Zacks Small-Cap Research

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Brian Marckx, CFA
bmarckx@zacks.com
Ph (312) 265-9474

scr.zacks.com

10 S. Riverside Plaza, Ste 1600, Chicago, IL 60606

# Zecotek Photonics (V.ZMS)

## V.ZMS: Some Delays But Fundamentals Intact

| | |
|---|---|
| **Current Recommendation** | **Buy** |
| Prior Recommendation | N/A |
| Date of Last Change | 10/02/2013 |
| Current Price (04/24/2015) | $0.36 |
| **Target Price** | **$2.00** |

## OUTLOOK

Zecotek is the only company in the world to own all key elements for a high performance PET scanner. Technology is protected by large patent portfolio. ZMS.V is well positioned to capitalize on growth of PET market. Their LFS scintillation crystals look to be superior to any other crystals on the market and with PET scanner performance tied to performance of crystals, demand for LFS crystals could be substantial. Major distributor recently signed and initial orders received. Crystals also to be used in high profile CERN experiments. Lawsuit whereby ZMS.V claimed patent infringement was just settled. We think the settlement now opens up significant opportunity for Zecotek, the benefits of which we think begin to be realized in the very near-term.

## SUMMARY DATA

| | |
|---|---|
| **52-Week High** | **$0.84** |
| **52-Week Low** | **$0.26** |
| **One-Year Return (%)** | **-47** |
| **Beta** | **N/A** |
| **Average Daily Volume (sh)** | **194,847** |
| **Shares Outstanding (mil)** | **110** |
| **Market Capitalization ($mil)** | **40** |
| **Short Interest Ratio (days)** | **N/A** |
| **Institutional Ownership (%)** | **N/A** |
| **Insider Ownership (%)** | **N/A** |
| **Annual Cash Dividend** | **N/A** |
| **Dividend Yield (%)** | **N/A** |
| **5-Yr. Historical Growth Rates** | |
| **Sales (%)** | **N/A** |
| **Earnings Per Share (%)** | **N/A** |
| **Dividend (%)** | **N/A** |
| **P/E using TTM EPS** | **N/A** |
| **P/E using 2015 Estimate** | **N/A** |
| **P/E using 2016 Estimate** | **N/A** |
| **Zacks Rank** | **N/A** |

| | |
|---|---|
| **Risk Level** | **N/A** |
| **Type of Stock** | **Large-Growth** |
| **Industry** | **Med Products** |

## ZACKS ESTIMATES

**Revenue**
(in '000 of $)

| | Q1 (Oct) | Q2 (Jan) | Q3 (Apr) | Q4 (Jul) | Year (Jul) |
|---|---|---|---|---|---|
| 2014 | 8 A | 41 A | 14 A | 23 A | 87 A |
| 2015 | 98 A | 76 A | 272 E | 1248 E | 1694 E |
| 2016 | | | | | 7397 E |
| 2017 | | | | | 10307 E |

**Earnings per Share**

| | Q1 (Oct) | Q2 (Jan) | Q3 (Apr) | Q4 (Jul) | Year (Jul) |
|---|---|---|---|---|---|
| 2014 | -$0.01 A | -$0.02 A | -$0.02 A | -$0.04 A | -$0.09 A |
| 2015 | -$0.02 A | -$0.02 A | -$0.01 E | -$0.00 E | -$0.06 E |
| 2016 | | | | | -$0.01 E |
| 2017 | | | | | $0.01 E |

Zacks Projected EPS Growth Rate - Next 5 Years % **N/A**

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## WHAT'S NEW…

### Q2 Financial Results, Corporate Update…

Zecotek recently filed fiscal Q2 2015 financials (ending January 2015) and released a corporate update on their imaging division. Q2 revenue, as we had anticipated, was insignificant and continues to reflect small orders from a potential customer that is still in the process of validating the company's MAPD and LFS crystals. Operating expenses were $2.3M, largely in-line with our $2.2M estimate and up considerably from the $1.6M in the prior year period with some cost-hangover from the recently settled lawsuit included in the most recent OpEx.

On the operational front ZMS continues to get closer to completing a proprietary IDM, with initial introduction still expected sometime this year and commercial sales forecasted to commence in 2016. As we have detailed in our ongoing coverage of ZMS, we think a high performance IDM could have strong appeal from PET manufacturers given the desire for plug-and-play capability which is largely not available today.

Validation of the LFS scintillation crystals for use in small PET scanners in applications such as pre-clinical pharmaceutical research for drug development is ongoing by certain international PET OEM's. In late December ZMS received $500k in deposits from customers investigating use of the company's LFS crystals in small and next-gen Time of Flight (TOF) PET scanners.

The crystals are also still being used in various experiments by CERN and remain a viable candidate for use in the Large Hadron Collider. While the validation and selection process has been drawn out longer than anticipated, we continue to view this as only delay and one unrelated to ZMS. CERN clearly continues to have substantial interest in ZMS's products given that they are used in several of CERN's experiments, including the high profile Comact Muon Solenoid project.

As a reminder the rebuild was done in order for the Collider to be able to operate at higher temperatures which will require crystals which are extremely hard with very fast decay times. Zecotek's LFS crystals, as compared to other commercially available crystals, look to be the highest performing based on a very high light yield (up to twice that of LSO, although slightly less than NaI(IT)), comparable density and atomic number to LSO (and much higher than NaI(TI)),and the fastest decay times of all the common scintillation materials. As such, and further supported by the ongoing relationship with CERN, we believe ZMS' LFS crystals remain a very viable candidate for further upgrades and enhancements to the Collider as well as other experiments at CERN. While a supply agreement with CERN, which ZMS had expected would be consummated in early 2015 has yet to be announced, we still think that this is still in the cards as CERN completes its validation process.

We also expect the $2 million deposit from Hamamatsu, which ZMS recorded on its balance sheet in December 2014, to begin bleeding into revenue on the income statement as Zecotek commences order fulfillment to its commercialization partner. Revenue related to the $500k order from international OEM's should also start to be recognized in the coming periods.

And finally, with the lawsuit against Philips and St. Gobain settled, this opens up the very real possibility that Philips and Zecotek enter into a supply agreement. Last year Philips suspended CT/PET scanner production at its Cleveland, OH facility after FDA raised concerns about manufacturing processes and controls. Philips did not provide specifics surrounding the issues cited by FDA although has publicly noted that production at Cleveland remains at a very low level and may not be back to cull capacity until the current year-end due in part because "it took longer than anticipated to complete the necessary remediation at some of our suppliers…." While speculation, this could relate to suppliers for crystals.

And conclusion of the lawsuit also removes any possible hesitance by any of ZMS' other potential customers, including other PET OEM's, CERN and Hamamtsu-related customers to place orders until the patent issue was resolved.

Relative to the Display business, as we noted in our prior update, we see potential from this segment to contribute in the future with the company's glasses-free 3D technology and 3D printing.

### Outlook

We updated our financial model and outlook since the resolution of the lawsuit which, as we have explained in our recent reports, we think will open up order flow and fulfillment and provides Zecotek with significantly greater

opportunity for new customer wins. We look for a significant increase in the rate of recognition of the outstanding portion of the $2.5 million in orders (Hamamatsu and int'l OEMs) over the near-term. We also incorporate the assumption that crystals orders that St. Gobain had been getting that infringed ZMS's 7,132,060 patent now go to Zecotek – which obviously includes orders from Philips.

CERN order flow had also been relatively minimal but, again, based on resolution of the lawsuit, we think this now accelerates and contributes during the current year. And while it's still too early to speculate on specific quantities that CERN may order from Zecotek, we think that it's reasonable that it could eventually be in the several million dollars to potentially tens of millions of dollars worth of product.

We also think there are other revenue opportunities that may materialize in the current year that we have not modeled. These could encompass licensing deals with either the Imaging and / or Display business products and patents.

In terms of operating expenses, we expect to see a substantial reduction in professional fees in (which aggregated to over $3.8 million in 2014) as a result of conclusion of the lawsuit. While we think R&D may remain elevated with ongoing development of various products, we look for improvement in operating loss with a ramp in revenue.

We are maintaining our Outperform rating and $2.00/share price target. We continue to think the shares remain highly undervalued with the delay in recognition of the Hamamatsu order and CERN supply agreement putting downward pressure on the stock price and offering an attractive entry point. With the lawsuit now resolved, we think revenue growth steepens significantly.

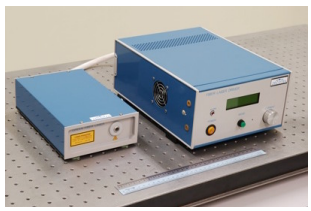
## BACKGROUND

**Three Operating Businesses, Current Main Focus is Imaging Systems**
The company has three operating businesses; Zecotek Imaging, which develops high resolution imaging products and components for the medical field (includes LFS crystals, the company's current focus), Zecotek Lasers, laser systems for the medical and industrial fields, and Zecotek Display, the company's proprietary display technology which provides 3-D viewing without glasses and is aimed at the medical, industrial and consumer markets.



- **Zecotek Display Systems (ZDS)** is focused on a proprietary 3-D technology which provides unique, multi-dimensional viewing without requiring glasses. The display allows viewers sitting at different angles to see separate views. Potential end markets include medical, video gaming, graphic design, and military, among others. We think the display systems business has significant potential given the huge and various markets interested in high quality 3-D technology and the unmet demand due to the fact that most currently commercialized technologies require glasses, which consumers find an annoyance. We had just recently viewed the business as sort of a back-burner opportunity as Zecotek focused on their LFS crystals and their MAPD but recent developments in the display business, including a July 2014 announcement that they signed a letter of intent for Aquarius, Russia's largest computer company, to acquire 20% of Zecotek Display Systems for $7 million, now have us believing Zecotek's display systems business may have more near-term potential than we had previously thought. These displays are for flat screen and large screen formats and also for use with a 3D printer. The company has made significant and rapid progress with product development in the Display business and expects to have a working 3D printer during 2015. We also think an announcement related to 3D displays may be forthcoming.

- **Zecotek Laser Systems (ZLS)** develops lasers and laser components for applications in the medical and industrial sectors as well as for research purposes. The company develops two main types of lasers; visible fiber lasers (VFL) and thin film lasers.



Their VFL lasers cover wavelengths in the green, blue and red spectral ranges and are manufactured using the company's proprietary fiber optical technology. Zecotek notes certain advantages of their lasers including; high beam quality and stability, compact design and high efficiency, adjustment-free operation, no water cooling, wavelength output in most of the visible spectrum, and broad continuous wavelength tuneability. The tuneability within wide spectral ranges, along with relatively lower cost compared to conventional lasers are specifically noteworthy benefits. Their VFL lasers are sold to various industries and for a variety of applications, these include; medical (DNA sequencing, flow cytometry, ophthalmology, dermatology, urology), printing, material processing (laser writing, lithography), and research (spectrsocopy, fluorescent analysis), among others. Zecotek's VFL lasers are currently used by the National Cancer Institute, a division of the U.S. National Institutes of Health (NIH).

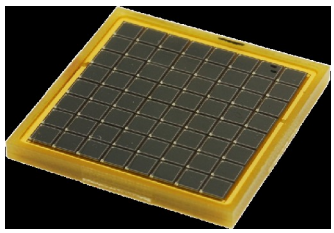
Zecotek's thin film lasers are still under development. The company has previously noted that it was partnered with the Advanced Materials and Process Engineering Lab at the University of British Columbia in development of thin film waveguide structures for the next generation of diode-pumped solid-state (DPSS) lasers.

Most recently however, in early 2014 Zecotek noted in its Q2 2014 quarterly filing that it is revising the Laser Systems' technology portfolio, restructuring the business and now focusing on "ready technologies geared to cater for the ever expanding security market demands." What this means in terms of near-term projects, product development or product commercialization is unclear – however, we think it may indicate that the company will look to incorporate its laser technology into products with more broad-based applications. However, similar to the Display Systems segment, we still do not model any contribution from the Lasers Systems business as product development is still in too early of a stage to reasonably estimate financial contribution from these segments.

- **Zecotek Imaging Systems (ZIS)** develops and manufactures components for advanced imaging products, mainly for the medical industry, including PET and MRI scanners. The ZIS business is where most of Zecotek's current attention remains focused and includes their LFS scintillation crystals, MAPD, and integrated PET/MRI assemblies. As the products from the ZIS business, most importantly the LFS scintillation crystals, aggregate the majority of Zecotek's near-term opportunity, this is where we dedicate most of our discussion. In 2009

Zecotek received the Frost and Sullivan award for "Best Enabling Technology" for its MAPD and LFS scintillation materials.

The main components of PET scanners which have to do with capturing the images are crystals and photo-detectors. During a PET procedure a patient is injected with an imaging agent. As the agent decays it emits a positron, and eventually produces photons, which are detected by scintillation crystals. These crystals create a burst of light which are then captured by the photo detectors which multiply the signal, allowing for it to be detected. Millions of these events can occur in a single scan which are then reconstructed with computer algorithms to produce single images. The majority of PET scanners sold today also have CT capability which provides for enhanced resolution and greater localization of lesions, which is particularly desirable for oncology applications. Hybrid PET/MRI scanners, which provide even better visualization of soft tissue and have lower radiation than PET/CT, have recently evolved as a major area of growth for PET manufacturers with Siemens introducing the first fully-integrated PET/MRI scanner in the U.S. in 2011.



Zecotek's **MAPD** have been developed to replace photo multiplier tubes, which are the most commonly used photo detector in PET scanners and gamma cameras. Photo multipliers are a type of vacuum tube, but unlike most vacuum tubes, photo multipliers are not obsolete. Photo multiplier tubes are very sensitive detectors of light with high gain, low noise and very fast response, which has made them ideal for applications such as in advanced medical imaging cameras. They do have some drawbacks, however, including they are relatively large, expensive, and require very high voltage. Another meaningful disadvantage is that strong magnetic fields can impede the performance of photo multiplier tubes. Therefore a combination PET/MRI machine can not easily be constructed using photo multiplier tubes as MRI (magnetic resonance imaging) produces strong magnetic fields. Zecotek and the University of Washington have collaborated in designs for a PET/MRI scanner using the company's newest generation MAPD's.

Zecotek's MAPD have been developed to have all the benefits of photo multiplier tubes (high sensitivity, high gain, low noise, fast response) without the drawbacks. Zecotek's MAPD uses relatively low voltage and the solid-state design makes them much more compact than photo multiplier tubes. It also is not affected by magnetic fields. Zecotek's MAPD target markets encompass all those currently served by photo multiplier tubes which, along with medical technology, includes high energy physics, astronomy, pharmaceutical research, security, defense, and environmental monitoring.

Due to the drawbacks of PMT and advantages of solid-state photo detectors, PET manufacturers have a significant interest in building their scanners with this better technology. The initial solid-state detectors were built with technologies called silicon photo multipliers (SiPM) and multi-pixel photon counters (MPPC), technologies which were invented and patented by scientists who now work for Zecotek. Zecotek improved on these technologies which resulted in the MAPD technology. The MAPD overcomes certain limitations of SiPM and improves overall performance. PMT suppliers have moved towards offering PET manufacturers solid-state technology but in the form of SiPM and MPPC. Zecotek believes their MAPD technology is the optimum solution for the PET manufacturers as well as high-energy physics such as calorimeters and part of the Large Hadron Collider machine in CERN. Zecotek has authored a white paper on their MAPD which references studies that have been conducted which have shown the high performance of their MAPD technology.

Hamamatsu Photonics, which Zecotek recently signed a distribution agreement with (discussed below), is the world's largest supplier of PET photo detectors.




*SOURCE: hamamatsu.com*

Hamamatsu's capabilities extend much further than just manufacturing and distribution, however. The company is deeply engaged in PET-related research and development as well, which also extends into the relationship with Zecotek. Zecotek has several variants of MAPDs and the two companies will collaborate on improvements of Zecotek's photo detectors and modules with Hamamatsu in the lead role. Hamamatsu will also largely be responsible for funding joint R&D and product development. Both companies will retain ownership of their patents and IP.

Hamamatsu is very much on the cutting edge of medical imaging technology innovation and founded the Hamamatsu Medical Imaging Center (picture) where they conduct medical imaging and conduct R&D and clinical trials. Hamamatsu has developed their own photo detectors which are used in TOF-PET/CT scanners.

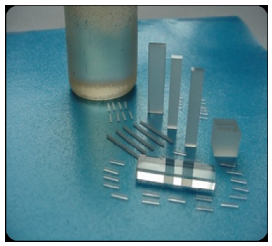
Therefore, Zecotek's agreement with Hamamatsu which includes collaborative efforts on product innovations is much more compelling than just from a distribution standpoint, particularly given Zecotek's large and potentially very appealing patent portfolio.

***MAPD Used by CERN…***

Zecotek notes that their MAPD has undergone testing by a number of institutions including the European Organization for Nuclear Research (CERN), a world-renowned institution run by 20 European member states which (per CERN website) uses "the world's largest and most complex scientific instruments to study the basic constituents of matter - the fundamental particles." CERN has used Zecotek's MAPD photo detectors in several projects and experiments over the last few years all with positive results. CERN has chosen Zecotek's MAPD as an alternative to photo multiplier tubes. Given the strict criteria set by CERN engineers relative to selection of photo detectors, the fact that CERN continues to come to Zecotek for their MAPD for use in their experiments is a clear vote of confidence in the technology. And as CERN is a world leader in scientific research, this vote of confidence carries potentially significant influence and one which commercial manufacturer's of PET systems and other instruments may likely heed. And as we discuss below, CERN is also using Zecotek's LFS crystals in a revolution experiment to clarify the existence of the Higgs Boson.

Zecotek initially partnered with the National NanoFab Center (NNFC), a South Korean nanotechnology company, to manufacture their MAPD photo detectors for the commercial market. With the recently penned agreement with Hamamatsu, manufacturing of the MAPD will now transfer over to Hamamatsu. Zecotek expects to showcase their next-gen MAPD ("MAPD-3") in April 2015 which we think could also potentially commercially launch during the year.

**LFS Scintillation Crystals**



Scintillation means flash of light or luminescence. Scintillation materials are designed to absorb the energy of an incoming particle and then re-emit the energy as light. In applications that use scintillation materials, the more light produced by the material, the better. The company's proprietary and patented LFS scintillation crystals have been designed to provide for certain critical advantages over other commonly used scintillation crystals including high light yields and ultra fast decay times. As the performance of PET cameras is directly effected by the properties of the scintillation crystals used in the scanner, higher light yields and faster decay times means better quality pictures. Important to understand is that there can be significant performance differences between makes and models of PET scanners and the most important link in the components of a scanner that dictate performance is the quality and performance of the crystals. The crystals typically account for about one-third of the total cost of a scanner (PET/CT scanners can cost as much as $2 million) and each scanner requires as many as 30k of these crystals.

The desired properties of scintillators include high light output, high density, high atomic number, short decay time, fast speed, low cost, and hardness, with high light output and short decay time among the most important characteristics. Today, the three most commonly used scintillation materials in PET and gamma cameras are bismuth germanate (BGO), lutetium oxyorthosilicate (LSO) and gadolinium oxyorthosilicate (GSO). BGO has been the most widely used material in legacy PET scanners but since the discovery of LSO, which has certain advantages over BGO, LSO (and LYSO, a related material) has become the scintillation material of choice for new PET scanners (since ~2005).

High light output and short decay time (decay time is a measure of how long until a crystal emits light after absorption of a photon) were not a common combination in scintillation crystals until LSO was discovered, which performs relatively well (compared to BGO and GSO) on both measures. Another scintillation material, NaI(TI), has very high light output but low density and a low atomic number, which means it is relatively inefficient at absorbing photons (i.e. - low stopping power). Despite the shortcomings of NaI(TI), it has been the dominant scintillator material for more than 50 years and remains the material of choice in single-photon emission computed tomography (SPECT)[1]. Meanwhile LSO seems to have combined the best of BGO (i.e. - high density and atomic number) and NaI(TI) (i.e. - high light yield) which has recently made it the scintillation material of choice for the major PET manufacturers.

***LFS's Advantages Trump Competition…***

[1] Saeterstol, Jostein. Characterization of Scintillation Crystals for Positron Emission Tomography. University of Bergen. June 2010

The performance of Zecotek's LFS scintillation crystals, however, looks to even trump that of LSO. With a very high light yield (up to twice that of LSO, although slightly less than NaI(IT)), comparable density and atomic number to LSO (and much higher than NaI(Tl)), and the fastest decay times of all the common scintillation materials, Zecotek's scintillators appear to be the most competitive and highest performance material. In addition to superior performance over competing scintillation materials, Zecotek's LFS crystals are also lower cost. And with the photo detector and scintillation material typically accounting for approximately 60% - 65% of a PET scanner's cost, lower cost and better performing scintillation crystals are significant advantages.

Below is a chart from a white paper authored by Zecotek comparing the characteristics of each scinitillation material. We have verified the performances listed in this chart for the competing materials to other published data in the public domain which agree with Zecotek's findings. The LFS data was taken from trials performed by the University of Washington, CERN, and the Institute for Theoretical and Experimental Physics ) Moscow, Russia.

**LFS scintillation crystals: Industry product comparison**

| Parameter \ Crystal* | Tl:NaI | BGO | LSO | GSO | LYSO | LFS-3 | LFS-7 | LFS-8 |
|---|---|---|---|---|---|---|---|---|
| Density, g/cm$^3$ | 3.67 | 7.13 | 7.4 | 6.71 | 7.1 | **7.35** | **7.4** | **7.4** |
| Effective at. number | 51 | 74 | 66 | 57 | 66 | **64** | **64** | **64** |
| Attenuation length, cm | 2.6 | 1.11 | 1.14 | 1.38 | 1.12 | **1.15** | **1.12** | **1.14** |
| Decay constant, ns | 230 | 300 | 40 | 30–60 | 41 | **25–33** | **30–35** | **12–25** |
| Max emission, nm | 415 | 480 | 420 | 430 | 420 | **425** | **412–416** | **422** |
| Light yield (NaI:Tl=100%) | 100 | 7–12 | 40–75 | 20 | 70–80 | **80–85** | **80–85** | **80–85** |
| Refractive index | 1.85 | 2.15 | 1.82 | 1.85 | 1.81 | **1.81** | **1.81** | **1.81** |
| Energy resolution $^{137}$Cs, % | 8 | 12–14 | 10–14 | 9.5 | 8.0 | **8** | **8** | **7** |
| Absorbed γ-ray irradiation dose, rad (rad. hardness, %/cm)† | 10 (?) | $10^{2-3}$ (?) | $10^{6}$ (7) | $10^{6-9}$ (6) | $10^{6}$ (7) | **$10^{8}$ (2)** | **$10^{8}$ (7)** | **$10^{8}$ (7)** |
| Hygroscopicity | strong | No | No | No | No | **No** | **No** | **No** |
| Hardness, Moh | 2 | 4.5 | 5.8 | 5.7 | 5.8 | **5.8** | **5.8** | **5.8** |
| Cleavage | (100) | none | none | (100) | none | **none** | **none** | **none** |
| Boule size, mm | Ø400x600 | Ø100x250 | Ø75x200 | Ø75x150 | Ø75x150 | **Ø90x250** | **Ø90x250** | **Ø50x200** |

* The chemical composition of the competing crystals: BGO — $Bi_4Ge_3O_{12}$, LSO — $Ce:Lu_2SiO_5$, GSO — $Ce:Gd_2SiO_5$; LYSO — $Ce:Lu_{1.8}Y_{0.2}SiO_5$.

† Induced optical transmission loss after exposure to radiation is a more realistic and quantifiable measure of the radiation hardness than the absorbed radiation dose.

*SOURCE:Zecotek*

Similar to the OEM PET manufacturer market, the market for medical imaging crystals is largely highly concentrated between only a few major suppliers. In general BGO crystals are not considered competitive in terms of performance to LYSO and LSO crystals. Zecotek's LFS crystals would compete against LYSO and LSO crystals, the major manufacturers of which are Saint-Gobain and Crystal Photonics. A third manufacturer, CTI Molecular Imaging, had been a long-term JV of Siemens' and was eventually acquired by the PET OEM in 2005, which afforded Siemens the ability to source their crystals through their wholly-owned supply chain.

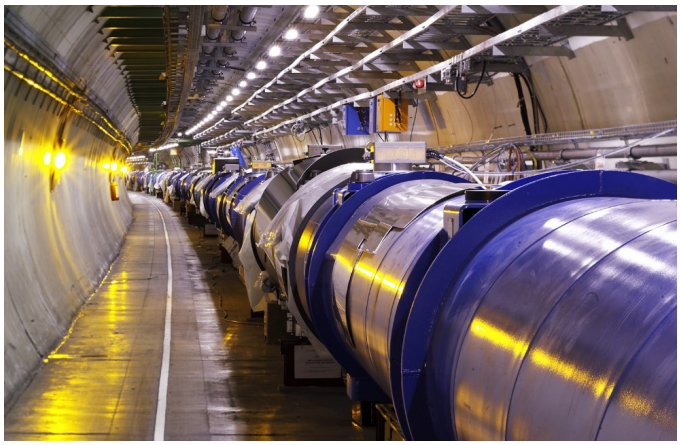
***LFS Crystals Validation Supported By Use In High Profile Experiments…***

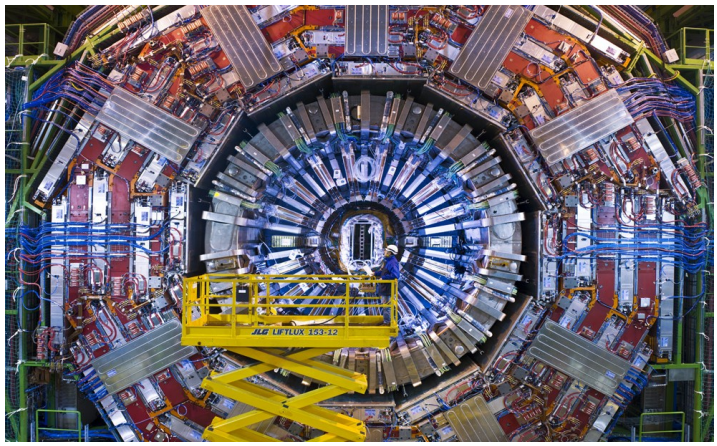
The LFS crystals have been used in trials since 2007 including by The Paul Sherrer Institute (Switzerland) in a PET program focused on increasing performance of PET scanners, Shinshu University (Japan) in trials for their next-gen PET imaging program focused on improving resolution of 3-D imaging in cancer, and trials by the University of Washington and CERN. The various studies over the recent years have aided in the validation of the performance of the LFS crystals.

Employment of the crystals has since evolved to the late stages of validation and is now at a point where they are being utilized as components in scanners and other instruments. This includes being used in development of a new PET system by NuCare Medical Systems, a South Korean nuclear imaging company and in a trial PET scanning device by a (undisclosed) Japanese OEM PET manufacturer. And most recently, in November 2014 Zecotek announced an initial shipment of a $500k order of the crystals to the NIITFA Automation Research Centre for Technical Physics (in Russia) related to the development of a PET scanner.

Scientific applications of the LFS crystals has also evolved beyond just validation of the material and moved to utilization of the crystals for scientific discovery purposes. The Large Hadron Collider has undergone a rebuild in order so it can operate at higher temperatures. The rebuilding process is nearing completion with experiments expected to resume in early 2015. Higher temperatures will require extremely hard crystals - which is one of the reasons that CERN is validating Zecotek's LFS crystals. Zecotek's MAPD may also be used by CERN. Use by CERN in the Collider and/or other high profile experiments should provide significant validation of the properties and performance of the LFS crystals and almost certainly provide Zecotek and Hamamatsu with a valuable and very credible marketing message to the commercial marketplace (Zecotek's LFS-3 crystals will be sold commercially and used in the MAPD product).

## Large Hadron Collider





*SOURCE: boston.com*

Zecotek recently announced that a new configuration of their LFS crystals was requested by CERN for their Compact Muon Solenoid (CMS) experiment. Per Dr. Michael Arenton, Senior Research Scientist with CERN, "We are pleased with the performance of Zecotek's new LFS-3 configuration using plates geometry and we are confident that it will pass all the prerequisites needed for the new electromagnetic calorimeter part of CERN's LHC and CMS upgrades."

Following the initial announcement in late July 2014 that CERN had requested LFS crystals for this new experiment, ZMS announced that CERN will be installing the crystals in the Large Hadron Collider. This is the final validation stage by CERN before the organization would fully adopt the crystals for their experiments. Then in early December Zecotek announced that CERN provided positive feedback on their assessment of the crystals, placed additional orders and expects that the contract should be finalized early next year. While finalization of a supply agreement with CERN has been delayed, we believe this is still in the cards as product validation is completed. We view this as an indication that order flow should accelerate in the coming months.

***Now On The Cusp of Full Commercialization…***

The next link in the chain of evolution of the LFS crystals is expected to be full-blown commercialization. In mid-July 2013 Zecotek announced a partnership with Hamamatsu Photonics to commercialize the company's imaging products including their photo detectors, LFS crystals and integrator detector modules. Tokyo-based Hamamatsu has approximately $1 billion in annual sales, is the leading supplier of optoelectronic components used in PET scanners and counts major OEM PET manufacturers as customers, including Philips and GE. Hamamatsu also has a long-standing relationship with CERN - in fact we think the relationship between Zecotek and Hamamatsu may have been facilitated by an introduction through CERN.

Under this exclusive commercialization and joint development agreement, Hamamatsu will handle marketing and distribution of most of Zecotek's imaging products including their LFS crystals and solid-state MAPD photo

detectors. Hamamatsu will also manufacture the MAPD and IDM products. Zecotek received its first order from Hamamatsu in late July 2013. We view the relationship with Hamamatsu as a significant positive development for Zecotek as while Zecotek had already established compelling products (particularly the LFS crystals), substantial distribution and customer relationships (particularly with the PET OEM's) had been the missing piece of the puzzle until now. Hamamatsu also brings R&D and product development resources and will largely be funding these activities for ongoing improvement of Zecotek's existing products as well as potentially bringing new products to market. Hamamatsu's relationships, marketing muscle and distribution reach should be an ideal fit for Zecotek's products. Hamamatsu has placed an aggregate of $2M of orders for Zecotek's LFS scintillation crystals which are slated for use in third party PET scanners as well as for in-house use by Hamamatsu.

But while we think this relationship with Hamamatsu is a major positive for Zecotek, revenue from this distribution agreement has so far been somewhat of a disappointment. Despite $2.0M worth of orders placed by Hamamatsu since July 2013, Zecotek has recorded only about $260k in revenue since that time through the end of the most recent reporting period (January 30, 2015). We think a major hindrance to order fulfillment, as well as consummation of a supply agreement with CERN, was the outstanding lawsuit with Philips / St. Gobain. With the lawsuit now settled, we think order flow and fulfillment and revenue recognition with increase.

**Integrated Detector Module**
Zecotek is also working on an Integrated Detector Module (IDM) which combines their LFS crystals, an array of their MAPD photo detectors and a readout system into a single assembly for use in PET and gamma scanners. The IDM allows PET manufacturers to forego having to purchase the three components separately. The components of the IDM represent approximately 75% of the total cost of a PET scanner.

Given that the IDM has the potential to reduce the cost of building a PET scanner with potentially less maintenance required (compared to separate components), this offers a much more affordable option for less well-heeled manufacturers, particularly those that service lower-income markets. Zecotek envisions the initial market for their IDM as small PET manufacturers in emerging countries.

In January 2013 the company announced that they had completed the design concept of the IDM. The IDM will also be manufactured by Hamamatsu, which will also be directly involved in ongoing R&D related to ongoing improvements of the product. The IDM has already been validated in prototyped machines. Additional functionality and added value will be incorporated into the IDM including a data acquisition board. The next step prior to commercialization will be to optimize components to reduce input costs and to facilitate full-scale production and manufacturing. Hamamatsu continues to work to optimize the design of the IDM that will use Zecotek’s crystals. Upon completion, we would expect to see shipments of the LFS crystals (and related revenue) to Hamamatsu accelerate.

And although we do not foresee a commercial introduction of the IDM in 2015, we think a launch the following year, assuming development continues on-track, is a fair estimate.

**Patent Portfolio**
Zecotek has a large patent portfolio, covering all of the company's major products including lasers, displays, LFS crystals, photo detectors, and other PET component technologies. Zecotek is the only company to own all key elements for a high-end PET scanner. As of April 2014 Zecotek owned or controlled over 50 patents.

While the carrying value of the patent portfolio is relatively minimal, the true tangible value could be substantial, particular relative to ZMS.V's current book and market values of about ($3.1) million and $39 million, respectively.

Below is Zecotek's patent portfolio from their most recent public filings;

| Key Technology | Patent/App. No | Date Filed | Jurisdiction | Status |
|---|---|---|---|---|
| 3D displays | 7,944,465 | 27-02-06 | US, CA, AU | Granted |
| | 13/108,249 | 16-05-11 | US | Pending |
| | 8,243,127 | 27-06-07 | US | Granted |
| | PCT/IB2007/003309 | 07-11-07 | PCT, IN, JP | Pending |
| | 201070065 | 07-11-07 | EA (RU) | Granted |
| | 10-2010-7001958 | 07-11-07 | KR | N. of Allowance |
| | EP 2177041 | 07-11-07 | DE, GB, FR, NL | Granted |
| | 200780100317.0 | 07-11-07 | CN | Granted |
| | 13/546,877 | 11-07-12 | US | Pending |
| | 13/742,247 | 15-01-13 | PCT, US | Pending |
| | 14/167,512 | 29-01-14 | US | Pending |
| | 14/167,544 | 29-01-14 | US | Pending |
| LFS scintillation crystals | 7,132,060 | 21-07-05 | US | Granted |
| | 2242545 | 04-11-03 | RU | Granted |
| | PCT/RU2004/000094 | 12-03-04 | PCT, AU, CA, CN, EA, DE, FR, GB, JP, NL | Granted |
| | 1493/KOLNP/2006 | 12-03-04 | IN | Pending |
| | 13/861,971 | 12-04-13 | US | Pending |
| | PCT/CA2013/000349 | 26-04-13 | CA | Pending |
| Semiconductor photo-detectors (MAPD) | 2316848 | 01-06-06 | RU | Granted |
| | PCT/RU2007/000287 | 31-05-07 | PCT, AU, CA, EP, IN, MY | Pending |
| | 148413 | 31-05-07 | SG | Granted |
| | 200780024920.5 | 31-05-07 | CN | Granted |
| | 12/034,603 | 20-02-08 | US | N. of Allowance |
| | 5320610 | 31-05-07 | JP | Granted |
| | 10-2008-7032265 | 31-05-07 | KR | Granted |
| | 13/609,136 | 10-09-12 | US | Pending |
| | 61/382,632 | 13-08-13 | US | Pending |
| PET imaging technologies | 7,956,331 | 27-10-08 | US | Granted |
| | 8,003,948 B2* | 03-11-08 | US | Granted |
| | PCT/US2008/082273* | 03-11-08 | PCT, AU, CA, EP, JP, KR, CN | Pending |
| | 13/125,966* | 22-10-09 | US | N. of Allowance |
| | 8,431,904* | 26-10-09 | US | Granted |
| | 8,309,932* | 18-08-11 | US | Granted |
| | 13/232,944 | 14-09-11 | PCT, US | Pending |
| | 13/609,136 | 10-09-12 | US | Pending |
| | 2013-528480 | 14-03-13 | JP | Pending |
| | 13/750,995* | 25-01-13 | US | Pending |
| | 14/051,328 | 10-10-13 | PCT, US | Pending |
| Visible fibre lasers | 12/182,951 | 30-07-08 | PCT, US | Pending |
| | 2006119198 | 02-06-06 | RU | Granted |

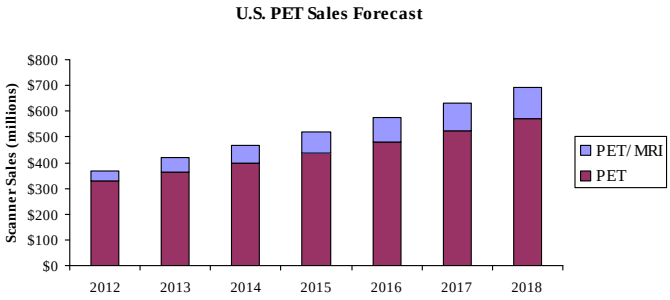
* Zecotek, as principal financier and development partner of imaging components with the University of Washington, has the exclusive license rights for improved data-processing electronics for new generation PET scanning devices.

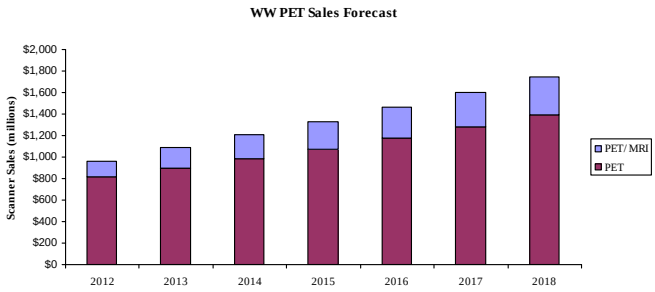
## MARKETS

***PET Systems Growth Fueled By Areas Zecotek Expects To Exploit…***

In January 2012 Bio-Tech Systems Inc. a healthcare market research firm specializing in medical imaging, published a report on forecasted growth of PET systems sales in both the U.S. and internationally[2]. The report noted that while U.S. sales volumes had been declining from about 2005 through 2009 due largely to uncertainties over reimbursement, that sales have since picked up. Worldwide, Bio-Tech estimates PET scanner sales to grow at a CAGR of just over 10% from 2012 to 2018 with much of this driven by increasing demand for hybrid PET/MRI machines, which they forecast to grow at a CAGR of 16% worldwide and 21% in the U.S.

[2] Burns, M. Report 340:Market For PET Radiopharmaceuticals and PET Imaging. Bio-Tech Systems Inc. Dec 10, 2010.




includes standalone PET and PET/CT

Bio-Tech Systems forecasts total U.S. PET and PET/MRI scanner sales to increase from about $368 million in 2012 to $690 million in 2018. Worldwide, they project this to go from $962 million in 2012 to $1.75 billion in 2018. Of particular interest, in relation to Zecotek, is that Bio-Tech Systems expects much of this forecasted growth to be fueled by increasing demand for higher resolution imaging, burgeoning interest in PET/MRI systems, and lower priced scanners with higher-end imaging capabilities. All of these are the sectors of the market that Zecotek expects to exploit. The competitive advantages of their LFS crystals (very high performance at potentially more competitive prices) and MAPD photo detectors (lower price, equal to or better performance than PMT and legacy solid-state detectors, and can be used with PET/MRI) potentially put them in an ideal position relative to where the bulk of the market growth is expected to come from over the next several years.

Visiongain, another life sciences market research firm, also recently published a report on the nuclear medicine industry. The authors of the report, titled, "Nuclear Medicine Imaging Devices: Global Market Prospects 2012-2022", note that developed markets such as the U.S. and U.K. are already highly saturated and growth in these markets will mostly come from upgrading stand-alone PET and SPECT systems with hybrid units (i.e. - with adding CT or MRI). This again, suggests potentially increasing demand for the likes of Zecotek's MAPD photo detector which, unlike PMT's, can be used side-by-side with MRI.

Visiongain also expects emerging markets such as China and India to offer more opportunity for growth due to the relative lack of nuclear medicine facilities and increased healthcare spending in those parts of the world. Visiongain notes that healthcare investment in emerging countries is expected to double over the next seven years. Zecotek has noted that they have a particularly strong focus in emerging markets. Emerging markets are the initial territories that they expect to target with their IDM product and the company has plans to identify and work with a strategic partner in India to manufacture PET scanners incorporating their components.

The high cost of the scanners from the major OEM's have largely precluded significant purchases from many of the emerging countries. This, however, offers a real potential opportunity for Zecotek as these developing countries, which largely have nationalized healthcare systems, are now looking to manufacture their own PET machines. With Zecotek owning all the major technology necessary to build a PET scanner and with lower-cost components, demand from emerging markets could be a real boon for the company.

***Medical Imaging Market Dominated By "Big 3"…***

The general medical imaging market is dominated by three manufacturers; GE, Siemens and Philips with approximate market share of 22%, 20% and 17%, respectively. Other players (market share) include Toshiba (9%), Hitachi (4%) and Shimadzu (2%).

Siemens and Philips have been the pioneers in advancements in PET/MRI scanners and in development of high-end scanners in general. Siemens, following its acquisition of CTI Molecular Imaging in 2005, sources its crystals through its internal supply chain and as such, there may be limited opportunity for Zecotek to sell crystals to Siemens, at least in the near-term. Terms of the lawsuit (Zecotek vs. Philips and St. Gobain) settlement were not disclosed although language in the press release indicates that a “business relationship” between Zecotek and Philips may have been part of this. Potentially this means a supply agreement was penned for Philips to buy ZMS’s crystals. In fact just days after announcement of the lawsuit settlement, Zecotek announced a new $500k crystals order for use in a next-gen Time-of-Flight PET (TOF) scanner.

GE's scanners still use BGO crystals, which may be considered inferior to LSO (used by Siemens) and LYSO (used by Philips). As such, GE may be highly interested in upgrading to higher performing crystals and, therefore, we view GE as a likely near-term customer for ZMS's crystals. GE and potentially the other smaller PET OEM's (combined which accounts for ~40% of the total market), would therefore be Zecotek's major target customers for their LFS crystals in the near-term.

With the crystals and photo detector of a PET scanner each accounting for approximately one-third of the cost of the machine and estimating that Zecotek's target market encompasses roughly 40% of the PET OEMs, we estimate the size of their current total market at about $290 million and estimated to grow to approximately $470 million in 2018. While not an enormous market size, it's important to keep in mind that the PET component and OEM markets are highly concentrated which provides for the potential for Zecotek to acquire significant market share in short-order, particularly if their components are considered higher performance and at least (or more) cost competitive than other suppliers'. And with Zecotek being the only company in the world to own all key elements (i.e. - scintillation crystals, solid-state MAPD photo detectors, and a data acquisition board and readout system) for a high performance PET scanner, just a small initial foothold into the PET OEM supply chain could potentially quickly turn into large and very valuable supply agreements over the long term.

***Other Markets Offer Future Opportunity, Particularly For Their 3D Technology…***
And while the PET component market is Zecotek's near-term focus, their other products target other customers, industries and applications which would significantly expand the size of their overall end markets. As an example glasses-free 3-D imaging could have huge appeal in the consumer and commercial markets. Zecotek also believes their technology could be ideal for the 3D printer market.

We note while development just recently started that Zecotek has made significant progress in moving its display-related business closer towards eventual commercialization. While the company had initially focused their 3D technology on the consumer TV space, Zecotek now believes there are greater opportunities elsewhere. Our recent discussions with management revealed that they expect to make a meaningful announcement in the near-term related to their focused pursuits with their 3D technology – which we eagerly await to hear more about.

And as it related to 3D printing, which is another endeavor in the Display segment, the company has indicated that they think they may have a commercially-viable product within the coming months. As a reminder, over the last few quarters Zecotek began designing a 3D interface platform between 3D printers and their 3D display technology as well as developing their own 3D printer. The interface would allow someone to see a 3D image of an object prior to actually printing it on a 3D printer. The user would be able to view the object from all angles and make any desired adjustments before they printed it, affording time, cost and materials savings. Relative to a 3D printer, Zecotek is working with their long-time contracting partner LT-Pyrkal (Armenia) in designing a compact, high speed and more efficient printer than the 3D printers currently on the market. Development has progressed fairly rapidly and as early as May 2014 the initial design for a 3D processing module was completed. Testing began in July and, as noted, the company expects to have a working unit sometime in 2015.

With the rapid growth in popularity of 3D printing, this could be another high-potential opportunity for Zecotek's 3D display technology. The company envisions initially subcontracting production of the 3D display units for the 3D printer application and then potentially partnering for wider distribution.

And Zecotek may also now be looking to revive their Laser Systems business. While the company has not provided much in the way of details, in the Q2 2014 quarterly filing they noted that they are “revising this division’s technology portfolio and re-structuring its business activities. Management is opting for ready technologies geared to cater for the ever expanding security market demands.” What this means in terms of near-term projects, product development or product commercialization is unclear – however, we think it may indicate that the company will look to incorporate its laser technology into products with more broad-based applications.

But while we still do not model a contribution from the Display or Lasers-related businesses (consumer or commercial related markets), we believe the recent progress could provide a greater chance of upside to our outlook. We will be monitoring ongoing developments and update our model if appropriate.

## FINANCIALS

**Balance Sheet / Cash Flow**
As of the most recent reporting period (ending 1/30/2015) the company had $3.3M in cash and equivalents. Cash burn, ex-changes in working capital, was approximately $2.3 million in the first six months of fiscal 2015. We expect cash burn to come down now with conclusion of the lawsuit, which consumed significant cash from legal fees.

**Recent Financial Performance**
Zecotek has generated immaterial revenue since inception through their most recent reporting period. By several measures 2014 was a disappointing year for Zecotek. This was particularly true from an income statement standpoint which suffered from delays in recognizing order revenue, product introductions being pushed back and elevated legal expenses. Despite $2.0 million in orders placed by Hamamatsu since the end of fiscal 2013, Zecotek recognized only about $200k in 2014. We do not expect a repeat in fiscal 2015.

**DCF values ZMS.V @ $2.00/share**
We have updated our financial model and outlook since the resolution of the lawsuit which, as we have explained above, we think will open up order flow and fulfillment and provides Zecotek with significantly greater opportunity for new customer wins. We look for a significant increase in the rate of recognition of the outstanding portion of the $2.5 million in orders over the near-term. We also incorporate the assumption that crystals orders that St. Gobain had been getting that infringed ZMS's 7,132,060 patent now go to Zecotek – which obviously includes orders from Philips.

CERN order flow had also been relatively minimal but, again, based on resolution of the lawsuit, we think this now accelerates and contributes during the current year. And while it's still too early to speculate on specific quantities that CERN may order from Zecotek, we think that it's reasonable that it could be in the several million dollars to potentially tens of millions of dollars worth of product.

We also think there are other revenue opportunities that may materialize in the current year that we have not modeled. These could encompass licensing deals with either the Imaging and / or Display business products and patents.

In terms of operating expenses, we expect to see a substantial reduction in professional fees in (which aggregated to over $3.8 million in 2014) as a result of conclusion of the lawsuit. While we think R&D may remain elevated with ongoing development of various products, we look for improvement in operating loss with a ramp in revenue.

We continue to think the shares remain highly undervalued with the delay in recognition of the Hamamatsu order and CERN supply agreement putting downward pressure on the stock price and offering an attractive entry point. With the lawsuit now resolved, we think revenue growth steepens significantly.

We look for revenue of $1.7 million in 2015 (up from $87k in 2014) to grow to $7.4 million in 2016 and $10.3 million in 2017. We use a 7.5% discount rate which we think appropriately reflects risk. Our terminal growth rate remains at 2%. Based on our DCF model, ZMS.V is valued at approximately $2.00/share. We are maintaining our Outperform rating.

## FINANCIAL MODEL

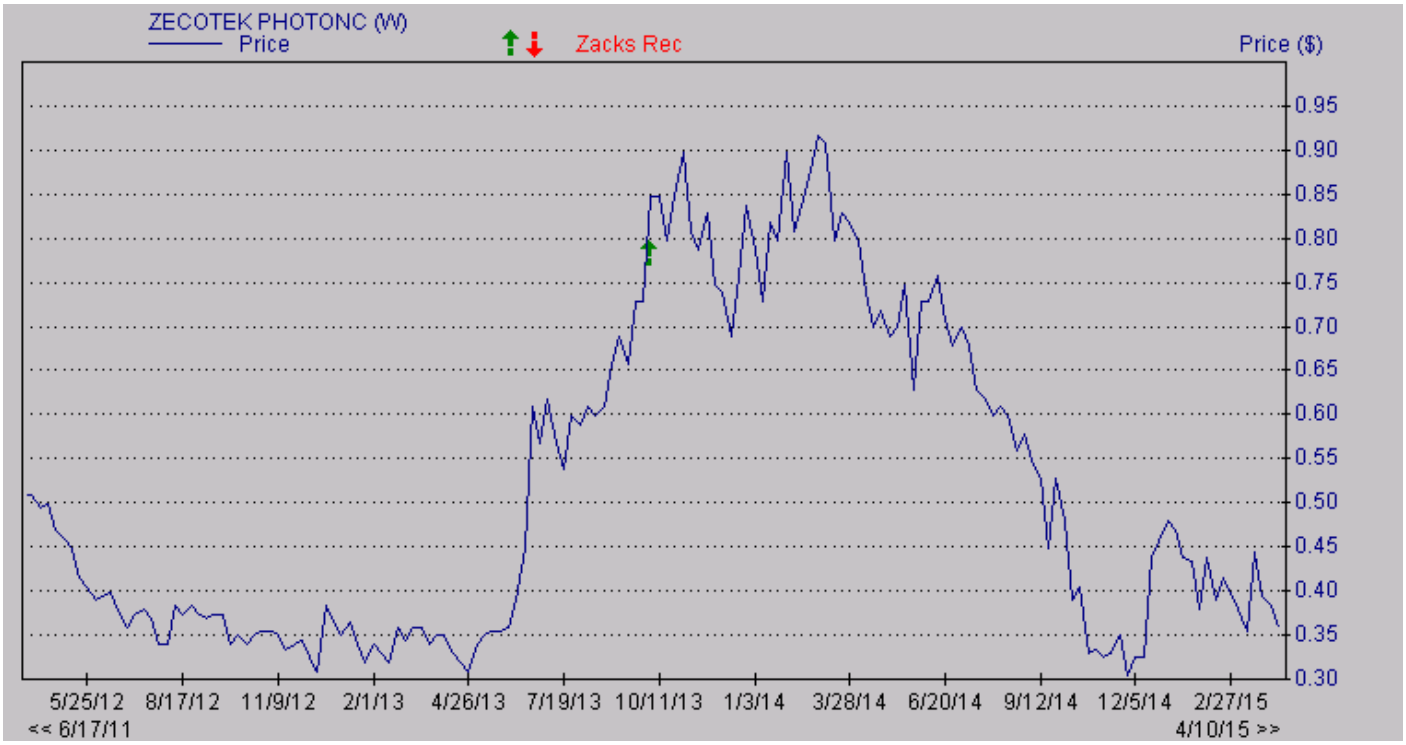
Zecotek Photonics Inc.

| | 2014 A | Q1A | Q2A | Q3E | Q4E | 2015 E | 2016 E | 2017 E | 2018 E |
|---|---|---|---|---|---|---|---|---|---|
| Total Revenues | $86.6 | $97.9 | $75.6 | $272.3 | $1,248.2 | $1,694.1 | $7,397.0 | $10,307.1 | $18,378.4 |
| *YOY Growth* | *118.5%* | *1100.5%* | *82.8%* | *1806.6%* | *5389.1%* | *1857.3%* | *336.6%* | *39.3%* | *78.3%* |
| SG&A | $6,857.3 | $2,018.9 | $1,838.6 | $1,441.0 | $1,351.0 | $6,649.5 | $7,102.0 | $7,524.2 | $8,123.2 |
| *% SG&A* | *7922.7%* | *2062.2%* | *2431.1%* | *529.1%* | *108.2%* | *392.5%* | *96.0%* | *73.0%* | *44.2%* |
| R&D | $1,682.4 | $397.2 | $472.0 | $368.0 | $401.0 | $1,638.2 | $1,388.0 | $1,344.0 | $1,657.0 |
| *% R&D* | *1943.8%* | *405.8%* | *624.1%* | *135.1%* | *32.1%* | *96.7%* | *18.8%* | *13.0%* | *9.0%* |
| Collaboration costs | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 |
| Operating Income | ($8,453.1) | ($2,318.2) | ($2,235.0) | ($1,536.7) | ($503.8) | ($6,593.7) | ($1,093.0) | $1,438.9 | $8,598.1 |
| *Operating Margin* | | *-* | *-* | *-* | *-* | *-389.2%* | *-14.8%* | *14.0%* | *46.8%* |
| Total Other Income (Expense) | ($203.0) | $2.1 | ($180.4) | $0.0 | $0.0 | ($178.3) | $0.0 | $0.0 | $0.0 |
| Pre-Tax Income | ($8,656.2) | ($2,316.2) | ($2,415.4) | ($1,536.7) | ($503.8) | ($6,772.0) | ($1,093.0) | $1,438.9 | $8,598.1 |
| Tax expense (benefit) | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 | $0.0 |
| *Tax Rate* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* | *0.0%* |
| Net Income | ($8,656.2) | ($2,316.2) | ($2,415.4) | ($1,536.7) | ($503.8) | ($6,772.0) | ($1,093.0) | $1,438.9 | $8,598.1 |
| *YOY Growth* | *23.0%* | *121.4%* | *44.7%* | *-22.1%* | *-87.3%* | *-21.8%* | *-83.9%* | *-231.7%* | *497.5%* |
| *Net Margin* | | *-* | *-* | *-* | *-* | *-399.7%* | *-14.8%* | *14.0%* | *46.8%* |
| EPS | ($0.09) | ($0.02) | ($0.02) | ($0.01) | ($0.00) | ($0.06) | ($0.01) | $0.01 | $0.07 |
| *YOY Growth* | *-0.8%* | *93.9%* | *20.5%* | *-33.0%* | *-89.4%* | *-33.5%* | *-85.1%* | *-227.3%* | *487.9%* |
| Diluted Shares O/S | 92,331 | 99,134 | 110,002 | 112,400 | 113,220 | 108,689 | 118,000 | 122,000 | 124,000 |

*Brian Marckx, CFA*

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