bundled in the tag price. This is an over simplification, because management does split out CNECT fees in some contracts.

Exhibit 4: Competitors in NFC analytics platforms		
Name	Key products	Description
CNECT Thinfilm	IntIT, MCI, G, RTA, mCTM (PDPS and silicon NFC labels sourced from THIN)	A turnkey multi-tenant cloud-based platform (hosted by Amazon Web Services (AWS) outside China) that integrates with Thinfilm's NFC tags. Provides a secure way to store, manage and track tags while managing consumer engagement and product authentication. Includes a mobile SDK to enable users to read, configure taps and run campaigns from mobile devices. Geolocations, time of tap and analytics are also provided via a graphic interface.
Qfuse (unlisted US company)	IntIT, MCI, G, RTA (NFC and QR codes)	The Qfuse platform provides tracking of NFC tags and QR labels providing data in map, tabular and graphic format as well as providing analytics. Integrates with Salesforce and CRM systems.
Connectthings Connectthings	IntIT, MCI, RTA, mCTM (BLE, NFC, QR code & WiFi)	Connectthings deploys networks of contactless technology beacons (Bluetooth low energy, NFC, QR code, wi-fi) in public spaces. The platform is running in 62 cities worldwide but mainly focused on Bluetooth beacon interactions and city- rather than product-located beacons. Key corporate clients include L'Oréal, Vodafone, BNP Paribas, Legrand and Solocal.
"Experiences" Smart Cosmos Smartrac	IntIT, MCI, RTA (NFC, QR codes, RFID, barcodes)	Platform enables clients to track the location and time of day/weather conditions of NFC taps, and track location in store of RFID tags. Provides data analysis and integrating with existing CRM and ERP systems. The messages to customers from NFC taps can be set to change for the time of day etc, as well as being different for different consumers as well as products and locations.
Unitag Unitag	G, RTA (NFC and QR codes)	Marketing and analytics platform, focused on NFC and QR code formats. Data can be exported but there is no integration with user's system. Clients include Cacharal, Lindt and Michelin.
Layerscape Intelligent Gateway NXP	IntIT	NXP is working with AWS to integrate the latter's Greengrass software into its Layerscape platform. Further details expected after completion of development

Source: Thinfilm, Edison Investment Research. Note: IntIT = integrates with partner IT system; MCI = map-centred interface; G = geolocation; RTA = real time analysis; mCTM = mobile contextualised content management and SDK = software development kit.

EAS Tag market: Well established but still considerable growth potential

The EAS tag market is served by many players incorporating externally sourced RFID silicon chips into tags that are sold to retailers along with tag readers and in-store sensors. Leading producer Checkpoint estimated the global EAS market at \$1.1bn in 2015, while Zebra Technologies

estimated in 2017 that penetration of passive UHF (RFID) in retail was still only around 5%, giving significant growth potential in a core area.

Thinfilm's printed EAS tags exhibit numerous advantages compared with conventional solutions. Firstly, once they are deactivated at point-of-purchase, they will stay deactivated. This contrasts with conventional magneto-resistive tags, which may reactivate when a garment is washed, causing significant embarrassment if the wearer of the garment tries to enter a store and have the reactivated tag sensed by an anti-theft device. This is a problem with RFID chips, estimated by TUV Rheinland to have a frequency of 23% in 2013. The printed tags can be easily incorporated into garments so that a potential purchaser can see what a garment looks like without a bulky tag getting in the way. The labels can be left in the garment post-purchase, for example in the sole of a shoe, or under the leather brand patch in jeans and chinos so a retail assistant only has to deactivate the tag rather than spend time removing it.

Sensitivities

- **Market Pioneer:** Thinfilm is pioneering a new technology and market. While the potential is clearly substantial, there is no guarantee that its products will be adopted by the market, or adopted in sufficient scale or pricing to generate substantial shareholder returns. Tag prices may need reducing further than we forecast to achieve forecast volume sales in the FMCG (fast moving consumer goods) sector.
- **Apple phone compatibility:** in June 2017 Apple announced that devices with iOS11 would be able to read NFC tags that use one of the five standards recognised by the NFC forum, but this currently excludes the TTF protocol used in Thinfilm's printed electronic tags. As discussed earlier, management is addressing this issue in several ways. We assume Apple will start to support TTF protocol by end 2019. Until then, customers wanting Apple-compatible tags will use conventional silicon tags either from Thinfilm or one of its competitors, making their choice of supplier based on the features of the associated software platform and tag cost. This may adversely affect revenue development in 2018 and 2019 if CNECT has less functionality than other software platforms, although our analysis (Exhibit 3) shows that CNECT is well-placed in comparison with competitors, or if competitors aggressively discount silicon tags. If iOS support is delayed into 2020 or beyond we believe it is possible that Thinfilm will redesign its printed electronic tags so they are Apple compliant. During 2020, fabrication production efficiencies should mean that the gross margin from tags using third-party silicon chips becomes less than from Thinfilm's own printed electronic TTF protocol tags. If Thinfilm has to continue selling third-party silicon tags during 2020, this will adversely affect gross margin and potentially capacity utilisation in the new R2R production facility. Alternatively, if Thinfilm has to switch to a redesigned printed electronic tag using an NFC Forum-compliant protocol, gross margins will be adversely affected because these redesigned tags will be larger than designs supporting the TTF protocol. Revenue growth from 2020 onwards will not be affected because of the superior robustness and resistance to cloning printed electronics tags compared with silicon ones.
- **Execution risk:** both the EAS and NFC tags have been proven in numerous customer deployments. However, these tags have been manufactured on single sheets of substrate, not using R2R production techniques. R2R production of EAS tags has commenced, but not all of the equipment required for R2R production of NFC tags has been commissioned.
- **Competition:** there are a number of companies developing silicon-based tags and associated software but relatively few developing tags deploying printed electronics. The industry is at a sufficiently early stage that competition is not the primary concern. Indeed, more competition could help develop the market and improve Thinfilm's sales prospects.
- **Reliance on suppliers:** electronics inks are a key part of the supply chain. There is a broad range of suppliers, of which Solvay is one of the largest. Thinfilm is becoming less and less

reliant on specific suppliers because it is moving towards mixing inks itself from standard products. The printing presses used by Thinfilm are the same as those used in the printing industry, but are adapted for use in electronics. Thinfilm uses several partners in South-East Asia for back-end processing. The equipment and skills used in back-end processing are relatively commoditised and therefore not a very sensitive part of the supply chain, but most short-term bottlenecks tend to be caused by this process.

- **Funding gap:** we estimate a funding gap of c \$25.5m until cash flow break even during 2019. We model this as satisfied through debt, in accordance with Edison policy, but note that further equity issues could dilute returns to existing shareholders.

Financials

Thin Film is pioneering a new market and, as is invariably the case, this has taken substantially more time and more investment than previously anticipated. While further obstacles may well be encountered, we believe that the building blocks to facilitate an acceleration in growth are now being put in place. Our base case estimates (shown in Exhibit 5) are based on a scenario whereby the business does successfully execute on plan and customer adoption is relatively robust. The range of potential outcomes is large however and highlight our sensitivity analysis in Exhibit 7.

Results summary: Q118

Revenue and other income rose by 6% year-on-year in Q118 to US\$1.2m. Revenue from sales of EAS and NFC tags grew by 35% to US\$0.4m, as 6m EAS tags were shipped in Q118 compared with 5m in Q117 and shipments of SpeedTags more than doubled. Income related to government grants and other funded projects rose by 14% to US\$0.4m. Q117 benefited from a joint development agreement with a global pharmaceutical company, whereas Q118 was flattered by US\$0.4m profit on disposal of equipment acquired when the company secured the Junction Avenue facility, as well as disposal of Linköping site assets and IP related to display and sensor technology. Operating costs (excluding depreciation and amortisation charges) reduced by 6% year-on-year to US\$ 13.9m. Higher payroll costs associated with full-time operation at the R2R production facility in San Jose was partly offset by lower premises costs as activity at the Linköping site has reduced and Q117 bore the cost of renting both the original and the new premises in San Jose. Operating losses widened by 6% to US\$13.7m. Losses before tax narrowed by 20% to US\$9.6m because of the beneficial impact of unrealised foreign currency gains.

Net cash reduced by US\$10.4m to US\$75.6m. Thinfilm invested US\$0.7m in working capital and US\$3.0m on capital expenditure (including pre-payments) primarily related to equipment for the new roll-based production line at the San Jose site. This was partly offset by a US\$1.0m inflow from the asset disposals referred to earlier. The only financial liability is \$12.0m arising from a long-term financial lease for the R2R production facility, which was created in November 2016.

Forecast: Assume Apple compatibility achieved by end 2019

Our model assumes that Thinfilm will sell 21m NFC tags in 2018, of which two-thirds will include silicon chips from third parties then almost 700m NFC tags in 2019, of which half will be silicon based, and over 1,500m NFC tags in 2020, of which less than 10% will be silicon. Putting this in context, 21m tags is equivalent to one in 20 of the clients currently signed up to the CNECT platform, implementing a campaign the size of the lovate programme. In our model, both SpeedTap (PDPS) and silicon tags are priced at 13c per unit, which includes integration with the CNECT software platform. We model 65 m EAS tags in 2018, reflecting use on jeans as well as footwear from Q218 onwards. This rises to over 150m units in 2019 and over 230m units in 2020. Estimated

revenues attributable to NFC tags in 2020 total \$197.9m, which is approximately 1% of the total global NFC market as forecast by Statista.

Exhibit 5: Analysis of sales and gross margin 2018-27e

\$m	2018e	2019e	2020e	2021e	2022e	2023e	2024e	2025e	2026e	2027e
Revenue by product line										
EAS	3.3	7.4	10.0	12.9	16.1	20.4	24.5	27.0	29.6	32.6
NFC OpenSense	0.4	6.9	22.0	36.0	37.8	39.7	41.7	51.1	56.6	57.5
NFC SpeedTap	0.4	46.4	161.6	225.2	268.0	264.9	312.9	365.0	438.0	467.6
NFC Silicon	1.9	33.9	14.3	-	-	-	-	-	-	-
Pass-through costs	0.2	4.4	7.6	14.0	15.7	17.8	19.6	21.8	23.6	23.7
Sales revenue	6.1	99.0	215.5	288.1	337.7	342.8	398.7	464.9	547.8	581.4
Total unit sales own production (m)	72	586	1,636	2,467	3,107	3,906	4,768	5,810	6,905	7,700
ASP own production (c/unit)	5.9	11.1	12.3	11.7	10.9	8.8	8.4	8.0	7.9	7.6
Share units produced in-house (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Production revenue	4.2	65.1	201.2	288.1	337.7	342.8	398.7	464.9	547.8	581.4
Other revenue*	3.8	35.3	15.8	1.5	1.6	1.6	1.7	1.8	1.8	1.8
Total revenue	8.0	100.4	217.0	289.7	339.2	344.5	400.4	466.7	549.6	583.2
Gross margin own production (%)	(26.0)	(2.7)	49.7	52.0	49.4	48.5	48.6	48.9	49.3	49.4

Source: Edison Investment Research. Note: *Grants and sales of silicon tags.

We model FY18 payroll, services and premises costs at Q118 levels as the R2R facility is already fully staffed. We assume that management will be investing heavily in sales and marketing to promote the advantages of the CNECT platform and gain share of the market that has been opened by Apple's decision to support NFC, and model a 20% y-o-y increase in expenditure during both 2018 and 2019. Since the R2R facility will be running in start-up mode during much of 2018, gross margin on product manufactured in-house is expected to be negative, but this is only a small proportion of total sales. By 2019 gross margin on NFC tags manufactured in-house is expected to be slightly lower than for silicon tags and by 2020 the gross margin on in-house NFC tags is expected to be better than that for silicon tags. At this point, assuming that the TTF protocol has been adopted by Apple, silicon tags will drop to 7% of total units shipped.

Capex is expected to be high again in 2018 (\$23.5m excluding capitalised development costs) as the company purchases and installs the rest of the equipment in the R2R facility, then it falls to \$8.0m (excluding capitalised development costs) in FY19 once the installation is complete.

Our model shows group revenues increasing almost fortyfold between 2017 and 2020 as the company reaches positive EBITDA and net profit in 2020. This is based on our expectation of rapid expansion of sales of NFC tags generally helped by Apple's adoption of NFC, the increased functionality of the CNECT software platform helping take market share, and use of conventional silicon tags as a temporary means of fulfilling demand. In addition, we assume that TTF will be compatible with iOS11 by 2020, leading to a sharp increase in sales of PDSP NFC tags.

Valuation

DCF valuation

Thinfilm is the only listed company focused on the development and manufacture of printed electronics, so a multiples-based analysis is not appropriate. We therefore use a DCF approach to value the business across a range of scenarios.

Given Thinfilm's relatively early stage of corporate development and the uncertainty regarding Apple's adoption of the TTF protocol, there is a wide margin of error in our unit sales forecasts. With the product mix and growth profile shown in Exhibits 5 and 6, which assume that Apple adopts the protocol by the end of 2019, our DCF calculation generates an indicative valuation of NOK3.01/share.

Exhibit 6: DCF summary										
\$m	2018e	2019e	2020e	2021e	2022e	2023e	2024e	2025e	2026e	2027e
Total revenue	8.0	100.4	217.0	289.7	339.2	344.5	400.4	466.7	549.6	583.2
Gross margin own production (%)	(26.0)	(2.7)	49.7	52.0	49.4	48.5	48.6	48.9	49.3	49.4
EBITDA	(52.4)	(27.6)	46.7	74.5	85.5	78.7	99.7	126.7	166.7	177.8
EBITDA Margin (%)	(654.4)	(27.5)	21.5	25.7	25.2	22.8	24.9	27.2	30.3	30.5
Depreciation	(4.8)	(6.9)	(7.1)	(6.9)	(7.0)	(7.3)	(7.6)	(8.0)	(8.1)	(8.6)
Share-based payments	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)	(2.3)
EBIT	(59.5)	(36.9)	37.3	65.3	76.1	69.1	89.8	116.4	156.3	166.8
Notional tax	0.0	0.0	0.0	0.0	0.0	0.0	(28.7)	(37.2)	(50.0)	(53.4)
Tax rate (%)	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00
EBITDA after tax	(52.4)	(27.6)	46.7	74.5	85.5	78.7	71.0	89.5	116.7	124.4
Change in working capital	8.3	(15.2)	(19.2)	(11.9)	(8.2)	(0.9)	(9.2)	(10.9)	(24.5)	(19.2)
Capex*	(25.0)	(9.6)	(4.8)	(7.8)	(8.9)	(9.3)	(10.6)	(12.2)	(14.2)	(15.2)
Capex/revenue (%)	311.9	9.6	2.2	2.7	2.6	2.7	2.7	2.6	2.6	2.6
Free cash flow	(69.1)	(52.5)	22.7	54.8	68.4	68.6	51.1	66.4	78.0	90.1
Terminal value										783
NPV of future cash flows	(69.1)	(45.8)	17.3	36.5	39.8	34.8	22.7	25.7	26.4	258.2
Value of future cash flows	346				WACC	14.5%				
FY17 net debt/(cash)	(86.0)				Terminal growth rate	3%				
Equity value	432.5				TV as % of total EV	53.5%				
Per share value (NOK)	3.01									

Source: Edison Investment Research. Note: *Including capitalised development costs. Exchange rate: US\$/NOK8.15.

Sensitivity analysis – bull and bear cases

The qualitative impact of delays in Apple adopting the TTF protocol is explored in detail in the Sensitivities section, but this is not the only factor that may adversely affect deployment of Thinfilm's tags. It is also dependent on how quickly the R2R facility becomes fully operational and on competitive activity, such as discounting.

Our analysis (Exhibit 7) indicates that the current share price (Bear case) factors in a revenue ramp-up that is c 23% slower than that adopted in our model. In principle, the roll-out rate could be slower than this, but each new client win, especially those requiring deployments in the size of lovate, reduces the downside risk to our base case. Conversely, tag deployment from 2021 onwards may be substantially more rapid than the rate shown in our base case if the tags are deployed as widely as management envisage and become as ubiquitous as semiconductors containing ARM processors, Bluetooth chips or graphics processors. If Thinfilm licences the technology to a third party, deployment is not limited by the capacity of the R2R facility. Our "Bull case" case models the R2R facility reaching full capacity in 2023, but with third-party capacity enabling tag deployment to be five times this level in 2027. This gives a valuation of NOK11.14/share.

Exhibit 7: Sensitivity analysis										
\$m	2018e	2019e	2020e	2021e	2022e	2023e	2024e	2025e	2026e	2027e
Rate of roll-out implied by current share price (Bear case)										
Total revenue (\$m)	7.3	79.4	169.7	226.4	265.3	270.3	314.4	366.0	430.4	457.0
EBITDA (\$m)	(52.6)	(34.9)	20.7	40.3	47.4	40.8	55.6	74.9	105.1	112.3
Indicative valuation (NOK/share)	1.63									
Third-party production capacity supporting higher volume ramp-up (Bull case)										
Total revenue (\$m)	8.0	100.4	217.0	479.2	802.8	797.0	922.0	1009.0	1021.7	1058.8
EBITDA (\$m)	(52.4)	(27.6)	46.7	179.3	327.4	339.6	432.7	495.0	512.8	536.2
Indicative valuation (NOK/share)	11.14									

Source: Edison Investment Research

Exhibit 8: Financial summary

	USD '000s	2016	2017	2018e	2019e	2020e
Year end December		IFRS	IFRS	IFRS	IFRS	IFRS
PROFIT & LOSS		USD	USD	USD	USD	USD
Revenue		3,845	5,907	8,013	100,419	216,995
EBITDA		(36,873)	(50,867)	(52,436)	(27,631)	46,708
Operating Profit (norm, before amort. and except.)		(40,049)	(57,858)	(57,225)	(34,542)	39,604
Intangible Amortisation		0	0	0	0	0
Exceptionals		0	0	0	0	0
Share-based payments		(1,433)	(2,220)	(2,308)	(2,308)	(2,308)
Operating Profit		(41,482)	(60,078)	(59,533)	(36,850)	37,296
Net Interest		(2,731)	374	63	(623)	(1,264)
Profit Before Tax (norm)		(42,780)	(57,484)	(57,162)	(35,165)	38,340
Profit Before Tax (FRS 3)		(44,213)	(59,704)	(59,470)	(37,473)	36,032
Tax		(282)	122	0	0	0
Profit After Tax (norm)		(43,062)	(57,362)	(57,162)	(35,165)	38,340
Profit After Tax (FRS 3)		(44,495)	(59,582)	(59,470)	(37,473)	36,032
Average Number of Shares Outstanding (m)		659.1	862.7	1,172.0	1,172.0	1,172.0
EPS - normalised (c)		(6.5)	(6.6)	(4.9)	(3.0)	3.3
EPS - (IFRS) (c)		(6.8)	(6.9)	(5.1)	(3.2)	3.1
Dividend per share (c)		0.0	0.0	0.0	0.0	0.0
EBITDA Margin (%)		N/A	N/A	N/A	N/A	21.5
Operating Margin (before GW and except.) (%)		N/A	N/A	N/A	N/A	18.3
BALANCE SHEET						
Fixed Assets		24,903	34,246	53,382	55,044	51,677
Intangible Assets		3,142	2,190	3,686	5,332	7,142
Tangible Assets		9,155	20,522	39,234	40,322	36,218
Investments		12,607	11,534	10,462	9,390	8,318
Current Assets		79,231	115,074	31,158	33,404	92,658
Stocks		1,086	709	1,317	16,507	35,670
Debtors		3,940	16,245	1,317	16,507	35,670
Cash		74,205	98,120	28,523	390	21,317
Other		0	0	0	0	0
Current Liabilities		(7,789)	(7,320)	(1,317)	(42,007)	(61,170)
Creditors		(7,789)	(7,320)	(1,317)	(16,507)	(35,670)
Short term borrowings		0	0	0	(25,500)	(25,500)
Long Term Liabilities		(12,850)	(12,125)	(11,581)	(11,037)	(10,493)
Long term borrowings		(12,581)	(12,125)	(11,581)	(11,037)	(10,493)
Other long term liabilities		(269)	0	0	0	0
Net Assets		83,495	129,875	71,641	35,404	72,671
CASH FLOW						
Operating Cash Flow		(37,412)	(52,281)	(44,120)	(42,821)	27,545
Net Interest		88	343	63	(623)	(1,264)
Tax		(118)	(38)	0	0	0
Capex		(5,350)	(27,107)	(24,996)	(9,646)	(4,810)
Acquisitions/disposals		0	0	0	0	0
Financing		101,124	103,285	0	0	0
Dividend payments and Other items		(67)	170	0	0	0
Net Cash Flow		58,265	24,372	(69,053)	(53,089)	21,471
Opening net debt/(cash)		(15,940)	(61,624)	(85,995)	(16,942)	36,147
Finance leases initiated		(12,581)	0	0	0	0
Other		0	0	0	0	0
Closing net debt/(cash)		(61,624)	(85,995)	(16,942)	36,147	14,677

Source: Company data, Edison Investment Research

Contact details Henrik Ibsens Gate 100 PO Box 2911 Solli NO-0230 Oslo Norway +47 23 27 51 59 www.thinfilm.no	Revenue by geography N/A
Management team CEO: Dr Davor Sutija CEO of Thinfilm since 2010, Dr Davor Sutija was previously senior vice president, product marketing at Microsoft subsidiary FAST and founding CEO at SINOR, a producer of electronic and PV-grade silicon ingots. He is a graduate of the Jerome Fisher Management and Technology program at the Wharton School and has a PhD from the University of California, Berkeley.	CFO: Ole Ronny Thorsnes Ole Ronny Thorsnes has been CFO of Thinfilm since August 2016. Previously he was vice president, mergers and acquisitions for Orkla, a leading supplier of branded consumer goods and concept solutions, operating primarily in the Nordic and Baltic regions. He has also worked as a senior associate at McKinsey and Company, which he joined in 2008.
Chief operating officer: Dr Peter Fischer Dr Peter Fischer has been CPO and COO of Thinfilm since joining at the start of 2014. Dr Fischer was previously CTO at Plastic Logic, a printed electronics start-up and producer of flexible displays, and held senior positions at Qimonda and Infineon Technologies.	Chief commercial officer: Christian Delay Christian Delay joined Thinfilm from the Ask Partner Network (APN, an IAC company) where he was responsible for the strategy and growth of APN's mobile business. His efforts focused on building search and advertising solutions that were integrated with, and distributed to, application developers and OEMs, which led to significant user, query and revenue growth. Prior to joining APN, he held senior positions at Opera Software, Obopay, Yahoo and Infospace.
CTO: Dr Christer Karlsson At Thinfilm since 2000, Dr Karlsson has a PhD in surface and semiconductor physics from Linköping University. He has served as a researcher, project manager and deputy research director at the National Defence Research Establishment, Sweden, in the field of laser systems including semiconductor lasers optics, signal processing and system design.	
Principal shareholders	(%)
Capita Financial Managers Ireland (Woodford Investment Management)	19.2
Invesco	15.0
Ferd	7.0
Nordnet Bank	3.6
First Asset Management	3.6
Old Mutual	2.7
BNP Paribas	2.5
Companies named in this report Avery Dennison ((AVY:US); CCL Industries (CCL/A:CN); Invengo Information Technology (002161:CH); NXP Semiconductors (NXPI:US); ParagonID (PID:FP); Qualcomm (QCOM:US); Xerox Corp (XRX:US); Zebra Technologies (ZBRA:US)	

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