

## EQUITY RESEARCH COVERAGE

### HARRIS & HARRIS GROUP: NANOTECH RENAISSANCE

[NASDAQ: TINY \$5.06]

Research<sup>2.0</sup>

Boston | New York | Paris

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## HIGHLIGHTS

- Harris & Harris Group (H&H) is experiencing a renaissance. The main catalysts for the renewal are more favorable financial market conditions for liquidity events and increasing penetration of nano-enabled products in global markets.
- So far this year H&H has experienced two liquidity events – **Amgen’s acquisition of BioVex for up to \$1 billion** and an \$82.5 million IPO by **NeoPhotonics**. Several more such events are likely in the next 6-12 months, **including a potential exciting IPO by Solazyme. Solazyme is H&H’s largest holding and a successful IPO could provide a significant boost to H&H’s NAV.**
- **Revenues and profitability are rising in many H&H portfolio companies as nano-enabled products gain traction in the market.** We’ve seen upbeat assessments from H&H portfolio companies in all three focus areas – healthcare, clean tech, and semis & electronics. **Solazyme’s revenues are up sharply over the past year** driven by the launch of several key partnerships, joint ventures and new consumer product offerings. **LED manufacturer Bridgelux expects revenues to triple this year** as it ramps up production, while **ABS Materials sees explosive growth in the years ahead** for its nano-enabled water remediation technology.
- **Metabolon is a late stage H&H portfolio company in the healthcare sector that is building out an innovative molecular diagnostics business** based on its metabolomics technology. Our in-depth analysis of Metabolon in this report suggests the company has considerable scope to grow and provide an attractive venture capital return for H&H in the future.
- **Laser Light Engines** is poised to deliver the **laser-based lighting technology that will be required for the next generation of digital and 3D projectors.** Not only will the quality of 3D cinema improve markedly but the operating costs and energy bills for theater owners will be dropping as well. **IMAX is a strategic investor and will be a leader in commercializing the technology.**
- **The coming decade will likely provide the growth and investment returns venture capitalists and long-term investors have been expecting from nanotechnology. We expect to see a 10-fold rise in the final product value of nano-enabled products globally.** H&H offers investors a unique investment vehicle to capitalize on the growth in nanotech commercialization that lies ahead.
- TINY has historically traded at a P/NAV of 2x, with a range in the past several years as high as 8.8x to as low as 0.57x. The reported NAV as of December 31, 2010 was \$4.76 and the stock is currently trading at 1.1x NAV. Our ongoing analysis of H&H portfolio companies suggests that the current NAV understates the intrinsic portfolio value by 45%, **which implies a fully valued share price of \$12 for TINY.**

Harris & Harris Group (H&H) is experiencing a renaissance as several investments have begun to bear fruit through liquidity events/exits – either in the form of an acquisition or an IPO – while many other portfolio companies are seeing accelerating revenue and profit growth as nano-enabled products increasingly penetrate the marketplace. This is a marked change from the past several years when there were no exits and most H&H portfolio companies were still heavily in the research phase of product development and not generating meaningful revenues or profits.

## LIQUIDITY RETURNS

Thus far in 2011, H&H has seen two liquidity events. The first was Amgen’s acquisition of H&H portfolio company BioVex for up to \$1 billion, which we summarized and discussed in a Research 2.0 [blog post](#). Amgen’s acquisition of BioVex is a strong validation of H&H’s investment thesis in healthcare, with a focus on next generation nano-enabled drug therapies, vaccines and diagnostics. H&H has six other private healthcare investments: one late-stage

(Metabolon), two mid-stage (Mersana and Ensemble) and three early-stage (Ancora, Enumeral and Poly Remedy).

The second liquidity event was NeoPhotonics (NPTN), which completed an IPO that raised \$82.5 million. H&H acquired an additional 50,000 shares in the IPO, bringing their total holdings to 450,907 shares.

As we observed in our NeoPhotonics [Pre-IPO note](#), the company is positioned well to benefit from increasing demand for high speed optical networking technology and equipment. Our updated valuation work on NeoPhotonics post-IPO puts the IV of the shares at around \$400 million, or \$16 a share – over 50% above Neo’s current share price.

The BioVex and NeoPhotonics liquidity events were significant in that they validated H&H’s investment process and further highlighted the potential of nanotechnology in the marketplace. Looking ahead to the remainder of the year, there are likely to be several more liquidity events in the H&H portfolio this year, including an exciting potential IPO by Solazyme.

Solazyme is currently the largest holding by value in the H&H portfolio at \$23,225,822 as of December 31, 2010. H&H’s cost basis is \$5,444,197 and they own 2.13 million shares of convertible preferred stock. Solazyme is an emerging pioneer of synthetic nanobiology technology.

Solazyme is in the early stages of building out a transformative, nano-enabled life sciences franchise that will usher in fundamentally new ways of producing chemicals, cosmetics, nutritional products and energy. Solazyme is pioneering a unique “indirect photosynthesis” technique to grow microalgae for multiple commercial uses. The company is rapidly expanding its revenues, fueled by partnerships and joint ventures across a range of sectors and geographies. According to Solazyme’s S-1 filing, in the past year it has:

- Produced over 400,000 liters (364 metric tons) of algae-based oil for the U.S. Navy.
- Entered into a 50/50 joint venture with Roquette Freses, S.A., one of the world’s largest starch and starch derivatives companies, with the goal of jointly developing, producing and marketing nutrition products worldwide.
- Began the sale of its consumer nutrition products containing Golden Chlorella in

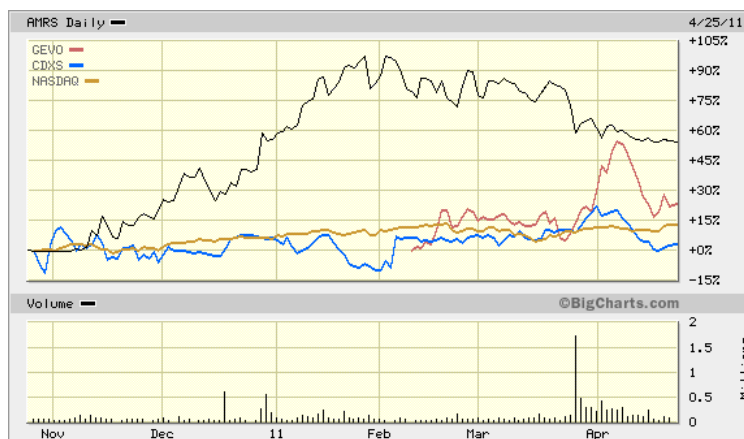
Whole Foods and GNC.

- Entered into arrangements with Sephora International, Sephora USA and QVC for the worldwide launch of its *Algenist* skin care products. Of note, *Algenist* sold out in eight minutes after debuting on QVC.
- Partnered with Honeywell UOP, Chevron, Qantas Airways, Ecopetrol, Unilever, and Bunge for the production of oils and chemicals.
- Executed a non-binding letter of intent with one of Brazil’s largest sugar cane processing companies for feedstock.
- Entered into both a joint development agreement and a non-binding off-take letter of intent with Dow Chemical Company in the field of dielectric fluids.

While Solazyme has been leveraging its microalgae-based technology platform and ramping up its business, we’ve seen increased receptivity by investors for public offerings of advanced biofuel companies. Over the past year, we’ve seen three successful IPOs – Amyris (AMRS), Codexis (CDXS) and, most recently, Richard Branson and Khosla Ventures-backed Gevo (GEO).

As the chart below shows, Amyris and Gevo have done quite well in terms of stock price performance following their respective IPOs, while Codexis has lagged in terms of market performance. Amyris has a market cap of over \$1 billion, while Gevo and Codexis have market caps of \$550 and \$365 million, respectively. Amyris’ market cap is 14.5 times LTM revenue, compared with 33 times for Gevo and 3.4 times for Codexis.

There is growing demand for alternative fuels and Solazyme has developed an innovative technology platform that could deliver large volumes of microalgae oil for commercial purposes in the years ahead.



We think a successful IPO by Solazyme could mark an inflection point for nano-enabled, alternative fuel production in the United States, which is an exciting prospect.<sup>1</sup>

Two or three venture-backed IPOs in a given year would put a smile on any venture capitalists' face – especially after experiencing a long draught as H&H did over the past five years. In addition to IPO liquidity events already completed and expected this year, H&H has publicly stated that three portfolio companies have retained bankers and two of these three have received non-binding letters of intent for potential acquisition. One is reminded of the old adage - when it rains, it pours!

## NANOTECH RENAISSANCE

The return of liquidity events is encouraging and is an important reason why we believe TINY should trade at a premium to its NAV. But there is more to the dynamics of the H&H story than renewed liquidity.

As we noted in our January 10, 2011 report, "[Harris & Harris Group: Survive to Thrive](#)," nanotechnology is transitioning from a research-intensive phase of evolution into an era dominated by commercialization activity. The total final market value of nano-enabled products worldwide is somewhere in the neighborhood of \$300 billion today, with one-third of the value in the U.S. Over the past decade, the growth rate of the final value of nano-enabled products has averaged 25% per year. In the decade ahead, we expect to see a tenfold increase in final market value of nano-enabled products as nanotechnology becomes a pervasive general purpose technology.

We can see the evolution of nanotech in H&H's portfolio group of companies. Between 2007 and 2010, aggregate revenue in the H&H portfolio group of companies increased from approximately \$198 million to approximately \$380 million, an average of approximately 24 percent per year. Over the past year, business activity has picked up and aggregate revenue of the portfolio companies has increased an average of 42%, from approximately \$267 million in 2009 to \$380 million in 2010.

Business activity in the H&H portfolio group of companies continues to ramp up in 2011. There have

been several announcements and disclosures made this year that highlight the rising importance of nanotech in the marketplace and the increasing potential value of the H&H group of portfolio companies. We have summarized these in the table on the next page (See "Selected H&H Portfolio Company Developments").

As the table illustrates, there is great deal of innovative nano-enabled commercialization activity ongoing that tells us nanotechnology is gathering momentum in the market. Nanotechnology is no longer a science project or the subject matter of science fiction novels. The activity we are seeing today is impressive, and we expect momentum to continue in the months and years ahead as nanotech becomes a mass-use technology in the U.S. and worldwide.

Over the past several months, we have been meeting with the management teams of several H&H portfolio companies in attempt to get a deeper view of nanotech commercialization activity and the potential value that lies within the H&H portfolio. We have met with Metabolon, a healthcare company that is pioneering innovative molecular-based diagnostics, and Laser Light Engines, which is developing a powerful solid-state photonics technology for digital cinema and other display markets. In the sections that follow, we take a closer look at these two H&H portfolio companies.

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<sup>1</sup> Research 2.0 is in the process of drafting a Pre-IPO report on Solazyme that will be published in the near future. The report is part of our ongoing and expanding coverage of emerging cleantech technologies and IPOs.

## SELECTED H&H PORTFOLIO COMPANY DEVELOPMENTS

### HEALTHCARE

**Biovex/Late Stage:** Announced the completion of an acquisition by biopharma giant Amgen for up to \$1 billion. The investment has potential to provide a 4.6x return to H&H.

**Metabolon/Late Stage:** Announced the receipt of a Certificate of Registration from the Centers for Medicare and Medicaid Services under the Clinical Laboratory Improvement Amendment (CLIA) for its new facility on Davis Drive in Research Triangle Park, NC. The CLIA registration allows Metabolon's clinical laboratory to perform high-complexity tests on patient samples.

**Mersana/Mid Stage:** Announced the initiation of a Phase 1b extension study with its lead nano-enabled cancer product, XMT-1001, a novel DNA topoisomerase I inhibitor based on the company's *Fleximer* polymer conjugate platform, in second-line gastric cancer and second-/third-line non-small cell lung cancer.

**Ensemble Therapeutics/Mid Stage:** Announced it has achieved an important milestone in its research collaboration with Bristol-Myers Squibb Company by successfully developing Ensemblins™ against one of the designated key drug targets, resulting in an undisclosed milestone payment to Ensemble.

### ELECTRONICS/SEMICONDUCTORS

**NeoPhotonics/Late Stage:** Announced the successful completion of an \$82.5 mm IPO.

**Cambrios/Mid Stage:** Announced that Nissha Printing Co., Ltd. began mass production of the world's first touch sensor films using Cambrios' metal nanowires (ClearOhm™ coating materials and coated films) as a transparent conductive film material. Synaptics, Inc. integrates these sensors into touch sensing systems for major smartphone manufacturers. Synaptics and Cambrios announced a Reference Design Partnership Agreement where the two companies will work together to bring ClearOhm™-based leading edge touch solutions to the market.

### CLEANTECH

**Solazyme/Last Stage:** Announced several partnerships with established companies and also filed a registration statement on form S-1 to register its shares of common stock for an IPO. Solazyme is seeking to raise \$100 million.

**Bridgelux/Late Stage:** Announced that the company booked \$30 million in revenue last year and expects to triple that this year as it seeks to cut the cost of LED lamps drastically by manufacturing the components using nano-enabled silicon rather than other materials. Management believes they have the ability to drive the cost of LED lamps to \$5 in the next two to three years from around \$40 today.

**ABS Materials/Mid Stage:** Announced that the company is ramping up the commercialization of its nano-enabled water purification technology. Management sees revenue potential of \$300 million within next five years.

**Contour Energy/Mid Stage:** Announced the addition of two new lithium batteries to its coin cell product line in response to worldwide demand driven by advanced electronics devices spanning OEM, consumer, medical and automotive markets. Contour's new 2016 and 2450 lithium coin cells provide the small form factor, extended run time, higher voltage and ability to operate under wide temperature ranges required by advanced and next-generation portable electronics.

## METABOLON: MOLECULAR DIAGNOSTICS FOR THE MASSES

Nanotechnology holds great promise in medicine and healthcare. Over the past decade, we have seen a great deal of research and development in nano-enabled healthcare technology. Nanotech penetration of therapeutics and diagnostics is still relatively small today at around 15%, or \$70 billion. However, in the decade ahead, as nano-enabled medicine and healthcare commercialization ramps up, we are likely to see that share rise sharply to 50% or more.<sup>2</sup>

Diagnostics is one area of healthcare that is ripe for technology disruption, as Clayton Christensen notes in his book, *The Innovator's Prescription*. "The technologies that enable precise diagnosis and subsequently predictably effective therapy," says Christensen, "are those that have the potential to transform healthcare through disruption." Such is the promise of nano-enabled diagnostic technology.

One of the companies pioneering advances in molecular diagnostics is Metabolon. Based in The Research Triangle and led by a talented and experienced management team that includes co-founder and CEO John Ryals, privately-held Metabolon is developing mechanism-based molecular diagnostics and providing broad service business solutions based on its innovative biochemical profiling technology. Founded in 2003 and having raised \$32 million in venture capital to date from investors, including H&H, Metabolon is building a scalable services business based around metabolomics and is in the early stages of launching an innovative and potentially lucrative molecular diagnostic business.

### B2B METABOLOMICS

To date, Metabolon's primary source of revenue generation has come from a B2B service model based on metabolomics. Metabolomics is the systematic study of the unique chemical fingerprints that particular cellular processes leave behind – specifically, the study of their small-molecule metabolite profiles. The metabolome represents the collection of all metabolites in a biological cell, tissue, organ or organism, which are the end products of cellular processes. Unlike RNA gene expression data and proteomic analyses, which do not tell the whole story of what

might be happening in a cell, metabolic profiling can give an instantaneous snapshot of the physiology of that cell.

There are about 2,400 small molecules in the human body, compared with about 25,000 genes and tens of thousands of proteins. Using proprietary software in conjunction with mass spectrometry instruments, Metabolon extracts small molecules out of samples and then processes the information contained within them. The emerging field of metabolomics is benefiting significantly from the expanding availability of user-friendly and affordable mass spec instruments.

Metabolon is leveraging the increasing power of mass spectrometry instruments and developing innovative software to advance the field of metabolomics. Mass spec instruments are critical to metabolomics, but Metabolon's secret sauce lies in its proprietary data processing software. The company has a growing patent portfolio – over 100 patents filed and 17 granted – that includes data analysis and software patents that cover critical aspects of its metabolomics platform. In addition, Metabolon has pending patents directed to small molecule biomarkers related to drug action, toxicity, carcinogens, aging and numerous diseases and disorders.

This powerful software allows for the extraction of relevant small molecule information in processes that typically produce massive amounts of noise – on the order of 90%. Think of pulling the proverbial needle out of a haystack and you can appreciate the potency of Metabolon's software.

Metabolon is employing metabolomics investigations to clarify the mechanism of action of several new compounds. The company is using its metabolomics platform technology in a range of studies, including following the global effects of disease processes on metabolism with the aim of uncovering new biomarkers.

The discovery of new biomarkers through Metabolon's metabolomics platform technology has fostered the development of its B2B service model. The company has over 275 clients today that include many of the major pharmaceutical, biotechnology, nutritional and consumer product companies as well as universities. Customers use Metabolon's technology to create innovative products and enhance or reengineer existing products. Employing Metabolon's technology, customers can solve complex problems in a matter of weeks that previously would have taken months, if not years.

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<sup>2</sup> See Mihail C. Roco, *The Long View of Nanotechnology Development: The NNI at 10 Years*.  
[http://www.wtec.org/nano2/docs/ChaptersPdf/Ch0\\_2\\_LTV\\_10-1121.pdf](http://www.wtec.org/nano2/docs/ChaptersPdf/Ch0_2_LTV_10-1121.pdf)

Metabolon's B2B service business is cash flow positive and has been growing at a healthy clip over the past several years. It generated \$14 million in revenues last year and some 90% of the business is repeat business from existing customers. The B2B service has given Metabolon a solid foundation to expand its operations and seek out new business opportunities. A major opportunity for the company lies in the area of healthcare diagnostics, which we will explore in the next section.

## DISRUPTIVE DIAGNOSTICS

There is a paradigm shift occurring in the field of clinical diagnostics in which high-resolution biochemical characterization of body fluids, by targeted metabolomics, is being used to assist the development of function-oriented diagnostics, moving from expensive immunoassays to cheaper, more specific, and more accurate mass spec assays. These new diagnostics are much more than just a positive or negative test for the condition. They also allow detailed subtyping and staging, which will direct personalized therapeutic regimens.

Metabolon is in the early stages of building out a molecular diagnostics business based on its metabolomics platform technology. Metabolon's diagnostics technology seeks to address some large markets where there are currently unmet needs, including insulin resistance and cancer.

Insulin resistance is the number one health problem in the world, affecting some 800 million people. Insulin is a hormone that regulates blood sugar in the body. After a meal, the pancreas produces insulin to move glucose from the blood into cells for fuel. People with type 2 diabetes either do not secrete enough insulin or their cells are resistant to its effects. The body's resistance to insulin is a precursor to diabetes - a debilitating condition that requires management. Managing the disease and its complications can last for many decades. Long-term complications from diabetes include cardiovascular disease, retinopathy, neuropathy, and nephropathy. Type 2 diabetes has a huge impact on patient quality of life and healthcare costs.

Metabolon is identifying biomarkers for insulin resistance, with the objective of developing a test that can measure the level of insulin resistance in non-diabetic at-risk patients. The company has discovered a number of significant biochemical markers indicative of Type 2 diabetes. These markers are currently

being incorporated as part of Metabolon's *Quantose* series of diagnostic products. The *Quantose* products are targeted at different stages of diabetes: pre-diabetes, drug efficacy and complications of the disease.

Metabolon's diagnostic test for insulin resistance is relatively inexpensive at \$100-\$125 per test and is easily administered by physicians. According to the company, there is scope to do up to 20 million diagnostic tests per year on humans so there is a \$2 billion-plus market opportunity in the U.S. alone. The company is in the process of identifying a partner to assist with the sales of the insulin resistance diagnostic test, and will be establishing six beta test sites later this year.

Metabolon's technology can also be used to detect insulin resistances in pets, such as cats. Some 10% of the 80 million cats in the U.S. are diabetic. We expect to see some announcements from Metabolon in the months ahead related to its insulin resistance diagnostic technology for pets. It could become another sizable market opportunity for the company in the future.

In terms of potential competition in the diabetes diagnostics market, there is another company to keep an eye on: Kleiner Perkins-backed Tethys Bioscience. Tethys is developing a diabetes risk test called *PreDx*. *PreDx* is a quantitative test that employs a complex algorithm to analyze a defined set of biomarkers implicated in the development of diabetes. Unlike Metabolon's test, *PreDx* does not monitor insulin resistance. And at around \$600 per test, Tethys' product is considerably more expensive than Metabolon's.

The other major opportunity in diagnostics for Metabolon is cancer. There is little question that there is huge potential value in cancer diagnostic technology, which in many cases is still at a primitive stage today. Cancer is a metabolic problem. Metabolon is developing novel diagnostic tests to detect various types of cancer.

One of the areas Metabolon is focusing on is prostate cancer. The company believes there is a \$550 million addressable market for prostate cancer diagnostics. There is a large gray area related to conventional diagnostics for prostate cancer - some 60% of people tested fall within a PSA level between 4 and 10.

Metabolon has identified biomarkers that would complement PSA, a protein long used for detection of prostate cancer, to guide the decision on whether

to biopsy a patient or not. Researchers screened a large number of metabolites in normal, benign, and malignant cells. They found sarcosine to be a marker for aggressive prostate cancer and preliminary investigations indicate that sarcosine may be a useful marker of prostate cancer invasion and aggressivity. If this is correct, sarcosine may have potential both as a biomarker and as a therapeutic target.

Metabolon is developing two diagnostics tests for prostate cancer. One test complements the PSA in helping a physician/patient decide whether to move forward to a prostate biopsy while the second is a test

Metabolon’s molecular diagnostic business will commence later this year when the company launches tests for insulin resistance and urological cancers. Metabolon’s new facility on Davis Drive in Research Triangle Park, NC has received receipt of a Certificate of Registration from the Centers for Medicare and Medicaid Services under the Clinical Laboratory Improvement Amendment (CLIA). The CLIA registration allows Metabolon's clinical laboratory to perform high-complexity tests on patient samples. Additional tests will be added in 2012 as the company builds out its molecular diagnostics business.

METABOLON CANCER DIAGNOSTIC PIPELINE			
Product	Market Size	Unmet Clinical Need	Test Description
Bladder Cancer Aggressiveness	\$165 mm	Guide treatment decision: active surveillance, cystectomy, adjuvant chemotherapy	Distinguish aggressive hi-grade tumors from less aggressive, biopsy
Nephrotoxicity of Cisplatin in Bladder Cancer	\$100 mm	Prevention of AKI	Monitoring test for targeted therapy nephrotox in RCC, blood
Hepatotoxicity of Taxotere in Prostate Cancer	\$60 mm	Prevention of DILI	Monitoring test for taxotere hepatotoxicity in HRPC, blood
Nephrotoxicity of Targeted Agents in RCC	\$70 mm	Prevention of AKI	Monitoring test for targeted therapy nephrotox in RCC, blood

Source: Metabolon

performed with the biopsy to help assess how aggressive an individual patient's cancer is to aid in treatment decisions.

Metabolon is also exploring diagnostics for detecting liver and kidney damage in chemotherapy patients. The company believes their metabolomic technology platform can be used to create powerful diagnostics with other types of cancer, including urological (i.e., bladder), colorectal and early lung cancer. These are relatively large and growing areas and represent a combined \$400 million-plus addressable market opportunity.

There is little question that clinical diagnostics is an important piece of winning the battle against cancer. Early detection is critical. If a cancer is caught at an early stage, there is a much higher likelihood of it becoming manageable. It is with cancer and other life-threatening diseases that there is tremendous potential for nano-enabled diagnostics technology to have a positive impact on humanity and health care in the years ahead.

### METABOLON VALUATION ANALYSIS

Looking at the clinical diagnostic market overall, we believe there is \$100 million-plus revenue opportunity for Metabolon over the next five years. While the B2B Metabolomics business is generating positive cash flow and is likely to continue growing at a healthy pace, the molecular diagnostics business will require additional financial capital.

Most of that capital will likely be used to build out a sales and distribution channel for Metabolon’s cancer diagnostics business. The company is likely to partner with an established company to distribute its insulin resistant diagnostic product so there will be little capital required for that part of the business. We assume the company will require \$20-\$30 million of new capital to seed the molecular diagnostics business.

Our base case intrinsic value (IV) model assumes a successful \$20-\$30 million capital raise later this year. We have projected a 5-year average revenue growth rate of 45% driven by increasing sales asso-

ciated with the insulin resistance and cancer diagnostics business, with gross margins expanding to 76% by 2015 from around 62% currently. Importantly, we are using a 30% discount rate to compute present value, which is double the value we typically use in our technology company valuation analysis. We believe the higher discount rate is justified by the evolutionary stage of the company and the fact that the diagnostics business has yet to be launched. Based on these assumptions, we estimate Metabolon's IV around \$350 million.

H&H owns 1.52 million shares of convertible preferred Metabolon stock as well as 74,348 warrants on the Series B convertible preferred stock that expire 3/25/15. Based on our valuation analysis, H&H has the potential to experience an attractive 5-10x return on its investment in Metabolon.

### Metabolon Intrinsic Valuation Model

Dec YE	2007	2008	2009	2010	2011	2012	2013	2014	2015	NA	Ticker
YoY Change \$		1.4	0.8	6.1	4.0	12.0	26.5	39.2	54.5	<b>Private</b>	Exchange
Total Revenue	\$6	\$7	\$8	\$14	\$18	\$30	\$56	\$96	\$150	45%	Rev Growth
YoY Growth		24.5%	11.7%	79.2%	29.0%	67.4%	88.9%	69.6%	57.1%	<b>\$1.00</b>	Current Price
COGS %	48.9%	44.5%	46.8%	38.4%	37.1%	30.5%	26.3%	24.1%	24.0%	27	Shares Out
COGS \$	\$2.7	\$3.1	\$3.6	\$5.3	\$6.6	\$9.1	\$14.8	\$23.0	\$36.0		
Gross Profit	\$2.8	\$3.8	\$4.1	\$8.5	\$11.2	\$20.7	\$41.5	\$72.5	\$114.0		
Gross Margin	51.1%	55.5%	53.2%	61.6%	62.9%	69.5%	73.7%	75.9%	76.0%	1%	Avg. Dilution
SG&A %		54.5%	187.9%	66.7%	67.4%	73.8%	51.5%	32.5%	22.0%	<b>\$27</b>	Cap (M)
SG&A	\$3.3	\$3.8	\$14.5	\$9.2	\$12.0	\$22.0	\$29.0	\$31.0	\$33.0	\$9	Cash
R&D %	23.2%	10.7%	8.1%	5.1%	11.2%	13.4%	14.2%	10.5%	10.0%	\$5	Debt
R&D \$	\$1.3	\$0.7	\$0.6	\$0.7	\$2.0	\$4.0	\$8.0	\$10.0	\$15.0	30%	Tax Rate
Operating Margin	-61%	-18%	-268%	-16%	-25%	-26%	11%	43%	58%	20	P/E Multiple
Operating Income	-\$2	-\$1	-\$11	-\$1	-\$3	-\$5	\$5	\$32	\$66	30%	Discount Rate
Other Income (expense)	0	0.3	-0.9	-0.2	0	0	0	0	0		
Taxes	-\$0.5	-\$0.2	-\$3.3	-\$0.4	-\$0.8	-\$1.6	\$1.4	\$9.5	\$19.8		
30%	30%	30%	30%	30%	30%	30%	30%	30%	30%	<b>\$9.20</b>	Intrinsic Value
Net Income	-\$1	\$0	-\$9	-\$1	-\$2	-\$4	\$3	\$22	\$46	820%	Up/Downside
Net Margin	-22%	-2%	-112%	-9%	-11%	-12%	6%	23%	31%		
Market Value Using P/E	-\$24	-\$3	-\$172	-\$24	-\$39	-\$74	\$63	\$441	\$924		
Cash Position				\$9	\$7	\$3	\$6	\$29	\$75		
Shares (M)	27	27	27	27	38	38	38	38	38		
Period Share Price	-\$1	\$0	-\$6	-\$1	-\$1	-\$2	\$2	\$11	\$24		
PV of MV 4 Years Out	-\$14	-\$26	\$22	\$154	\$324						
PV of Cash 4 Years Out	\$2	\$1	\$2	\$10	\$26						
PV MV + Cash	-\$11	-\$25	\$24	\$164	\$350						
PV Value Per Share	-\$0.42	-\$0.92	\$0.90	\$6.09	\$9.20						

## LASER LIGHT ENGINES: LIGHTING UP THE BIG SCREEN

Despite the shift to digital projection technology in theaters, we are still using old-fashioned giant light bulbs in the projectors for illumination and they are not bright enough. In addition, they are very expensive to operate, must be replaced 2-4x per year, and cost thousands of dollars. Some award-winning film producers have stated publicly they aren't interested in working with digital 3-D film because of the poor illumination from traditional technology.

Although laser-based light sources are known to be superior and have been tried in the past, the interference patterns generated by the light beams made the images unsuitable for viewing.

Laser Light Engines (LLE) has proprietary nano-enabled technology that has solved the interference pattern and produces the needed light colors in a simple and cost effective manner. Over time, it is likely that all digital and 3D theaters will convert to laser-based light sources.

The market opportunity for LLE is aligned with the shift to digital and 3D cinema screens and starts at the high end with systems for IMAX (IMAX has made a strategic investment in LLE) and then moves into the mainstream. We estimate that LLE has a near-term \$1.2B market opportunity over the next four or five years with more beyond that as the technology becomes more commonplace.

### LASERS ARE BETTER

The conversion to digital involves several different elements. The digital projector is similar to what many of us have encountered in conference rooms but with much more powerful optics and lighting inside. A large digital projector has a special Xenon-based lamp in it that is 15 times more powerful than those used in conference room projectors. Leading companies in the high-end digital projector market include Barco, Sony, Christie and NEC. Along with the projector, in many cases the screen is also upgrad-



ed, especially for 3D, with lower-light-loss surfaces or a silver coating to support polarized 3D methods.<sup>3</sup>

Operational cost savings is another major reason to shift to laser-based light sources. The high-powered lamps used to drive projectors today generate lots of heat, have a relatively short operating life, begin to degrade immediately with use and are very expensive.

The ability to deliver higher brightness and cost savings is a powerful combination for high-end uses like IMAX, theme parks and larger 3D cinemas. In addition to the improvement in quality and viewer experience the exhibitor can expect a 12 to 18 month payback period.

Volume manufacturing will continue to lower costs and provide similar economics for the mainstream market and ultimately even offices, homes and a diverse range of small venues. Ironically, the "burn out" factor looms larger at the lower end of the market because most users in this category are loath to spend an extra \$500 on a spare bulb for a \$1,500 projector.

Bright hot white lights that burn out and cost hundreds or thousands of dollars will eventually go the way of the cathode ray tube (CRT) into oblivion.

### TECHNOLOGY DISCUSSION

Using a laser-based light source is harder than it would seem. A major technical issue called "speckle" stems from the interference of light waves having the same frequency. This is exactly what happens when you try and use a laser light to project on a screen. When the light hits the surface of the screen it scatters with different phases and amplitudes. These add together to create a randomized intensity which results in an unpleasant "speckle" for viewers.

There are multiple ways to reduce speckle and some have been known for a long time. LLE has employed an array of techniques, some of which are patented and based on the use of novel nanomaterials, to achieve excellent results. LLE technology broadens the light spectrum and adjusts timing, polarization and beam angle all at the same time. Overcoming speckle was a necessary step but it's not sufficient. For laser light sources to be effective they also have to be inexpensive enough to be easily justifiable. If laser light sources cost \$1m their advantages wouldn't matter because few theaters, if any, would make the investment.

<sup>3</sup> For a more comprehensive treatment of this technology area please see: "[3D Computing from Digital Cinema to GPUs](#)" which we published with GigaOM Pro in October 2009.

LLE has also innovated here to leverage lower cost core technologies, like diode laser pumps, and then uses nanotechnology to deliver highly scalable lighting with the red, green and blue outputs needed for full color imaging. This approach makes the initial LLE offering economic for high-end screens like IMAX and will allow costs to come down rapidly with volume manufacturing to hit the price points needed for the broader market.

## MARKET OPPORTUNITY

The market opportunity for LLE follows a classic technology diffusion model. The starting point will be the high end very large format screens and then move to standard theaters; ultimately, we will see laser light sources in home and office projection equipment.

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*“The next generation of digital projection won’t be bulb-driven but laser-driven.” Rich Gelfond, CEO of IMAX at the March 2011 Gabelli Media Conference*

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With IMAX as a strategic investor, LLE has a great partner to work with for the initial very high-end systems that are needed for large format screens. These systems will carry higher prices in the low six figures. IMAX is expanding and believes that they can grow their current footprint of approximately 500 theaters to 1,300 over the next few years. IMAX alone is a \$100-200m opportunity for LLE. Given the opportunity afforded by LLE’s proprietary technology, it is not surprising IMAX wanted to make an investment in LLE.

There’s more to the high end than IMAX, and companies like Disney are intensely interested in upgrading to laser-based light for their large format displays and content.

Using industry projections for digital/3D screens, there will be 100,000 in operation in 2014. If all these screens went to LLE’s solution, the market opportunity would be over \$2B. Taking a much more conservative view and looking at just the 3D screens, the market that LLE is operating in is worth just over \$500m in the next five years.

But our own market intelligence suggests that the industry figures are likely to go up, possibly as much as 50% for future years. The main reason for this is that these forecasts were put together based on indus-

try activity in 2009 and 2010 when economic activity was below normal. Digital and 3D conversions continued through this period but have accelerated in 2011.

Using our own forecast for digital and 3D screen growth by 2015, we expect 60,000 3D screens in operation, which at a \$20K ASP puts our working total market opportunity for LLE at \$1.2B. Investors should realize that the ASP will be much higher in the early years and ultimately “blend down” to \$20-25K.

Beyond 2015, LLE growth would be driven by industry capacity additions but could also be supplemented with lower-cost products that could penetrate new markets in the home, office and outdoor advertising. We have not yet taken the time to estimate the market opportunity for this segment as it may require a different business model approach, like licensing, which would make any analysis more or less pure conjecture at this point. It is certainly going to happen but the timing, price points, margins and business model are unknowable for now.

## MANAGEMENT AND GROWTH STAGE

The management and board of LLE are comprised of industry experts including Doug Darrow, the CEO, who spent 23 years with Texas Instruments and was General Manager of their DLP Cinema division. The rest of the team members have extensive backgrounds in laser physics, fiber optics, engineering and growing start-ups into real companies. Bob Lambert, former SVP for worldwide technology strategy at Disney, serves on the board of directors.

Today LLE is focused on the first stage of commercializing their technology, which has resulted in initial orders, first stage manufacturing with deliveries, and revenue generation beginning in late 2011. The company is also laying the foundation for higher volume manufacturing in the future. LLE is categorized as an early stage investment by H&H, but it is clear from our analysis that the company is exiting the development stage and moving into expansion, with deliveries and rapid growth planned for the next 12-18 months.

While there could be an IPO in LLE’s future, it is more likely an established company will acquire LLE. It’s hard to know the expected total return to H&H if such an acquisition were to materialize. That said, we would expect the final transaction value of any deal to be above the current value H&H is carrying on their books, and thus enhancing to H&H’s future NAV.

## NEW INVESTMENT ACTIVITY

Earlier in the report, we mentioned several liquidity-enhancing transactions in the H&H portfolio. In the past several months, H&H has taken a few more steps to enhance the liquidity position of its investment portfolio.

Earlier this month, H&H invested in publicly-traded Champions Oncology (PINK: CSBR) (for details, see R2 blog post [here](#)). Champions Oncology is led by world-renowned oncologist Dr. David Sidransky of Johns Hopkins University in Baltimore, Maryland. The company has developed an innovative platform called *Tumorgrafts*<sup>TM</sup> that assists researchers and physicians in matching oncology drugs to patients. Champions' technology platform enables the company to build a proprietary tumor tissue library and create robust, predictive oncology models for testing. As such, it is a novel approach to personalizing cancer healthcare. We expect to see H&H making more investments in publicly traded microcap stocks that have venture capital-like characteristics and fit within H&H's nanotech-focused investment process.

In February, H&H disclosed a \$750,000 venture debt investment in Nano Terra, Inc., which included warrants as well. Nano Terra is a nano- and micro-technology development company headquartered in Brighton, MA. Nano Terra is developing long-term collaborations with its customers that build new business value by applying its interdisciplinary expertise, nano- and micro-technology toolset and knowhow to commercial problems.

Also in February, H&H announced the creation of a new \$10 million revolving credit facility with TD Bank, N.A. to be used in conjunction with its investments in venture debt. The facility, which matures in four years, generally bears interest, at H&H's option, based on (1) LIBOR plus 1.25% or (2) the higher of the federal funds rate plus fifty basis points (0.50%) or the U.S. prime rate as published in the Wall Street Journal. As we noted in our January 10, 2011 research note, H&H has a strategic goal of generating more predictable cash flows and timelines for returns on investment. These moves are part and parcel of this strategy, and we expect to see more such venture debt deals in the months ahead.

## CONCLUSION

Improved liquidity conditions and a brightening outlook for nano-enabled product commercialization

have created a favorable environment for H&H. In our view, there has not been a more favorable environment for the company since it began focusing on nanotechnology investments a decade ago. The early years at H&H were marked by heightened investor enthusiasm for nanotechnology, which led to inflated expectations and then disappointment, as we profiled in our January 10, 2011 report. This pattern of investor behavior is not uncommon to companies that are bringing disruptive, general purpose technologies to market.

We are past the stage of disappointment and entering a period of rising revenues and profitability driven by increased penetration of nano-enabled products in the global marketplace. The beginning of 2011 has seen two liquidity events associated with H&H portfolio companies. There are several more such events in the near term pipeline, including a potentially exciting public offering by Solazyme. Whereas the previous five years were characterized by illiquidity and finding a way to survive, we see this year and those in the foreseeable future as a time for H&H to thrive.

There are several initiatives that H&H is undertaking to streamline the company's investment process and increase NAV. The company has noted that it plans to divest itself of certain portfolio companies and reduce time spent with underperforming companies. Importantly, H&H is seeking ways of increasing liquidity and expanding its NAV as its portfolio matures and they experience profitable exits. We expect to see the pace of investment activity in private and publicly traded nanotech companies to increase in the months ahead. Additionally, we anticipate the company tapping into its new \$10 million revolving line of credit facility to provide venture debt. The interest payments on the venture debt deals offset portions of H&H's annual expenses providing a way to decrease the impact expenses have on H&H's NAV.

Having followed nanotechnology for over a decade, we are hard-pressed to think of a more propitious time for a company like H&H. Our sense is that many investors are still prone to look backward and focus on the disappointment that stemmed from the hype surrounding nanotechnology earlier in the previous decade. Investing is a discipline that attempts to discount the future, not the past. We believe the coming decade will likely provide the growth and investment returns venture capitalists and long-term investors have been expecting from nanotechnology. H&H offers investors a unique investment vehicle to capitalize on the growth in nanotech commercializa-

tion that lies ahead. TINY has historically traded at a P/NAV of 2x, with a range in the past several years as high at 8.8x to as low as 0.57x. The reported NAV as of December 31, 2010 was 4.76 and the stock is currently trading at 1.1x NAV. Our ongoing analysis

of H&H suggests that the current reported NAV understates the portfolio value by 45%, which would imply a fully valued share price of \$12 for TINY.

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