# Meta Materials, Inc. (MMAT)

## *A "Photonics" Company That's an Optical Illusion*

We are short shares of Meta Materials, a $1 billion market cap company whose business is comprised of a whole lot of nothing: no real revenue, no promising technologies, undeveloped products, no track record of achievement. The company is a collection of disjointed and failed laboratory experiments designed, in our opinion, to fuel a stock promotion scheme. From the archived records of Meta's websites, public information concerning its finances and research activity, and the securities filings of recent years, a clear picture emerges: Meta has habitually made outlandish and misleading claims about the feasibility, development, and commercial potential of various technologies only to repeatedly move the goalposts or retrospectively alter its claims, often just quietly dropping entire projects they had previously touted as pivotal.

Founded in 2011, Meta first claimed it was developing transparent thin films (TTFs) for three end markets: solar cells, LED lighting, and laser protection. In the solar business, Meta started by pretending it could double solar cell efficiency, proceeded to deceptively use stock photos to depict products "in the final stage of development," and then took investment funding from Lockheed Martin through a segment it later disclosed had already ceased activity at the time. Lockheed's "investment" was booked as deferred revenue and conveniently accounted for 70% of Meta's revenues between 2017-2020. Meta's solar efforts are still portrayed on its website as "early stage" nearly ten years – and zero results – after they began, while the LED lighting business mysteriously disappeared in 2020. Like solar, there's little evidence that a material business or notable technology ever existed.

Meanwhile, the laser protection segment *does* exist, but just barely. After six years supposedly developing laser glare protected (LGP) airplane windshields, Meta quietly scrapped the project in 2017, replacing it with less ambitious LGP glasses. These have been an abject failure, selling less than 100 units and $60,000 revenue in 4 years and proving Meta can't scale production of even the simplest of films. Then there's Meta's "wireless sensing" segment, which stems from its questionable C$4.7 million acquisition of a UK-based medtech firm with zero revenues and negligible assets that was owned by Meta's CEO and was promoting fake products, partly by misrepresenting the results of rudimentary biology experiments. Finally, Meta's "lithography" segment is comprised of "NanoWeb," a TTF technology it acquired in 2016 that remains in the same stage of development as in 2014. Multiple competing technologies have been commercialized in the interim while Meta has gone in reverse, terminating the licensure of a key patent, watching NanoWeb's inventors resign, and acquiring another penny stock which it claims will synergize with NanoWeb, but which NanoWeb's inventors told us is a distraction. Meta's actions suggest management has no interest in commercializing NanoWeb and wouldn't know how to if they tried.

Meta rose to billion-dollar status after agreeing to a reverse merger with defunct penny stock Torchlight Energy in December of 2020. The day it signed the deal, it appointed a CFO recently involved in an undisclosed paid promotion. In the ensuing 6 months, Torchlight's stock *twice* rose exponentially in tandem with seemingly orchestrated social media promotion into perfectly timed equity offerings. The first saved Meta from insolvency. The second raised $133 million at a $5 billion valuation in just two days that coincided with a retail-frenzy-driven melt-up in its stock price. Meta then exploited the timing and quirky accounting of the reverse merger to disclose the unseemly details of the raise as opaquely as possible. Disappearing segments, misleading product claims, fake medical devices, research funding for subsidiaries that don't exist, and circumstances so questionable around a penny stock reverse merger that it's now the subject of an SEC Enforcement subpoena. It's poetic that an optics company can be entirely made up of smoke and mirrors.

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# I. Company Background

**Meta Materials: Capitalization and Financial Results**

| Capitalization | |
|---|---|
| Share price ($) | $ 3.09 |
| Fully diluted shares (mm): | |
| Shares outstanding | 281.2 |
| Dilutive impact of options, warrants, deferred stock units (DSUs) | 28.0 |
| Total | 309.2 |
| Fully diluted market cap (mm) | $ 956 |
| Less: cash | 70 |
| Enterprise value | $ 886 |
| EV/revenue (trailing) | 560.9x |

| Financial results ($ mm) | 2019 | 2020 | TTM |
|---|---|---|---|
| Revenue | $ 1.2 | $ 1.5 | $ 1.6 |
| Net Loss | (11.1) | (19.8) | (34.9) |

*Source: company filings, Kerrisdale analysis*

Meta Materials ("Meta") debuted as a public company just last year, when it participated in a reverse merger with Continental Precious Metals (CPM), a defunct Canadian miner relegated to NEX trading that had become a public-company shell in search of a merger partner. Earlier this year, Meta took part in its second reverse merger in as many years, combining with Torchlight Energy, another public shell seeking a reverse merger target. Currently sporting a $950 million market capitalization, it might come as a surprise that Meta's business is comprised of, essentially, *nothing*.

Meta's public company filings and website portray an "advanced materials and photonics company…seeking to harness the power of light" in three areas: holography, lithography, and wireless sensing. But as we discuss at length below, Meta's three current "businesses" have generated just about zero product revenue over the last ten years despite continuously making grandiose product development claims. We expect this trend to continue given *that the company has never actually commercialized anything*.

To understand how a collection of primitive science experiments arrived at a billion-dollar valuation, it's worth recounting the last decade's worth of hype over which CEO George Palikaras has presided. By examining the ten-year track record of claims made by Palikaras and his management team, via Meta's websites, financial filings, research papers, and other publicly available information, it's easy to conclude that Meta repeatedly makes promotional and questionable claims about the viability, validity, promise, and even the existence of its technologies, only to abandon its previously hyped projects after some time passes.

Meta was founded in 2011 as Lamda Guard, an "advanced materials and systems engineering company…delivering nanotech solutions powered by metamaterials." Metamaterials were

described on the company's website as "artificially created materials…microscopically built from conventional materials such as metals…[fabricated] to create novel devices with unprecedented and exotic properties." Public records from the Atlantic Canada Opportunities Agency (ACOA) show that in 2012 the company received a $332,000 loan to work on transparent thin film (TTF) technology, and archives of the then-private company's webpage from 2013 to mid-2017 highlight three corporate segments, each focused on developing transparent metamaterial thin films for a different application:

- Lamda Lux thin films would enhance the output and efficiency of LED lighting
- Lamda Solar thin films would improve the absorption of solar panel cells
- Lamda Guard thin films would be applied to aircraft windows to protect against laser strikes that could affect pilot vision

In mid-2016, Meta acquired a small TTF company called Rolith. Founded by a group of optical scientists in 2008, Rolith had prototyped a conductive TTF called NanoWeb that had potential applications in a variety of different fields, from touch screens to automobile windshields to transparent antennas. Having run out of cash and unable to secure any more funding, Rolith's founders were forced to sell the company, and in mid-2016 struck a deal to sell to Meta for $2.5 million.

Two years later, in July 2018, Meta acquired London-based MediWise, "a medtech knowledge-driven company that empowers individuals to take control of their health." In the press release announcing the acquisition, Meta boasted of MediWise's "significant advancements in non-invasive glucose monitoring," including its development of "a new product called glucoWISE, [which] has the potential to safely detect the concentration of glucose in the blood stream without having to draw blood or use test strips." Strangely, the press release did *not* disclose that MediWise was approximately 50% owned by Meta's CEO, Georgios Palikaras, and his wife. Nor did it mention the C$4 million purchase price, or the C$700 thousand intercompany loan that Meta had provided MediWise, and which was forgiven in the course of the transaction *in addition* to the purchase price. There was also no mention that *glucoWISE didn't actually exist* or that MediWise had a negligible balance sheet and no record of any revenues. The deal, in retrospect, seems more like a bailout of a failed investment than a strategic acquisition.

Lamda Lux and Lamda Solar are now long gone, having mysteriously disappeared from Meta's website after its first reverse merger in 2020 with Continental Precious Metals. We can't find any evidence that either division has ever successfully produced so much as a single prototype and, as we describe below, we believe that Meta's presentation of its Solar and Lux segments was highly misleading. Meta currently describes itself as comprised of three new segments, which we explore at greater depth in what follows:

- Holography – this is the old Lamda Guard, which underwent a strategic pivot, redirecting its efforts from TTFs for aircraft windshields to "holographic" laser glare protection (LGP) glasses, which have followed the typical Meta path from hyped technology to abject failure.

- Lithography – the segment dedicated to NanoWeb development, except there hasn't been much in the way of development. In the 5+ years since the Rolith acquisition, an array of competitive conductive TTF alternatives have been developed, commercialized, and mass produced, while NanoWeb has remained in the same stage of commercialization as in 2014. Meta also ceased licensing from the University of Michigan a patent critical to the NanoWeb production process, which suggests that Meta is either not really invested in commercializing the product, or that it doesn't know how to – or both, considering that Rolith's founding scientists left the company within two years of its acquisition by Meta.
- Wireless Sensing – this segment houses the MediWise acquisition and is ostensibly working on the same exact projects that MediWise was working on 7 years ago, all of which sound like they emanate from a science fiction novel. Most prominently, this subsidiary is (still) developing a "non-invasive glucose monitor" using a mechanism that the clinical literature suggests is actually impossible.

Before assessing whether there's any commercial substance to these segments (in short: no), it's instructive to examine the quiet failure of Meta's early technological forays and the creative ways Meta was able to finance a façade of scientific accomplishment with no legitimate underpinning.

## II. Meta misrepresented its early TTF endeavors while securing funding from Lockheed through a subsidiary that doesn't seem to have existed

The evolution and fate of Lamda Solar and Lamda Lux, Meta's initial Thin Transparent Film projects, are perfectly reflective of the hype cycle fomented by Meta continuously over the years. The trajectory of Lamda Solar from one of the 3 initial corporate segments to a literal footnote is instructive:

- Lamda Solar was first described in 2013 as a segment "that designs high-efficiency solar cells," though Meta never gave any indication that it had any solar cell products in development.
- By late 2014, the segment was no longer designing solar cells but instead was "developing… a thin film that uses metamaterials…to dramatically increase solar cell efficiency (up to 100%) by collecting light from all angles and absorbing light over most useful spectrums." This was a bold claim, but we found no evidence that Meta ever demonstrated any scientific mechanism by which they would achieve a doubling of solar cell efficiency. The now-removed references to scientific publications that used to grace Meta's website did not even hint at any solar-related research.
- The 2014 description appears to have remained the same until 2016, when Meta claims to have been "in the final stages of development" of films that "are lightweight and easy to apply to crystalline and organic solar panels." The segment information even depicts a photo

of what is ostensibly a car using Lamda Solar technology, but in fact turns out to have been a stock photo of the famous 5th generation UNSW Sunswift vehicle (see below).

**Lamda Solar's Website Marketing in 2016**

From Meta's Lamda Solar Website (Archived on 5/30/2016)


*This new technology is in final stages of development.*

The Sunswift eVe (Source: Electric Vehicle News)

- By August of 2017, the official Lamda Solar downloadable factsheet describes how the solar cells use "NanoWeb technology…to capture all electrical power without blocking the light propagation," which is curious because Meta had previously claimed to be "in the final stages of development" of the Lamda Solar technology before it ever obtained the NanoWeb technology with the acquisition of Rolith in 2016.
- In June 2017, Meta announced that it "signed a $5.6 million (CAD) agreement with Lockheed Martin, which represents Lockheed Martin's first solar investment in Canada." The press release gave the impression that Lockheed would be buying a product called "metaSOLAR," which had never been described previously by Meta but was meant to be "the world's lightest weight and highest efficiency solar panel technology, suitable for flight." The actual contract, though, makes it clear that Lockheed was using the investment to discharge its Industrial and Technological Benefits (ITB) obligation, which requires defense contractors that sell equipment to the Canadian government to invest a portion of the

contract into Canadian businesses. The contract's project description also required Meta to "produce a ***prototype*** of the light-trapping metamaterial film," which indicates that Meta was not remotely close to the "final stages" of the development of anything (as it had previously claimed) and that 5 years after supposedly *beginning* development, it hadn't even come up with a prototype yet. The specific project objective was to "deliver a commercial prototype of a solar-powered drone for cargo deliveries, along with a manufacturing and commercialization plan." There is no evidence, either on Meta's current or archived websites, or in any of its filings or white papers, that this commercial prototype exists or that any of the contract's project objectives – which include "design, prototyping, drone integration, certification, production, scale-up, and marketing & sales activities" – have been met.

- Meta's description of the Lamda Solar segment remained unchanged from 2017 to 2020, prominently promoting the Lockheed "partnership" but never actually indicating any progress towards development of a product. Currently, Meta's website description of its solar business is the same one it's presented since 2014, except it's no longer called "Lamda Solar." The consistent description of the relationship with Lockheed as a "partnership" is also directly at odds with the contract, in which Lockheed stipulates that the agreement "is not intended to constitute, give effect to, or otherwise create a joint venture, ***partnership***, teaming agreement or other business entity of any kind. [emphasis added]" The current description still includes the claim that "META is ***at the early stage*** of developing new solar films that will have the potential to increase solar cell efficiency by collecting and absorbing light. [emphasis added]" Almost 10 years later, and still at the early stage! The company also continues to tout its solar "partnership" with Lockheed, but without disclosing that the agreement was signed almost 5 year ago, and will expire in 5 months after seemingly having produced nothing relevant to the contract terms. In fact, based on the terms of the contract, we think it's likely that Meta's seeming failure to meet any of the stated project objectives means that it's required to pay back the C$5.6 million to Lockheed.[1]
- Strangely, Meta's regulatory listing statement in connection with its reverse merger with CPM – dated March 5th, 2020 – discloses that the Lamda Solar subsidiary *has had no activity in the last 3 years*. If that's the case, why was the Lamda Solar segment still presented on the company's website? What exactly is the solar business presented on the website *now*? Worse, it turns out that Meta signed a "partnership" with Lockheed in *April of 2017*, when, according to the 2020 listing statement, the solar segment had already ceased activity. That also calls into question the legality of Lockheed's ITB investment and begs the question of whether Meta was exploiting Lockheed's legal requirement to get funding for a ***business that in fact didn't exist anymore***.[2]

[1] It's notable that it is not in Lockheed's interest to rock the boat on this money because it might jeopardize much larger contracts with the Canadian government.

[2] There is some conflation in the listing statement between NanoWeb and the solar business, with the implication that NanoWeb also has solar applications. While that is *possible*, NanoWeb, and the lithography subsidiary that was formerly Rolith, were domiciled in the United States, and as such would not qualify for the business activities eligible for the ITB credits needed by Lockheed.

Lamda Lux, another of Meta's initial corporate segments, apparently took a similar inauspicious path as Solar. Described in 2013 as a Meta subsidiary "that designs advanced light sources using nanocavities, which enhance light output (power & efficiency)," Lux quickly pivoted in 2014 to "optically transparent thin film that drastically increases the light output of LEDs by up to 10 times." The same basic description remained on Meta's website *through 2020 without so much as a single piece of incremental information*. After Meta redesigned its website in the wake of the reverse merger with CPM, the entire Lamda Lux segment mysteriously disappeared. As with Lamda Solar, Meta's 2020 listing document discloses that Lux had had no activity in the 3 years prior, so it's not clear why Meta continued to present the segment on its website. At least there was no dubious agreement signed with a global defense contractor.

Looking back over the last decade, major portions of Meta Materials' "operations" were, *at best*, an extended streak of failed TTF experiments dressed up in a veneer of promotional marketing around technological progress in faddish areas like solar and LED technology. But how did the company keep the show running?

## *Meta Materials creatively financed itself through research grants and customer deposits that were never earned, and more recently through reverse mergers*

It's difficult to assess Meta's financial performance before 2017 given its closely held nature, but since 2017 the company has used C$32 million in cash from operations and another C$10M in cash for capital expenditures (while generating cumulative losses of about C$55M). In that time, the company generated a grand total of about C$55 *thousand* in product revenue. So it's worth understanding how Meta financed these cash outflows, the majority of which have gone towards salaries, benefits, travel, entertainment, consulting, and "professional fees" for a company with 20-30 employees.

One way was through investing "partnerships" with multinational corporations that would never bother to follow up on project details:

- The aforementioned C$5.6 million deal with Lockheed was closed in April 2017. As previously described, none of the project objectives seem to have been achieved, but Meta got an upfront payment for the entire amount and has continued to book the deferred "development revenue" for the last 4 years. In fact, ***70% of Meta's entire revenue generated from 2017 to 2020 is just the realization of deferred revenue from creatively financing this "solar flight" project***, even though the company's Lamda Solar subsidiary was shuttered more than 5 years ago.
- In July of 2018, Satair, a subsidiary of Airbus that distributes aircraft parts and equipment, signed a $2 million (USD) purchase order for Meta's LGP glasses. Two months later, Satair signed an agreement to become the exclusive distributor of the LGP frames, paying Meta a C$1.3 million fee for the privilege. Two months after *that*, Satair advanced $500 thousand (C$655 thousand) in cash for the July purchase order. To date, of the $2 million order, only C$34 *thousand* has been filled, with about half a million dollars remaining an operating

liability. The exclusivity fee, meanwhile, was booked by Meta as deferred revenue, which it continues to recognize at the current time. It turns out that Satair essentially funded Meta to the tune of C$2 million in return for 50 pairs of overpriced glasses to which plenty of cheaper and better alternatives exist (more on that below).

The relationships with Lockheed and Satair provided Meta with two cash infusions totaling C$7.5 million that the company was able to *also* conveniently recognize as "development revenue" spread out over years, ironically without ever actually *developing* anything of value. Another creative source of funding for Meta over the years has been a variety of Canadian government-affiliated investments and loans:

- Between 2013 and 2019, the Atlantic Canada Opportunities Agency (ACOA), a Canadian government regional development agency, lent C$6.8 million to Meta, almost entirely in the form of interest free loans, and almost all of which is still outstanding. The lion's share of these loans – C$6 million – was meant to support the commercialization of the Lamda Guard laser protection shields, a project subsequently dropped by Meta, and the LGP glasses, which Meta has been unsuccessful in commercializing.
- Sustainable Development Technology Canada (SDTC), a Canadian government-sponsored foundation that funds "clean-tech" startups, agreed to invest C$5.4M in Meta in late 2017 to fund expenses related to a project titled "Enabling solar flight: a testing ground for lightweight and efficient solar panels." As with the Lockheed investment, this was over 3 years after Lamda Solar was no longer active, so it's not clear what Meta was going to do with the money. In the end, SDTC only invested C$1.99M, seemingly because Meta was not meeting its end of the deal, and there's since been no disclosure from Meta as to how, or if, the project is advancing.
- Innovacorp, the state-owned venture capital corporation of Nova Scotia, invested a total of C$3.1 in Meta (C$2M in 2015 and another C$1.1M in 2017) through private placement share purchases. The press release discussing the 2015 investment indicates that the capital was to be used to "develop an R&D and pilot production facility that will allow the manufacture of thin-films for cockpit windows." Meta dropped the cockpit window product around 2017.
- The Business Development Bank of Canada (BDC), another Canadian government-owned institution mandated to help develop Canadian businesses through financing, lent Meta C$5 million in April of 2020, right after the completion in March of the reverse merger with CPM. At that point, Meta had public shares as currency (though the stock was trading at a level that then implied a sub-C$40 million market capitalization), and the debt was structured as convertible into Meta stock.

In total, benevolent government funding for R&D (C$17 million) and hollow corporate partnerships (C$7.5 million) have provided Meta with C$25 million in funding over the last 5 years. Other sources of cash included an array of loans and equity infusions from small investors, some who were already shareholders; an C$8.3 million equity investment from private-equity firm Radar Capital in 2017 that was meant to be invested in commercializing the LGP glasses; and C$4 million that was on CPM's balance sheet prior to the reverse merger, and was assumed by Meta after the deal's closing.

Despite successfully raising money for projects that may have not existed, and certainly weren't going anywhere, Meta's financial position has been – until recently – quite precarious. The 2020 reverse merger listing document acknowledges "material uncertainty that may cast significant doubt about the ability of Meta to continue as a going concern." The same acknowledgement is disclosed in all of Meta's financial statements from 2018 through the first quarter of this year, including in all the independent auditor's reports from EY and KPMG (on the annual financials for 2018, 2019, and 2020). Meta was so close to insolvency after agreeing to its (second) reverse merger with Torchlight in September of last year, that the merger agreement stipulated a $10 million bridge loan from Torchlight prior to the deal's closing, which the latter agreed to raise through an equity offering this past February.

Immediately prior to agreeing to the reverse merger with Meta, Torchlight was a penny stock promotion with a $20 million market cap set to be delisted from the NASDAQ. Just five months later, Torchlight successfully raised $26 million in the offering meant to fund the bridge loan to Meta. Then, just four months and multiple deal-closing delays later, Torchlight took advantage of a social-media fueled-melt-up in its stock price to raise about $130 million through an at-the-market (ATM) shelf it rapidly put in place with Roth Capital. The path from a reverse merger agreement between two micro-cap penny-stock companies to the current billion-dollar valuation of the combined entity is worth recounting.

## III. The Path to the Torchlight Merger was Filled with Red Flags: A Questionable CFO Appointment, Blatant Retail Promotion, and Opaque Disclosures

The initial announcement of Meta's reverse merger with Torchlight was greeted by investors with a proverbial shrug. Torchlight's stock, then trading at 30¢/share, declined in the following days to 20¢/share, while Meta's Canadian listing barely budged. That started changing in the last week of November 2020, as Torchlight's ticker – TRCH – began trending on both Twitter and reddit. By the end of December, the stock price had tripled.

In the midst of this run, on December 14, Meta and Torchlight finalized their merger agreement. Also on December 14, Meta announced that it had appointed a new CFO, Kenneth Rice. Rice was an interesting choice. Per the press release that announced his appointment, Rice had been the CFO of small-cap Alseres Pharmaceuticals from 2005 to 2019. Meta failed to mention that Rice presided over a 99.9% stock price decline at Alseres, from a split-adjusted $10,000 per share to just $10. Meta also failed to mention Rice's recent involvement as one of three board members at Hoth Therapeutics, a preclinical biotech company that went public in 2019 at a $50 million valuation. Rice was the co-owner of Chelexa BioSciences, a company that licensed to Hoth a "drug compound platform" – described by Hoth as its primary asset – in return for a 10% ownership stake. In addition to Hoth's stock price having declined 90% since its IPO just 2 years ago, Hoth has also been embroiled in controversy given multiple undisclosed paid promotions, including at the time of its IPO, as well as its longstanding involvement with

Laidlaw & Company, a brokerage firm that has been censured by FINRA several times, including just recently for market manipulation, and which was the underwriter of Hoth's IPO. It's hard to blame Meta for not disclosing its new CFO's somewhat checkered past, but we think it's worth pointing out that this is not Rice's first time participating in a hyped technology story with little actual substance combined with evidence of retail promotion.

As 2021 began, Torchlight's stock price continued to rise along with the associated din on reddit and Twitter, conveniently doubling in price into the company's February 10 equity offering, and then more than doubling again in the following week. Through mid-April, as the merger's consummation kept getting delayed and the associated social media volume subsided, the stock price coincidentally declined by half. The decline was arrested once Torchlight published an April 15th update on the proposed merger indicating that the two companies were still on track to complete the deal. Once again, Twitter and reddit buzz about the stock started to rise and the stock proceeded to jump 8.5x from its mid-April low of $2.54 to an intraday high of $21.76 by mid-June.

At that point, Torchlight sold about $133 million in stock through an at-the-market arrangement that it put in place through Roth Capital Partners on June 16th. We strongly suspect that the observed pattern is not a coincidence: Meta recruited a CFO whose previous company was involved in paid stock promotions; Torchlight's stock – the currency being used to take Meta public via reverse merger – was promoted systematically by prominent retail-oriented social media accounts; a massive stock price run ensued; and the result was equity issuance on a massive scale: in just two days this past June, Torchlight raised about double the capital that both it and Meta had raised, combined, over the last decade.

Despite being the largest raise in the company's history, Meta's disclosures on the matter remain especially opaque. On June 16, following a week and a half period during which its stock more than doubled, Torchlight filed a prospectus detailing a $100 million ATM offering agreement to be executed with Roth Capital as agent. Just 3 trading days later – on June 21 – Torchlight filed a second prospectus after market-close upsizing the ATM offering to $250 million and disclosing that it exhausted the 6/16 offering arrangement by selling 5.87 million shares (split-adjusted) for $100 million. Given the realized price of these sales – $17.04/share – it's clear that Torchlight sold all $100 million on that day (6/21), the only day of the year that the stock traded that high. Curiously, though, Torchlight didn't disclose what it sold under the upsized 6/21 authorization until a note in a footnote to an exhibit of an amended 8-K filed on August 17th. In the notes to the pro-forma financials disclosed in that filing, Meta reveals that a total of about 8.05 million shares were sold for $133 million in the ATM raise, implying that Torchlight sold an incremental 2.2 million shares at an average price of $15.33 on 6/22.[3] Because of the reverse merger structure, Meta's 10-Q for the quarter ending June 30 was filed for Meta's operations rather than for Torchlight, and Meta apparently felt no need or obligation to prominently disclose the details of the massive ATM issuance despite its obvious materiality.

[3] It's clear that Torchlight sold the rest of the shares on that one day – 6/22 – because the stock never traded above $11.88 from 6/23 onward.

In short, the 6 months leading up to the completion of Meta's reverse merger with Torchlight were replete with red flags: Meta appointed a CFO that was previously a key player in a highly promoted biotech sham. Then, social media retail promotion *twice* led to Torchlight's stock exponentially rising, both times into the teeth of significant capital raises. The details of the massive $133 million second capital raise – when they are disclosed at all – are buried in the minutiae of multiple securities filings that show that Meta/Torchlight took a single day to dump as much stock as it was legally allowed to into a retail speculative frenzy and, on that same day, went back to the trough to file for even more. Then, through the sleight of hand inherent in a reverse merger, Meta left the details of the raise somewhat obscure, burying the fact that the rest of the shares were sold just one day after the first batch, and that in total, the company sold more than 8 million shares at an average price of $16.57 and an implied valuation of ***over $5 billion***. Of course, the shares never again traded anywhere close to that price, and it's laughable to expect that they ever will. Given that salacious fact pattern, it's not surprising that Meta disclosed on November 15th – in its most recent 10-Q, buried in a footnote, of course – that it received an SEC Division of Enforcement subpoena in *September* regarding "among other things, the merger involving Torchlight Energy Resources, Inc."

## IV. Meta's Current "Operations" are a Collection of Hopeless, Fake, and Obsolete Science Experiments

Meta's press releases and recent filings are meant to give (mostly retail) investors the impression of an advanced materials company with proprietary "nano" technology that can be applied to making progress in fields like medtech, automotive, 5G telecom, and "augmented reality." If those sound like industries that coincidentally are expected to have the most exciting growth opportunities right now, and have therefore garnered the most generous valuations, that's not a coincidence. As Meta's experience with Lamda Solar and Lamda Lux have shown, the company has a track record of making misleading announcements and proclamations around its capabilities in trendy industries, such as solar and LED lighting ten years ago, only to quietly fail and move on to promoting the next breakthrough. But as with Solar and Lux, we expect Meta's current businesses – to the extent they really exist – to wallow in irrelevance.

### *Meta's holography business has been an abject failure and we expect more of the same*

As described briefly above, Meta's holography segment is the old Lamda Guard, which began with the idea of developing and producing a transparent thin film that would be placed over aircraft windshields to protect pilots from laser strikes, which can dangerously incapacitate pilots temporarily. Archives of Meta's website show that in September 2013, the company claimed that it had already "developed an optically transparent thin film filter that selectively blocks narrow light frequencies… and can be adhesively applied on existing surfaces such as cockpit windows or windshields." In June 2014, Meta announced that it had signed an agreement with Airbus to test its design, but there seems to have been no progress on the technology until February 2017, at which point Meta signed another agreement with Airbus, this time to "validate,

certify, and commercialize" the laser-protection technology. Always opportunistic on the capital-raising front, two months later Meta parlayed that agreement with Airbus to raise $8.3 million in equity from a group led by Radar Capital to "support commercialization of the windscreen film and to add needed staff."

In June 2017, Meta announced that it had signed a memorandum of understanding with Satair, Airbus's parts and equipment distribution subsidiary, that would lead to Satair being the exclusive distributor of the windscreen film technology that Meta had branded as metaAIR. The announcement declared that certification of the metaAIR technology from the major global aviation regulators (FAA, EASA, and TCCA) was expected in early 2018, at which point Satair would presumably begin selling the film – which could be applied to any airplane windshield internally – to major aircraft manufacturers and airlines, including its own parent company, Airbus. Incredibly, while Meta's website continued to promote the application of the metaAIR technology to airplane windshields right up until the website's redesign in the wake of the CPM merger, the June 2017 announcement was the last time that the metaAIR windscreen would ever be mentioned as a potential product. By October 2018, when Meta signed another agreement with Satair, discussion of the windscreen product had essentially disappeared.

The October 2018 agreement, which designated Satair as the exclusive distributor of metaAIR products, no longer referred to aircraft windshields but instead to laser glare protection (LGP) eyewear. In February 2019, Satair's customer solutions director announced that the initial metaAIR product applications for the consumer market would appear in the first quarter of that year and, indeed, the Satair brochure library does feature Meta's metaAIR LGP glasses. The problem is that the glasses have been a complete commercial failure. While Satair paid Meta $1 million (C$1.3 million) in the 2018 agreement to become the exclusive distributor of the glasses through 2026, and even put in a C$2 million purchase order before that distribution agreement was even signed, Meta's financial filings indicate that it has never been able to actually produce the glasses at even modest scale. A total of 50 units were sold to Satair in 2019, while another 2 were sold to an undisclosed national air force. We estimate that Meta also sold about 30 units through its website in the first quarter of this year (maybe it was the fact that they put the glasses on sale for $1000, a large price cut from the normal $1800 MSRP). That's it.

We count *at least* C$18.5 million in funding that Meta has raised in debt, equity, and deferred revenue since 2014 for the express purpose of developing and commercializing LGP technology, and the result has been fewer than 100 pairs of glasses sold for about $62 *thousand* in total revenues. In that context, it's worth asking: what exactly did Meta do with that money if it never successfully produced LGP glasses at scale? The CPM merger listing document from March of 2020 states that Meta

> completed the construction of its metaAIR eyewear production facility in Q1 2019 and started providing its eyewear to several airlines for in-market flight tests through its distributor, Satair. The Company has not received significant orders from any airlines yet, however, it is further increasing its reach to airlines through Airbus and Satair. Satair prepared a series of marketing blogs to promote MTI's laser glare protection eyewear solution to increase market awareness in the existing laser glare protection market.

We can't find any record of Satair's blog posts marketing metaAIR glasses, and it's difficult to explain why, if Meta really had completed the construction of a production facility, they didn't fill Satair's C$2 million purchase order *of which Satair had already provided a cash down payment of C$500 thousand!* If the tens of millions of dollars that were raised explicitly for the development and commercialization of this technology over the last seven years were really invested for that purpose, Meta's inability to manufacture the metaAIR glasses at any level of scale reflects the magnitude of its operational ineptitude. It also suggests that, consistent with its longstanding practice, Meta may have greatly exaggerated its accomplishment of completing a production facility.

It's notable that the metaAIR product is not even very good. The underlying holographic technology, which involves using lasers to alter the optical properties of transparent light-sensitive polymers that comprise a thin film, is difficult and expensive to implement. It's also complete overkill for a niche product with a lot of competition from cheaper and lower-tech alternatives that happen to do a much better job at protecting pilots' eyes from potential laser strikes. Dye-based lenses, such as those manufactured by Gentex and Revision, offer better durability, protection from multiple angles, and protection from a range of dangerous wavelengths, all for 15% of the price for which the metaAIR frames sell. Non-holographic thin-film options, such as those from Iridian and PerriQuest effectively offer the same protection as metaAIR lenses, also for 10-15% of the price. The metaAIR glasses are expensive, lack peripheral vision protection, are extremely vulnerable to scratching, and were only developed to protect from green-wavelength lasers (whereas the competitors mentioned here also offer protection from blue and red wavelengths). Even if Meta could figure out how to make them, they probably wouldn't sell anyway.

Meta's latest absurd claim is that it will use its holographic "expertise" to improve augmented reality (AR) eyewear. But holography for AR is a commoditized and widely available technology, already incorporated in AR devices by large (and competent) technology companies like Cisco and Microsoft, while Facebook is already knee-deep into developing the next generation of holographic AR. It's laughable to expect that Meta Materials will be able to develop any AR technology of value when it can't even master basic holography to compete with niche sunglasses manufacturers.

## *Meta's med-tech segment is a sham*

Meta's "Wireless Sensing" business is the old MediWise, a small UK medical technology company acquired by Meta in July 2018 for C$4 million. Digging into the MediWise story revealed a familiar pattern of smoke and mirrors that Meta exhibited in its other segments, though with the added bonus of a questionable set of related party transactions.

MediWise was founded in 2010 by Meta's CEO, George Palikaras. Beginning in July 2012, MediWise claimed that its "current focus is on early-stage breast and prostate tumour detection using microwave imaging and real-time in-vivo-dosimetry (IVD) monitoring through implantable wireless sensors." The details of this R&D program were not described, but it must have been

an extremely efficient effort: the UK Companies House filing history, which keeps public records of all registered limited companies in the country, shows that in 2012 MediWise generated no revenues, an operating loss of ~£80 thousand and tangible assets at cost of £7 thousand. To be focused on imaging-based tumor detection *and* implantable wireless sensors on that kind of budget is obviously impossible unless those goals are *really* aspirational.

A year later, in August 2013, MediWise's website indicates that its focus had changed. At that point, MediWise claimed, metamaterials technology "has allowed MediWise to develop three wireless products for the medical diagnostics market: the first accurate, non-invasive on-ear glucose sensor and mobile platform for continuous diabetes management; the first radio-wave imaging scanner for early-stage screening of breast cancer aimed at younger women; and the first real-time wearable radiation sensor for cancer patients undergoing radiotherapy treatments." All this on an even thinner budget, and with no incremental capital expenditures, compared to 2012!

In mid-2014, MediWise unveiled glucoWISE in the "Products" section of its website. A depiction of the glucoWISE "non-invasive, wireless, glucose-sensing platform" and the attendant description can be seen below. glucoWISE would be the holy grail of diabetes management, allowing patients to check their blood sugar by simply placing the monitor in between their thumb and index finger and getting a digital readout of their glucose levels. No lancing device or finger-pricks would be necessary. MediWise even claimed the device was "*more accurate than the average blood glucose monitor.*"

**glucoWISE as Promoted by MediWise in 2014**


*Source: MediWise archived website*

*But glucoWISE didn't exist*. In fact, though glucoWISE remains the centerpiece of Meta's "Wireless Sensing" technology, it still doesn't exist. And it never will. John L. Smith, an accomplished research scientist and medtech executive has, for the last 15 years, updated his synopsis of the quest to invent a non-invasive glucose monitor. Smith documents close to a dozen different proposed modalities and dozens of different companies' attempts. While Smith is agnostic as to whether such a feat is possible, his research makes it clear that it's never been done and, as of the present time, there's no sign that anyone is even close to the achievement. glucoWISE is actually just a bit player in the long history of exaggerated claims of having developed a non-invasive glucose monitor. Smith recounts how MediWise originally said they expected to begin taking "pre-orders" for glucoWISE in late 2016, but of course nothing ever came of that. Smith shows how this is a common pattern in the field, as these sorts of announcements by small companies have "perennially…been premature and meant to generate hype."

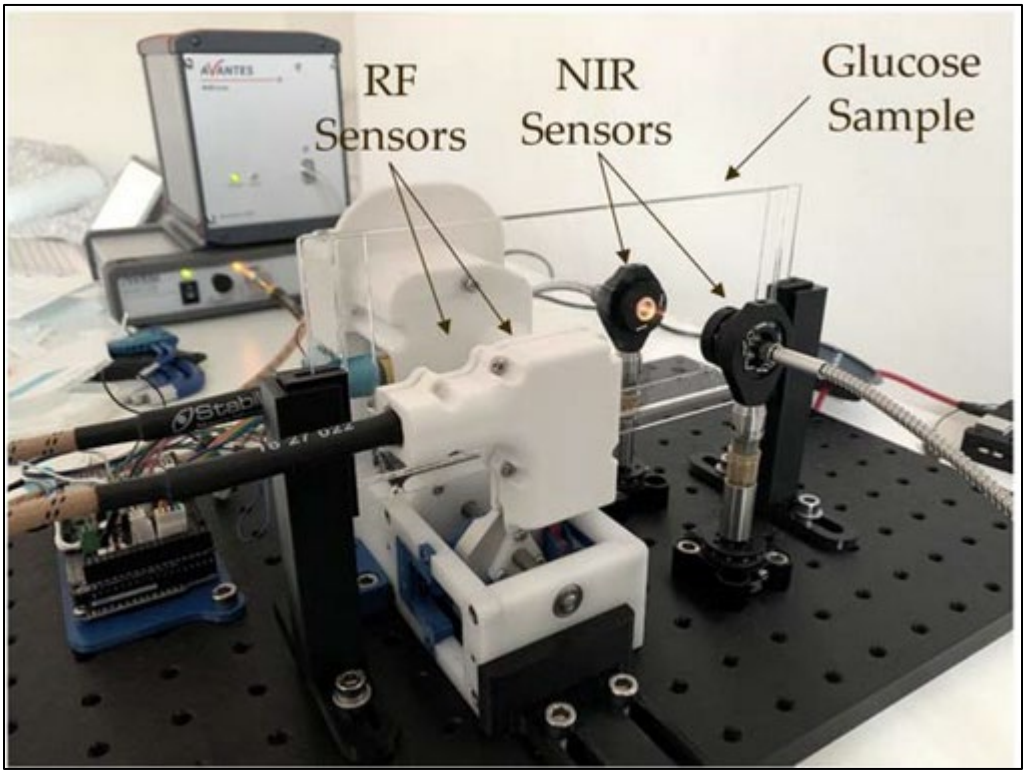
The "clinical literature" around glucoWISE, meanwhile, is comical. One study from 2018 that was sponsored by MediWise described how pigs were injected with enough glucose to bring their blood sugar levels to more than 10x the normal levels found in humans, and 2-3x levels that could quickly kill someone. Using the radio-frequency detection method that would hypothetically underlie a glucoWISE prototype, the researchers found that the resulting measurements *correlated* to the measurements being taken by actual blood glucose monitors, but no numerical results were published. The "glucoWISE" method also detected phantom spikes in blood sugar that were never present in the actual blood samples. So the method could only vaguely detect the direction of change in blood glucose, and only when the changes were large enough to kill someone, and on top of that, it would detect phantom changes that weren't even happening.

This past July, Meta announced that it "completed a UK-funded project towards developing non-invasive glucose sensing system." In the first paragraph of the press release, Meta proclaimed that it completed a project to "develop a non-invasive glucose sensing prototype, which combined radio wave and optical sensors to improve accuracy in predicting glucose level changes." Only later on does it become a bit clearer that the "improved accuracy" is not compared to traditional glucose monitoring but to glucose monitoring using just one of the two sensor methodologies used in the project.

The press release also depicts computer-generated pictures of the monitoring system – which doesn't actually exist – for promotional purposes (see below). Most laughably, the underlying scientific study to which the press release links indicates that the project basically just tested whether some lab-rigged sensors can detect *changes in the concentrations of glucose in solutions composed of only glucose and water, and using concentrations that ranged 2-50x normal blood-glucose levels*. And even then, the sensors weren't very accurate. The audacity of using measurements of glucose in *water* to suggest progress in measuring *blood glucose through the skin barrier* is hard to comprehend. The proclamations are so misleading that they should deem suspect almost any "scientific" claim that Meta makes.

**glucoWISE Press Release vs Lab Experiment**

*META's glucoWISE® Point-of-Care "Home Hub" Product Concept*




The top figure shows Meta's computer-generated depiction of its glucoWISE Hub concept, while the referenced lab experiment in the bottom picture shows a bunch of lab-rigged sensors applied to a glucose-in-water sample that is completely transparent.

*Source: MediWise Press Release, Cano-Garcia, H et al* Enhancing the Accuracy of Non-Invasive Glucose Sensing in Aqueous Solutions Using Combined Millimeter Wave and Near Infrared Transmission

Besides glucoWISE, Meta claims to be developing an "MRI amplifier" that will allow MRI operators to "acquire the same or better image quality in much less time" than existing technology, as well as "radio wave imaging devices" for rapid detection of strokes. There are no

timelines, further descriptions, clinical papers, or even bare bones mechanisms disclosed either on Meta's website or in its filings related to these endeavors. In the CPM merger listing document, Meta claims that its MRI technology has been demonstrated through a "number of animal and pre-clinical human studies" but provides no references, and the only paper we could find was one that studied "radio-frequency-activated" automatic on/off switches for MRI machines. Once again, Meta's promotional material is vastly at odds with any existing reality. Meanwhile, the cancer screening "technology" that Meta alluded to as late as the 2020 listing statement has mysteriously disappeared.

Finally, as if to confirm our doubts over the legitimacy of any of Meta's medical technology, the company announced in its third quarter letter to investors that its wireless sensing segment was "developing a bio-photonic sensor with sensitivity and performance enhanced by nanomaterial to meet rising demand for point-of-care/point-of-use testing for COVID-19 and 50 other molecules." Not only that, but the product is also "portable and smartphone-attached." Even the armchair virologists on social media know that the idea of using optical sensors to test for a virus is obviously a scam.

Fake medical devices and hyperbolic technology claims aren't the only red flags at Meta's wireless sensing business. The 2018 acquisition of MediWise deserves a bit more scrutiny. The private financial statements filed with Companies House show that as of year-end 2016, MediWise had 3 employees, no revenues, and negligible tangible assets (£8 thousand). In 2017, that changed a bit with Meta – controlled by Palikaras – lending C$700 thousand to MediWise, which was also controlled by Palikaras. Meta started 2017 with C$2.9 million in cash on its balance sheet, but was set to burn through C$8 million over the course of the year. Recall that in mid-2017, Meta raised C$8.3 million in equity to fund the commercialization of metaAIR. It sure seems that the raise also helped fund the loan to MediWise. It's not clear what MediWise did with the money, but its 2017 year-end balance sheet shows just £21 thousand in cash and no incremental increase in fixed assets, which means it *spent* essentially all the money it borrowed from Meta. Against this backdrop, Meta agreed to acquire MediWise for C$4 million in mid-2018 *in addition to cancelling the C$700 thousand inter-company loan*. Considering that MediWise had no assets, no revenues, and no useful intellectual property at that point, the acquisition seems to have been an underhanded transfer of cash from Meta's new shareholders (the group led by Radar Capital) to Meta's old shareholders through the acquisition of MediWise, which was owned primarily by Palikaras and his wife.

While "wireless sensing" may not seem like one of the more prominent parts of Meta Materials, we think that Palikaras' track record here is reflective of the same general approach we described with holography: the products being promoted either don't exist or are grossly overstated, the underlying scientific effort is a sham, and all of it is enmeshed in a complicated series of financial transactions that seem more related to enriching management than developing any profitable business.

### *NanoWeb hasn't progressed since 2014, Meta seems to have no intention of commercializing it having ceased licensing a key patent, and it's obsolete anyway*

Meta's lithography segment is primarily composed of NanoWeb, a conductive TTF technology that it obtained when it acquired Rolith Incorporated in 2016. Rolith was founded in 2008 by a group of scientists working on ITO alternatives for conductive thin films. ITO – or indium tin oxide – is the most common material microscopically deposited onto transparent substrates, like glass, to give them the conductive properties necessary for applications such as touch screens and interactive displays. Almost every phone, and the overwhelming majority of touch-screen laptops or wearables, have a thin invisible layer of ITO that transmits electric current across the surface of the device. But while ITO has excellent optoelectronic properties – it allows for both high conductivity *and* transparency – it's imperfect. It's extremely brittle so it doesn't work as well on stretchy or flexible surfaces, and it doesn't adhere well to thin and flexible polymer substrates.

Broadly, there have been three different alternatives developed over the past 15 years to potentially overcome the weaknesses of ITO: carbon nanotubes (CNTs), silver nanowires (AgNW), and metal mesh (MM). Each of these methods microscopically deposits different materials (graphene, silver, and usually aluminum, respectively) onto thin transparent substrates in distinct configurations using a variety of deposition methods. Rolith was one of the many pioneers of the metal mesh modality, innovating both on the nano-scale deposition methodology and patterning (i.e., the lithography) of the metal onto the polymer substrate. What set Rolith apart from the other budding startups in the space was that its methods resulted in a thin film that was both highly conductive and highly transparent, to a degree that none of the CNT or AgNW startups were able to achieve *at that time* (2014).[4]

Based on discussions with several of the founding scientists at Rolith, it seems that the company was running out of cash in 2015 and was unsuccessful in finding any venture capital investment. As a result, the company sold itself to Meta in mid-2016 for $2.5 million. The founders were looking for an acquirer that would help them scale their prototype into mass production, with potential applications like efficient windshield de-fogging, EMI shielding, and even advanced touchscreens. Today, conductive TTF solutions would also be applicable to 5G antennas placed on neighborhood or municipal structures that would be transparent and therefore less disruptive.

What the scientists at Rolith didn't realize was that Meta wasn't exactly the right partner to commercialize *anything*. In the 5 years since Meta has acquired Rolith, the competition in the field of conductive TTFs has exploded while, unsurprisingly, Rolith's NanoWeb lithography hasn't advanced at all. The graphics, descriptions, and specs that Meta uses in its NanoWeb

[4] We take Rolith's claims at face value. It's worth noting that Rolith never officially published the results it displayed on its website, and it never produced a spec sheet for an actual commercial product. Rather, it was only a prototype that it claimed to have developed.

white paper and marketing materials are *all* literally taken from one paper published by Rolith's founding scientists in *2014,* as well as the Rolith website in *2015*. It's telling that the white paper's "development history" timeline (on page 4) ends in 2014, almost as if it were possible to take a 2014-era technology and commercialize it 7-8 years later in a field bursting with intense competition. The website's description of NanoWeb applications comes directly from the 2016 white paper published on Meta's website, including the same stock photography, again as if nothing in the rest of the industry has changed in more than 5 years. Almost comically, Meta's NanoWeb product website displays an IDTechEx award won by NanoWeb that, upon inspection, appears to be from 2013!

In the time since NanoWeb's development was essentially frozen, multiple conductive TTF technologies have been commercialized:

- TPK Holding, a Taiwanese manufacturer of conductive glass-related products, acquired AgNW-startup Cambrios in late 2017 and has since advanced silver nanowire technology to the point that it is rumored to be supplying Apple with the conductive display for the latter's entry into the foldable phone arena.
- Since Cambrios liquidated itself, and its IP, to TPK, its personnel have restarted operations and have commercialized their own conductive polymer-based TTF to the point that it actually has a real data sheet with specs that it guarantees customers.
- C3Nano has also commercialized its own version of AgNW-based conductive films, having raised $60 million in venture capital and generated $5-10 million in 2020 revenues. C3 also has public spec sheets showing that its commercial product has reached transparency and conductivity parameters similar to what NanoWeb was able to do in the lab.
- Chasm Advanced Materials, another well-funded startup in the conductive TTF space, has developed a CNT-AgNW hybrid solution that it has begun producing at scale. Chasm's product spec sheet shows that it's been able to develop a commercial scalable product that is superior to NanoWeb's 2015 prototype in both transparency and conductivity.
- Zenithnano, founded in 2018, has worked with some of the same scientists that were involved in developing the lithography methods at Rolith a decade ago, particularly Jay Guo and his lab at the University of Michigan. Zenith's conductive TTFs use a next-generation method of basically plating the entire substrate with an extraordinarily thin film of silver that is more transparent than any CNT, AgNW, or metal mesh method to date. The ubiquitous coverage of the substrate with the silver film allows for unprecedented levels of conductivity. Industry participants, including some of Zenithnano's investors, have told us that the company is producing at scale and already has its films being sold into one multinational laptop manufacturer and one big-screen television company.

The above is by no means an exhaustive list, but it should suffice to show that the overall conductive TTF sector has rapidly progressed while NanoWeb has laid dormant. At the current time, there is no NanoWeb spec sheet to be found, and Meta's website says that NanoWeb transparent conductors are "coming soon!" As of March 2020, Meta stated that its "labs in Pleasanton, California can produce a meter long sample of NanoWeb for a variety of applications." Those meter-long samples were the subject of the Rolith scientists' 2014 paper referenced above, so it's clear that not much has changed in the intervening 6 years.

Most recently, Meta used $72 million of the $140 million in cash on its balance sheet to buy Nanotech, a Canadian penny-stock company that manufactures anti-counterfeit films that can be used with paper currency or luxury consumer goods. Meta has tried to claim that there are synergies between the lithography capabilities possessed by Nanotech and the lithography technology needed to scale and commercialize Nanoweb. But we spoke with several of NanoWeb's founding scientists, none of whom have remained at Meta since the 2016 acquisition, and they explained that they're extremely familiar with Nanotech's rudimentary technology and that it would make no sense to even try to repurpose any of Nanotech's manufacturing methods for the purpose of commercializing NanoWeb. Meta's pronouncements conflating the two production processes are indicative of Meta's management team either misleading investors or having no idea about what's involved in commercializing NanoWeb and manufacturing it at scale.

Even if Meta wanted to commercialize NanoWeb, and knew how to do it, one notable obstacle laying in its path relates to intellectual property. In late 2012, Rolith licensed a critical patterning method patent from the University of Michigan that was meant to be used in its lithography process. We discussed this with members of Jay Guo's lab, and they told us that when they inquired with the university's office that arranges IP licenses, they were told that Meta stopped paying for the license "years ago." The fact pattern – zero development of NanoWeb, acquisition that has nothing to do with NanoWeb, and cessation of a critical patent license – leads us to believe that Meta's management has no intention of ever commercializing NanoWeb at all, and is using the same promotional playbook it's used in the rest of its business since 2012. It's no wonder Rolith's key founding scientists resigned from Meta in 2018.

## V. Conclusion

Almost every stage of Meta's journey, from its founding to its recent acquisition of Nanotech, has been marked by plentiful red flags. It deceptively promoted its early endeavors, seemingly in the pursuit of funding that almost certainly would not have been forthcoming if the truth were known to Meta's counterparties. The company's current operations range from the dismal failure of LGP glasses to the empty husk of the once-interesting NanoWeb to the outright falsehoods being told to promote non-existent medical devices. If that weren't enough, the questionable circumstances around its reverse merger with Torchlight – tainted by a dubious CFO appointment, promotional social media buzz, and purposely muddied disclosures around suspiciously successful capital raises – make our assessment that much more damning. We don't believe Meta is worth any more than the cash on its books – 25¢ a share – though there's a good chance that the company will squander even that. Holograms and thin films are a fitting metaphor for Meta: a company that looks interesting at first glance but turns out to be a hollow illusion behind a flimsy veneer of aggressive promotion.

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