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<p>Report Date: September 15, 2021</p> <p>Company: Danimer Scientific, Inc.</p> <p>Ticker: DNMR US</p>	<p>Industry: Bioplastics</p> <p>Stock Price: \$17.24</p> <p>Market Cap: \$1.7 billion</p> <p>Float: 60.8%</p> <p>Average Daily Volume (90-day): \$33.4 million</p>
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Danimer Scientific: Misleading, Amateurism, and Hail Marys

Introduction

Hope is not a plan. So how do you figure out whether an early stage technology company will succeed? The short answer is to “play the man, not the ball.” Because it’s nearly impossible to effectively evaluate early stage tech, we look for behaviors that indicate a company is not “real” and likely won’t be. One example would be a company rolling a truck down a hill, or a company claiming that it has numerous “binding” commitments when in reality, there are very few.¹

DNMR gives us a lot of these flags. In our view, DNMR has misled investors about having over \$200 million of “take or pay” agreements. We feel it has misled investors by stating that its only impediment to selling more product is lack of capacity when the products it hopes to sell do not yet exist. It expressly claimed that it can sell everything it produces, but in actuality the demand for its products appears to be quite weak. DNMR has announced four iterations of its capacity expansion plan in eight months, which indicates that it is likely to waste significant time and money trying to scale. Yet, DNMR’s purchase of Novomer seems to be a tacit admission that its fermentation might not scale. In 2015, DNMR claimed that Bainbridge had 60 million pounds per year of capacity; but, today it’s supposedly just a demonstration plant. DNMR has tried to mislead investors into believing that bag developed with PepsiCo is PHA when it is really PLA-based. DNMR claims its TAM is approximately \$1 trillion, which probably qualifies DNMR for the TAM Exaggeration Hall of Fame.

Danimer has been trying to commercialize PHA since 2007 when it bought the technology from Procter & Gamble after P&G had itself spent over a decade trying to develop a PHA business. Logically, what changed in the 13 years since DNMR began developing its PHA business? To us, the key change was that due to Covid, there was suddenly a flood of unsophisticated money being sprayed at developmental companies through SPACs. Can infusing DNMR with hundreds of millions of dollars make its PHA business “real”? We think not.

¹ Hat tip to Hindenburg Research.

Summary

Muddy Waters is short DNMR. We conclude that DNMR has significantly misrepresented the state of its customer relationships, product development, readiness to scale, and TAM for PHAs. Both the money that DNMR spent buying Novomer and the cash it intends to spend on capacity expansion strike us as Hail Marys – spending money based on hope rather than on realism.

- Like numerous other SPACs, DNMR has greatly misrepresented the state of its business by making highly misleading claims.
- What DNMR can produce seems to have limited demand, which is in stark contrast to CEO Stephen Croskrey’s pronouncement that DNMR can sell all the PHA it produces and the company’s claim that it is “fully sold-out of [2022E] Kentucky capacity from overwhelming customer demand”.² Instead, DNMR seems unable to make PHA for the products for which there seems to be a significant potential market. DNMR has likely not produced PHA for products sold to end users, other than straws and possibly plastic shopping bags.
- Supporting our conclusion that demand for DNMR’s existing products seems quite weak are DNMR’s apparent significant (but below the radar) PHA production misses in each of Q1 and Q2 this year. Using company favorable assumptions, we estimate that DNMR has been operating at only approximately 28% of capacity, rather than the expected 50%. Less company favorable, but still reasonable, assumptions yield estimates as low as 18% of capacity. Moreover, DNMR’s slow-turning inventory (~3x) consistently shows zero to de minimis amounts of work in process while having material balances of both raw materials and finished goods, which we think shows that there is not much demand for what DNMR is capable of producing. A subset of this concern is that DNMR could be producing significant amounts of non-salable product due to production issues.
- The PHA products for which there could be significant demand, such as potato chip bags and candy wrappers, appear to be well beyond DNMR’s technical capabilities to produce at scale economically in the near future – regardless of whether it adds capacity. Management promotionally brags that DNMR has achieved “the Holy Grail” of plastics. Yet, DNMR seems not to have solved numerous technical challenges needed to commercialize PHA for a wide range of products. One has to wonder why so many established companies have eschewed acquiring this supposed Holy Grail prior to its having gone public during the Great SPAC Orgy of 2020.
- DNMR has greatly misled investors about its partnerships. When DNMR went public, Mr. Croskrey said on CNBC that the company was “sitting on over \$200 million of take or pay offtake agreements, and we had customers like PepsiCo, Nestlé, Bacardi, you know, expecting us to be able to grow our capacity, so we had to find a way to find a lot of cash fast.” We believe that the products DNMR hopes to produce for these partners are in the very early stages of development, and that production capacity was not even close to being an issue for these products. These purported “take or pay” agreements reportedly have outs for the customers if DNMR has been unable to develop product that meets customer requirements. Moreover, we understand that the PepsiCo take or pay was for pilot plant scale, and that DNMR likely has not finalized a commercial-scale

² DNMR, 1Q21 earnings call, May 17, 2021

agreement with PepsiCo. We also understand that Mars Wrigley will likely not be using in scale a DNMR plastics wrapper before 2025 – if ever; and, that PepsiCo is probably many years away (if ever) from any sizable PHA compound purchases from DNMR.

- We consider DNMR amateurish when it comes to production. DNMR’s ever-shifting plans for capacity give us the impression that it’s throwing a Hail Mary – building expensive capacity to make products that DNMR has not even shown that it can produce economically. We count four iterations of DNMR’s expansion plans in eight months since it went public. This includes two versions of DNMR’s production plan for Novomer (on which we question DNMR’s due diligence). The latest iteration of DNMR’s plan appears to be greatly misleading, purportedly increasing planned capacity from the previous 315 million pounds per year to 390 million PPY, all for less money! Except DNMR seems to be comparing apples to oranges – under the new plan, its nameplate capacity only adds up to 250 million PPY. In other words, the new plan is less capacity for less money.
- DNMR’s misleading statements about production capacity are not just SPAC Orgy behavior – it was misstating capacity even in 2015. At that time, DNMR produced a video that prominently features its current CTO and COO, while the then-CEO made the claim that the Bainbridge, Georgia plant had a PHA nameplate capacity of 60 million PPY.³ DNMR now refers to Bainbridge as a “PHA demonstration plant.”⁴
- DNMR seems to be glossing over the difficulties of bringing any new plant up to “commercial scale” (i.e., 75% of capacity). One bioplastics production veteran stated that it can take teams without commercial-scale production experience five to seven years to bring a PLA production facility to commercial scale. He opined that scaling PHA production is much more difficult than for PLA: that increased difficulty can potentially push out the timeframe. The challenge of scaling PHA production is apparently one of the reasons why Archer-Daniels-Midland and Metabolix ended up selling their PHA business for \$10 million after having invested over \$300 million in a production facility.^{5,6}
- The Novomer acquisition in no way alleviates our concerns about DNMR’s inexperienced and haphazard approach to production. Rather, the acquisition indicates DNMR is concerned that its fermentation technology will not scale or work as previously believed. Despite Novomer having been in operation for many years, its pilot plant reportedly produces only a few pounds per day. Novomer’s production facility is reportedly a small demonstration unit, and it has apparently not tested its production processes for a commercial-scale plant. We are under the impression that Novomer was on life support when DNMR acquired it.
- The Novomer acquisition seems more a lightly-diligenced Hail Mary to pump the narrative than a well-conceived strategic move. It is effectively a bet on a technology that has not been proven at scale. Novomer would make up 30% of product formulations at best, which seems to us to be just another change-up in a constantly shifting production plan. More problematically, Novomer appears to have been hollowed out of staff post-

³ <https://vimeo.com/100113767>

⁴ DNMR 2020 10-K, p. 24.

⁵ <https://cen.acs.org/articles/93/i21/Final-Hour-Biobased-Plastics-Maker.html>

⁶ <https://cen.acs.org/articles/94/i34/Metabolix-selling-PHA-business.html>

acquisition, while foundational patents in the portfolio have expired. A full-scale production facility likely needs to be located near a petroleum source, which would belie DNMR's green narrative. In fact, renewable ethylene oxide and carbon monoxide feedstocks appear to be too scarce and expensive, and DNMR appears to have excluded them from the latest plan.⁷

- Putting these company-specific issues aside, we believe DNMR's claim that "500 billion pounds of plastic waste could be eliminated by DNMR" to be highly misleading.⁸ Bullish investors have taken this to mean that DNMR's TAM is \$1 trillion, which we find delusional. A much more realistic TAM for PHA-based packaging seems to be \$4 billion to \$5 billion. Recycling plastic and recapturing the stored energy from the hydrocarbons in the plastics is much closer to being a "Holy Grail" than PHAs are. Bioplastics cause negative externalities, such as increasing consumer littering and making recycling of blended plastics difficult.⁹ Instead, bioplastics seem best suited for targeted solutions, which likely fall far, far short of the 500 billion tons of plastic DNMR claims it can replace.

Demand for DNMR's PHA Products Seems Weak

The products that DNMR can actually make seem to have limited demand. Conversely, DNMR appears largely unable to manufacture the products that underlie the purported "over \$200 million of take or pay offtake agreements." After extensive searching, we were only able to find straws and shopping bags made with DNMR's PHA available for sale. We conclude that DNMR's product line is so limited in part because of a years-long failure to solve key development and production problems. The accuracy of our assessment of DNMR's real product line is supported by our estimates that DNMR utilized only approximately 18% to 28% of its PHA production capacity in Q1 and Q2, depending on the percent of neat PHA in the finished products as well as how much PHA production ended up in inventory.¹⁰ The consistent zero to de minimis value of work-in-progress inventory, compared to material amounts of finished goods and raw materials, also indicates that the demand for DNMR's products is weak.

We searched the web for PHA-based product offerings of the following announced DNMR customers: WinCup (phade), UrthPact, CPG (Biolo), and Eagle Beverage. These companies were offering PHA-based straws. Among these, we found one company, CPG, offering single use PHA-based bags and films. Otherwise, we found no evidence of other PHA-based products

⁷ DNMR 2Q21 Earnings Presentation, Footnotes to Slides 8, 9

⁸ DNMR Oct. 2020 Investor Presentation, Slide 9.

⁹ <https://www.greenpeace.org/static/planet4-eastasia-stateless/84075f56-biodegradable-plastics-report.pdf>

Greenpeace's opinion on biodegradable plastics is similar: "The call for a reduction in the use of plastic grows louder each day. Unfortunately, there is no single solution and switching to biodegradable materials or any other single-use material will not be the silver bullet. Widespread plastic pollution is a result of systematic problems that include over-consuming behavior, reliance on the single-use convenience, and a non-sustainable linear economic model that ignores end-of-life waste disposal."

¹⁰ Per company comments, we consider capacity to be 20 million PPY of neat PHA. A sell-side analyst confirmed that DNMR discusses utilization of neat PHA capacity, and not of final compounded / blended product capacity.

produced with DNMR PHAs, such as single-serving coffee pods, water bottles, plastic caps, snack foods packaging, clam shell containers, f&b utensils, diapers, etc.^{11,12}

DNMR Seems to Have Fallen Short of PHA Production Goals, Indicating Weak Demand

Using company favorable assumptions, we estimate that DNMR produced less than 1.5 million pounds of neat PHA of in each of Q1 and Q2, implying a miss of approximately 40%. The estimate supports our view that demand for DNMR PHA compounds is poor. Our methodology is below:

	Q1	Q2	Total
PHA Compound Sales (\$ mm)	3.82	4.21	8.03
Finished Goods Build (\$ mm)	2.15	1.17	3.32
Price / Pound Assumption	\$2.85	\$2.75	\$2.80
= Compound Pounds Produced (mm)	2.09	1.96	4.05
DNMR PHA Content Assumption	70.0%	70.0%	70.0%
= Neat PHA Pounds Produced (mm)	1.47	1.37	2.84
Utilization at 20 mm PPY	29.3%	27.4%	28.4%

Our Q1 and Q2 average price per pound for PHA compounds are the prices DNMR provided across its PLA and PHA compounds, which is company favorable given that DNMR has stated PHA compound ASPs are “significantly higher” than those of PLA compounds.¹³ We estimate that the PHA compounds contain 70% neat PHA, which is company favorable. We had WinCup phade brand straws analyzed for PHA content, and the result was that PHAs constituted 61.7% (the margin of error is ±5%). Patent documents and analyst notes state that other product formulations may contain as little as 25% PHA.^{14,15} If we were to use a 62% PHA content assumption, utilization would drop to 25.1% from 28.4%, and if DNMR’s Finished Goods inventory contains some PLA compounds, the utilization would again be lower.

To the extent our estimate is accurate, this anemic production supports our view that DNMR PHA compounds are in low demand, and DNMR is incapable of producing PHA compounds that would be in high demand. These conclusions stand in stark contrast to DNMR’s statements. DNMR repeatedly told the market that production at Kentucky was running at 50% of its 20 million pound per year nameplate capacity; that Kentucky would reach 100% of capacity by the end of 2021; and that DNMR has “huge customer demand” and sells substantially all the PHA it can make.^{16,17}

¹¹ DNMR presentations, sell-side analyst reports

¹² DNMR July 29, 2021, M&A Call

¹³ DNMR 1Q21 earnings call, “the average cost per pound of PHA-based products sold was significantly higher than PLA based products sold”

¹⁴ <https://patentcenter.uspto.gov/#/applications/62733869/ifw/docs>

¹⁵ Sell-side Analyst report June 24, 2021.

¹⁶ <https://www.youtube.com/watch?v=1lndZj5Vkg8>

¹⁷ DNMR 1Q21 & 2Q21 earnings calls

Nor does DNMR’s “debottlenecking” in late Q2 2021 explain its seemingly low PHA production.¹⁸ The debottlenecking project took just two weeks followed by a short period of testing.^{19,20} As such, at most we think it reasonable to assume that Q2 capacity utilization would decrease only modestly (~17%-33%), leaving 3.4 million to 4.2 million pounds of capacity available in Q2. At 50% utilization, total neat PHA production for H1 2021 therefore should have been roughly 4.2 million – 4.6 million pounds. The estimated 2.8 million pounds produced is well below the available quarterly production capacity. We think that the apparent low production volume and persistently high finished goods inventory is due to weak demand for DNMR’s PHA compounds.

The oddity of DNMR’s inventory movements supports our conclusion that demand for DNMR’s products is poor. Below is a table of DNMR’s inventory detail and annualized turnover. Our interpretation is that DNMR’s sub-scale production of PHA compounds consistently outstrips demand, as there is a significant, persistent finished product balance and essentially no work in process. One subset of this concern is the possibility that DNMR is producing significant amounts of non-salable product.

DNMR Inventory Schedule (\$ mm)				
	Q3 2020	FY 2020	Q1 2021	Q1 2022
Raw Materials	7.5	6.8	8.0	7.7
Work In Process	-	0.1	0.1	-
Finished Goods	5.7	6.7	8.8	10.0
Total	13.2	13.7	16.8	17.7
Annualized Turns	2.7x	3.0x	2.9x	2.9x

Source: S&P Capital IQ

While one could do contortions to try to explain this phenomenon, we think the simplest explanation is that the demand for the PHA products DNMR can actually make is just not there. This is particularly true given that DNMR’s annualized inventory turnover has generally been at or less than 3.0 times.

Investors Have Been Misled on Partnerships

DNMR has misled investors about the state of its partnerships. Rather than there being \$200 million of buying waiting on DNMR to build capacity, its partners mostly appear to be patiently working with DNMR to develop products that one day might – or might not – come to fruition. The purported take or pay contracts reportedly (and logically) do not obligate the customers to purchase material if it does not meet customer requirements or is not produced.

¹⁸ DNMR 1Q21 earnings call “... in the latter part of the second quarter 2021, we are scheduled to temporarily take the Kentucky plant off-line to implement several debottlenecking initiatives.”

¹⁹ Sell-side Analyst report June 24, 2021.

²⁰ DNMR 2Q21 earnings call “After taking steps to optimize our processes and equipment, the facility was brought back online in late May, and we used early June to confirm that both fermentation and downstream processing of our material is running at the projected levels.”

DNMR has prominently featured its customer agreements with Mars Wrigley, PepsiCo's Frito-Lay, Nestlé and others. The narrative is that these agreements provide strong sales visibility over the next few years. We disagree.

We understand that in all likelihood, the earliest Mars Wrigley will purchase commercial quantities of wrappers using DNMR PHA is 2025 – if ever. We further understand that PepsiCo views DNMR PHA potato chip bags as being several years away at best from a commercial-scale roll out. DNMR misleadingly implies that a PLA bag that it developed with PEP that won a bioplastics award is actually a PHA bag. DNMR faces numerous, significant challenges in bringing a broad range of PHA-based products to commercial scale.

Mars Wrigley

We understand from a well-placed source familiar with Mars Wrigley's sustainable packaging development programs that there are critical issues to solve before it can produce packaging using DNMR's PHA at scale, and that he sees DNMR and Mars Wrigley being able to do so no sooner than 2025. It is possible that the program never comes to fruition.

Analyst: It sounds like a lot more development is needed before there'll be kind of a sample package that can start to be tested. Do you have an idea of what the timeline is?

Mars Source: So, that's a good question. Because to give you an idea the R&D team internally involved at Mars, that is, brought to the Danimer project, was an R&D team that it's really for a long-term project, like 5 to 10 years.

Analyst: Hmm. Okay, so we're looking at a fairly long time horizon.

Mars Source: I mean, 2025, I hope we will have something by 2025, yes.

Analyst: Okay, but you're already like two years into it, right?

Mars Source: Yes, we are, but the two years were mainly negotiating the partnership, so, uh, of course, there were some materials. I mean we already have some materials so that they were tested, et cetera, but, I think like we are not there for having the packaging.

Analyst: Yeah, it's always amazing to learn like how much work is involved in trying to develop a package, which seems like something very simple, but it's actually just amazing how much R&D and development, and how many brains and minds and people; you know how many hours go into these types of projects, it's incredible.

Mars Source: I can tell you it's huge, its huge. And keep in mind, for a food company. We cannot compromise the quality of our goods. You know, we cannot allow ourselves to go into the market with the packaging that we might have a challenge with the content. It might be easier for other types of packaging that you don't pack food. But in our case, it's extremely complicated.

Pepsi

DNMR is still years away from the commercial rollout of a PHA bag for PepsiCo – at best. Investors might be surprised to hear this, given DNMR's misleading presentation of a PLA-based bag it developed over 10 years with PepsiCo. Even if DNMR and PepsiCo can develop the PHA bag, it is highly questionable whether PepsiCo will use it because of the likely cost and resulting litter problem.

In making the case that there is robust demand for DNMR’s PHA products, DNMR touts that “PepsiCo is committed to converting all their snack food packaging to recyclable, compostable, or biodegradable products by 2025.”²¹ According to a well-placed PepsiCo source, the PHA bag it is developing with DNMR is one to two years away from having a final form ready for biodegradability testing. We understand that this testing can take up to a year to complete. This timeline might be surprising because DNMR’s February 3, 2021 investor presentation misleadingly features a DNMR PepsiCo bag that won a bioplastics award in three slides. DNMR previously developed this bag with PepsiCo, but it uses PLA.^{22,23} The bag reportedly took almost 10 years to develop. One of the misleading slides that strongly implies that this PLA bag is a “PHA Customer Collaboration Case” is below:²⁴

PHA Customer Collaboration Case Studies Underscores High Customer Acceptance

<div style="text-align: center;">  <p>Danimer & PepsiCo Awarded the 2018 Innovation in Bioplastics Award</p>  </div> <div style="background-color: #e0f0e0; padding: 5px; margin-top: 10px;"> <p>Collaboration Background</p> <ul style="list-style-type: none"> ■ Owns 6% of Danimer’s common equity ■ Joint R&D to design, develop, manufacture and evaluate PHA based resins for individual layers suitable for flexible food packaging ■ Partnership with Danimer Nodax® PHA expects to enhance Pepsi’s ESG initiatives </div> <div style="background-color: #f0f0f0; padding: 5px; margin-top: 10px; font-size: small;"> <p><i>“Ability to seamlessly adapt to existing manufacturing value chains, without the need to change equipment or processes.”</i></p> <p>– Danimer Customer</p> </div>	<div style="text-align: center;">  <p>Danimer & WinCup Awarded the 2020 Innovation in Bioplastics Award</p>  </div> <div style="background-color: #e0f0e0; padding: 5px; margin-top: 10px;"> <p>Collaboration Background</p> <ul style="list-style-type: none"> ■ WinCup created the Phade straws using Danimer’s Nodax® PHA ■ First drinking straws that can biodegrade without losing the feel and quality of plastic ■ Partnership led to a 2-year contract worth \$27mm (2022) for PHA-based straws to be sold at Walmart, with large-scale trials with top tier retail and fast food companies </div> <div style="background-color: #f0f0f0; padding: 5px; margin-top: 10px; font-size: small;"> <p><i>“Danimer PHA really is the only marine, soil, industrial and home degradable product out there that can be made at commercial volumes.”</i></p> <p>– Danimer Customer</p> </div>	<div style="text-align: center;">  <p>Nestle and Danimer Scientific Team Up to Develop Biodegradable Water Bottle</p>  </div> <div style="background-color: #e0f0e0; padding: 5px; margin-top: 10px;"> <p>Collaboration Background</p> <ul style="list-style-type: none"> ■ Six year R&D agreement to develop PHA for Nestle’s PureLife water business ■ Development for biodegradable water bottles and other products </div> <div style="background-color: #f0f0f0; padding: 5px; margin-top: 10px; font-size: small;"> <p><i>“PHA is the only biopolymer that is completely natural. There is nothing else like it, it is going to be the backbone of the future.”</i></p> <p>– Danimer Customer</p> </div>
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13

²¹ DNMR Investor Call Transcript, Oct. 5, 2020.

²² A source well-placed to understand PEP’s flexible packaging programs confirmed that the PEP bag described in the press release and tested in 2018 was made only of PLA, with no PHA at all.

²³ <https://www.recyclingtoday.com/article/pepsico-snack-bag-made-from-compostable-bioplastic/>

²⁴ DNMR-Live Oak [Feb 3, 2021 investor presentation](#)

Even if DNMR and PepsiCo can develop a PHA bag in the next few years, it is far from certain that PepsiCo will want to use it.²⁵ We understand that PepsiCo is exploring a variety of options to achieve its sustainable packaging goal, and PepsiCo senior leadership still seems undecided as to whether to commit to DNMR at scale or pursue other avenues more aggressively. Two high-level sources familiar with PepsiCo programs indicated that PepsiCo's leadership is concerned about the economics of PHA bags. They come with a high cost, and customer willingness to accept the tradeoff is a concern. Moreover, marketing biodegradable bags is problematic because lightweight snack pack bags are already a litter problem. Stating that a bag will naturally degrade is likely to exacerbate littering.

DNMR Seems Amateurish About Production

DNMR's plan to spend at least ~\$600 million to ~\$700 million on capacity expansion strikes us as a way to justify its stock price more than anything else. The first clue that DNMR is winging its production planning is its constantly shifting expansion plan, which has undergone four iterations in eight months since DNMR went public, including two different Novomer plans. The unit capacity costs have also swung without explanation. Initially, Novomer's expansion was slated to cost \$1.25 to \$1.56 per pound of annual capacity. Now the estimated range works out to \$1.67 to \$3.00 of CapEx per pound. The current plan's capacity does not even add up arithmetically, which we think is the result of DNMR again misleading investors. This is nothing new though, as DNMR has been misleading on the production front for years. In 2015, DNMR claimed that its Bainbridge, Georgia facility could produce 60 million pounds per year. Now that facility is merely a "PHA demonstration plant." One wonders how much money DNMR could have incinerated on plant designs and construction had SPACapalooza happened half a decade earlier.

²⁵ According to a PepsiCo manager with whom we spoke, the recently released "Off the Eaten Path" brand bag made with DNMR materials is also made from PLA compounds. Recent DNMR inventory increases in 1Q21 and 2Q21 may also have been related to its launch.

Money is a Helluva Drug

Who is “planning” DNMR’s production?

Feb 3	DNMR stated that it would break ground in Q1 22 on a Greenfield Plant that would give it total capacity of ~125 million PPY from three fermenters.
Mar 29	Greenfield expansion doubled in size within 54 days to six fermenters producing ~250 million PPY.
Jul 29	Due to the Novomer acquisition, the Greenfield goes back to three fermenters (~125 million PPY) after 122 days. The capacity is projected to cost \$2.80 per pound INCLUDING extruders. Novomer plant capacity will be ~160 million PPY (~80,000 TPY) at a cost of \$1.25 - \$1.56 per pound EXCLUDING extruders.
Aug 16	After 18 days i) upping the Greenfield expansion cost \$3.00 / lb EXCLUDING extruders and \$3.64-\$3.94 / lb INCLUDING Extruders, ii) Novomer Rinnovo planned plant capacity decreases by 62.5% to 60 million PPY, but cost jumps to \$1.67 to \$3.00 / lb EXCLUDING extruders, and iii) DNMR claims overall finished product capacity of ~390 million pounds when announced plant capacities only add to ~250 million.



Source: Chappelle’s Show Season 2, Episode 4, “Charlie Murphy’s True Hollywood Stories”

Misleading About the New “Plan”

DNMR appears to be trying to give investors the impression that by acquiring Novomer, its new planned capacity will exceed that of its old plan – while costing significantly less. DNMR is being highly misleading in the capacity comparison between the old and new plans shown below:²⁶

²⁶ DNMR Q2 2021 Presentation, Slide 8.

Novomer Deal Dynamics to Accelerate Production and Reduce Costs

Attractive Deal Dynamics (2025E)		
Return Metric	Danimer Standalone Greenfield	Danimer / Novomer Facility Network
Finished Product Capacity (lbs)	315mm	~390mm ⁽¹⁾
Growth Capex	\$826mm +/- 25%	\$600mm – \$700mm ⁽²⁾
ROIC	~25% ⁽³⁾	>35%



Under the old plan, DNMR reached 315 million PPY by including six fermenters at its Greenfield plant in Bainbridge, which were to collectively yield 250 million PPY. When the expanded Bainbridge was added to Kentucky Phase I of 20 million PPY and Phase II of 45 million PPY, the result was 315 million PPY. DNMR states, though, that much of the purported cost saving of the new plan is from reducing the number of Greenfield fermenters to three, which would halve Bainbridge capacity to roughly 125 million PPY. As shown below, the new numbers only add up to 250 million PPY – not 390 million PPY.

Facility	Capacity (mm ppy)
Kentucky phase I	20
Kentucky phase II	45
Bainbridge	125
New Novomer Rinnovo plants	60
Sum	250

How does DNMR stretch 250 million to 390 million? We have no idea, but see this as another example of DNMR management brazenly manipulating investors into buying its narrative.

One source familiar with DNMR's plant construction opined that DNMR's approach to building plants is "unorganized", while his overall assessment is, "These guys don't know how to build plants yet." DNMR seems to be glossing over the difficulties of bringing any new plant up to commercial scale (i.e., 75% of capacity). One bioplastics production veteran stated that it can take teams without commercial-scale production experience five to seven years to bring a PLA production facility to commercial scale. He opined that scaling PHA production is much more difficult than doing the same for PLA, and this increased difficulty can potentially push out the timeframe needed to scale.

DNMR Has a Long History of Failed Production Claims

DNMR produced a video in 2015 in which its then-CEO claimed that it had largely completed a capacity expansion project at Bainbridge that would bring annual PHA nameplate capacity to 60 million pounds.²⁷ This video prominently included current COO Michael Smith and CTO Phil Van Trump, so investors should be skeptical of any attempt by DNMR to throw its former CEO under the bus for making that claim. The Bainbridge PHA plant's purported capacity as of 2015 was 3x the current planned capacity of the Winchester Kentucky's plant's Phase I scale. However, DNMR now describes Bainbridge as merely a "PHA demonstration plant."²⁸

The Novomer Acquisition Seems to be a Hail Mary

Our research on Novomer causes us to think that the \$152 million cash Novomer acquisition is based more on hope than realism, and could signal that DNMR has concerns about scaling its own technology. We spoke with two former senior Novomer managers whose comments largely belie the narrative that DNMR is pushing regarding Novomer. We conclude that DNMR has misrepresented the development state of Novomer's technology. By late 2019, Novomer had reportedly been hollowed out – it was out of cash, many of its top technical people had left, key portions of its patent portfolio had expired or were soon to expire, and the plant had unresolved "first principles" issues (i.e., fundamental concepts or assumptions). Putting aside the likelihood that many significant technical challenges remain unsolved, we think that DNMR's CapEx projections are potentially way low. DNMR is taking on significant risk by buying Novomer without a complete design for a Schedule A plant. We similarly think that DNMR's OpEx projections are too rosy. The apparent dependence of the Novomer production process on hydrocarbon feedstocks seemingly cannot be positive for customer and end user acceptance of DNMR's PHA products and its "green" narrative.^{29,30}

DNMR's touted acquisition benefits seem to us to be a significant oversell. Two former Novomer employees we spoke with noted that the plant designs are dated, the technology was not fully completed, feedstocks are an issue, and this is yet another technology for which DNMR

²⁷ <https://vimeo.com/100113767>

²⁸ Live Oak, S-4A, p.129; Danimer, S-1A, p. 51

²⁹ DNMR 2Q21 Earnings Presentation, Footnotes to Slides 8, 9

³⁰ In theory, Novomer can use "green" EO & CO feedstocks, but a) they are more expensive, b) supply is very tight – especially for CO, and c) DNMR's presentation states that it intends to purchase non-renewables.

needs to develop understanding to scale. DNMR positions Novomer's Rinnovo p(3HP) product as helping DNMR achieve simpler production that will also be 10x faster than fermentation, while requiring less OpEx and 80% lower CapEx on a per pound basis!³¹ DNMR's announcement that it intends to replace 30% of DNMR's final product formulations with Novomer's PHA seems to be providing false hope to customers and investors that there is a pathway to a more competitive offering. Based on our understanding of Novomer, the foregoing optimism does not seem warranted, because Novomer seems not to have the technology or processes to make these hopes real.

Novomer's inability to solve its first principles issues and commercialize its PHA technology apparently led to it running out of money in late 2019. Novomer's headcount reportedly had dropped by the end of 2019 from approximately 60 to about 10. The departures seemingly included most of Novomer's senior talent, including the lead scientists responsible for the majority of its patent submissions, plant engineering, and design work. Many of Novomer's base patents had reportedly expired or were expiring, leaving largely process patents that are generally less protective. One of the former Novomer senior managers believes that the capital needed at that time to complete development of the technology and build a commercial-scale plant was between \$300 million and \$500 million. This range is considerably higher than the \$200 million to \$250 million range the market has been led to believe an 80,000 ton per year Novomer plant would run.³² (We assume that 2021 costs would be higher still.) Novomer was also reportedly impeded by other issues, including needing to use expensive and explosive feedstocks and expensive organic catalysts. Novomer's November 2019 hiring of Jeff Uhrig as CEO was apparently to prepare the company for a sale, as Mr. Uhrig's prior position as CEO included selling the company.^{33,34} We understand that the \$152 million sale consideration was roughly equal to the amounts invested in Novomer plus grant funding. Several potential buyers and licensees apparently have passed on acquiring Novomer since 2016, including its own investor SABIC, a large polymer manufacturer.³⁵

It is unlikely that Novomer resolved its fundamental and other issues before DNMR bought it. The former managers with whom we spoke understand that the announcement of a successful test production run made in March 2021 was performed on a pilot plant capable of producing only sample quantities of a few kilograms per day.³⁶ (A prior pilot plant had also been built, but it was even smaller.) Descriptions of the severity of the plant design problems varied between the two sources, but both assessed that there was still critical work needed when they left. The former Novomer manager who was involved in the design and construction of both plants stated that the myriad issues were unlikely to have been solved between when he left in mid-2019 and the present. When asked about the possibility of there having been a subsequent breakthrough, he stated:

³¹ July 29, 2021 DNMR Investor Call.

³² Sell-side analyst report, July 29, 2021

³³ <https://www.linkedin.com/in/jeff-uhrig-0b56333/>

³⁴ <https://www.siruschemistry.com/nippon-shokubai-acquires-sirus-inc-expanding-its-core-business-under-reborn-nippon-shokubai-2020/>

³⁵ <https://www.sabic.com/en>

³⁶ <https://www.plasticstoday.com/advanced-recycling/novomer-develops-industrys-lowest-cost-process-produce-compostable-plastics>

“Anything is possible. I mean, there is no impossibility. I think I would rather say it is improbable given that there were no, there were no experienced people left. All the senior guys who had all the knowledge and the information were all gone. They were functioning on a team of less than a dozen people. It is possible, but highly improbable, and some of the issues were very fundamental. And technical guys talk about first principles issues which required significant investment or serendipity. Given that it is unlikely they made investment. Let's hope they had serendipity fall into place, because then that gives you the break that you need.”

DNMR presents Novomer as not just being a low-CapEx project but one with low production costs as well, which we believe is misleading. Other major shortcomings in DNMR’s planning appear to be the analysis of Novomer’s raw materials and catalysts costs and sourcing. Novomer’s catalytic process is dependent not just on metal catalysts like aluminum and cobalt, but according to a former Novomer scientist involved in developing the plants, also requires expensive organic catalysts and exotic ligands. Questions and comments on catalysts in the July 29 M&A call focused on the metals only, without touching on the organics; it is not clear if this was overlooked, not fully understood, or intentionally excluded. Further, the Novomer process is dependent on large volumes of low-cost ethylene oxide (EO) and carbon monoxide (CO) for production. EO is expensive and extremely dangerous, both highly explosive and toxic. EO plant explosions tend to be spectacular and deadly.^{37,38,39} We understand that any future plant would need to be located on a shared site with a major EO producer or adjacent to one such that the producer could pipe it over. Novomer’s plans for the plant did not come with a site location.⁴⁰ The primary manufacturers of EO are petrochemical manufacturers, the same companies DNMR is on a quest to supplant with its PHA. Further, we understand that green CO from biomass is not readily available in large quantities.

One of the former Novomer managers believes that the economics of using Novomer’s high-cost plastics to replace traditional polymers do not work. He stated that Novomer’s “economics were nowhere close to making it desirable commercially”, and then elaborated:

“And by the way, it's not only the Novomer process. Just to be clear, I think all the guys who are in PHA struggle to compete in the polymer marketplace. The cost of producing these polymers is pretty high. The market tolerance for— because remember, these are all low-end polymers, they do not go into high-end material, they go into very basic stuff, which has very low price points. All the guys have the same problem. So, that's why you will find him even guys like Metabolix⁴¹ ended up trying to chase the downstream of the PHA.”

The other former employee was more measured, but still believed Novomer’s biodegradable polymers could attain attractive economics only at very large scale, where multiple plants were

³⁷ <https://www.chemistryworld.com/news/deadly-explosion-at-ethylene-oxide-plant-in-spain/4011005.article>

³⁸ <https://www.youtube.com/watch?v=2UnKLM2Eag>

³⁹ https://www.youtube.com/watch?v=mJ3oHcGQ_I

⁴⁰ DNMR 2Q21 earnings call, DNMR CEO Croskrey, “We look forward to updating you further on our plans for the Rinnovo commercial plant once we have completed the site selection process.”

⁴¹ Metabolix was an early PHA developer that went bankrupt and was sold to CJ CheilJedang Corp.

being built, thereby reducing capex through volume, (i.e., by ordering and making all of the reactors at the same time). This former does believe, however, that Novomer's downstream acrylic acid business is viable.

The seeming speed of DNMR's due diligence on Novomer indicates a lack of thoroughness. In 2016, Saudi Aramco, which had been an investor in Novomer for three years, acquired Novomer's Converge polyol business. Despite Aramco having had a board seat, it reportedly still sent teams of engineers for approximately eight months to diligence Novomer's polyol business.⁴² Moreover, it purchased a Schedule A engineering plant design, not just a prototype.⁴³ Aramco also hired the person most familiar with its technology, Novomer co-founder and former VP of Catalyst Development Scott Allen. In contrast, DNMR completed its purchase only three weeks after announcing the merger agreement, apparently failed to hire the core scientists who conducted the R&D underlying the remaining IP portfolio, and bought merely a prototype design—one that likely contains unresolved engineering issues. We are left wondering whether it was substance or just a desire to flog a narrative that drove the decision to acquire Novomer.

Hyperexaggerated TAM

DNMR claims a TAM of 500 billion pounds of plastic to which analysts have ascribed a \$800 billion to \$1.0 trillion value. The below slide strikes us as ludicrous:



One easy way of sanity-checking this claim is to search for estimates for the bioplastics. Of course such estimates vary widely, but we found none that remotely approached DNMR's PHA TAM claim. The 2020 bioplastics market estimates we found range from \$3.5 billion⁴⁴ to \$9.2

⁴² <https://finance.yahoo.com/news/saudi-aramco-energy-ventures-llc-140000324.html>

⁴³ <https://processengr.com/process-design/detailed-process-design-schedule-a-fel-2-fel-3-feed-or-basic-engineering-packages/>

⁴⁴ <https://www.openpr.com/news/2315095/biodegradable-plastics-market-size-analysis-manufacturers>

billion.⁴⁵ For 2027, they range from \$6.8 billion⁴⁶ to \$7.6 billion.⁴⁷ We found a 2031 bioplastics market estimate of \$47 billion.⁴⁸ PHA is likely only to constitute a slice of the bioplastics market.

The experts with whom we spoke disputed DNMR's TAM and the potential for PHA to dominate the bioplastics market.

“My projection is if PLA is a billion pounds per year right now and that took let's see up in here to like fifteen or twenty years to get to a billion pounds per year, PHA I think can go a lot faster, but there'll be like two billion pounds, you're not going to be a hundred billion pounds.”

- PepsiCo source

“And you know the unfortunate part of everything, is I think a lot of people do not realize that the market opportunity for biodegradable polymers is very limited. Because the reality is that so much energy is stored within most polymers, you actually want to reuse them. You want to find ways to pull it back.”

- Novomer former manager

According to a bioplastics industry expert with whom we spoke, the four fastest-growing bioplastics are PLA, PBAT, starch, and then PHA. PHAs have potential to grow their share quickly, with several manufacturers coming online in the next few years; however, at the same time, he emphasized that the challenges of ramping up actual capacity to theoretical nameplate capacity were large and not easily or quickly overcome. Meanwhile, PLA will remain the dominant player because of its much lower selling price, established large-scale capacity, and more mature technology.

There are industry, economic, technical, policy, and regulatory reasons why PHA – and bioplastics overall – will not be nearly as large as DNMR purports.

Industry – Entrenched Interests

Global efforts at building out recycling infrastructure to date have created entrenched interests ranging from owners of recycling equipment (often municipalities) to petrochemical companies with plans and technology capable of recovering and reusing current polymers.^{49,50} Meanwhile, PHAs and other bioplastics are often demonized as contaminants in the recycling feedstock

⁴⁵ <https://www.globenewswire.com/en/news-release/2021/07/13/2262101/0/en/Bioplastics-Market-Global-Sales-are-Expected-to-Grow-Healthily-to-Reach-US-47-Billion-by-2031.html>

⁴⁶ <https://www.openpr.com/news/2315095/biodegradable-plastics-market-size-analysis-manufacturers>

⁴⁷ <https://www.grandviewresearch.com/industry-analysis/biodegradable-plastics-market>

⁴⁸ <https://www.globenewswire.com/en/news-release/2021/07/13/2262101/0/en/Bioplastics-Market-Global-Sales-are-Expected-to-Grow-Healthily-to-Reach-US-47-Billion-by-2031.html>

⁴⁹ <https://www.mckinsey.com/industries/chemicals/our-insights/how-plastics-waste-recycling-could-transform-the-chemical-industry>

⁵⁰ <https://www.plasticsnews.com/perspective/unlocking-circular-economy-petrochemical-manufacturers-lead-charge-reinvent-recycling>

streams.⁵¹ To solve this contamination requires special infrared scanners to identify bioplastics in the waste stream and additional separation equipment or staff to strip them out. Many composters do not like compostable plastics because the rate at which they degrade is too slow for their production, reducing their turnover.⁵² They also do cite issues with sorting and screening the stream to remove the bioplastics from entry or to send them back for additional time in compost, and the additional costs in the form of time and capex to do so. The most successful recycling programs have been for PET bottles, with new investment continuing to pour into this space, including into developing markets.^{53,54,55} While the systems are still underachieving on a global scale, there is momentum in the rPET space that will keep it moving for the foreseeable future. We believe PET applications for water, drinks, and carbonated beverages should be excluded from DNMR's TAM.⁵⁶

Economic and Technical – Costs and Technical Challenges Ill-Suited for Price-Sensitive FMCG

One of the main obstacles to adoption of PHAs is their price. The second is the difficulty of achieving scale necessary to drive down production costs. PLA is already a much higher-cost material than traditional plastics, and PHA is several times (~3x or more) more expensive than PLA. We believe PHA companies that focus on lower-volume, higher-end plastics will achieve greater market success than those targeting high-volume, low-price FMCG and CPG market customers.

Policy – Favors Reduction and Reuse Over New Production

The Ellen MacArthur Foundation's "New Plastics Economy Vision" has a long-term goal to shift all plastics away from nonrenewable petroleum feedstocks and energy sources, but this end goal does not equate to a PHA TAM. The foundation's plans specifically explain that compostable plastics are not a blanket solution and that no plastic should end up in the environment.^{57,58,59}

As most of DNMR's prospective large, future CPG customers have joined the pledges to reach the sustainability goals laid out by the Ellen MacArthur foundation, these policy statements have weight. The priority is first and foremost to reduce and reuse. Recently efforts have pushed manufacturers to change the design of packages and plastics to avoid virgin plastic as much as possible. There is a keen desire to establish a circular economy that prioritizes reducing the

⁵¹ Bank of America 2021 Global Agriculture & Materials Conference, Mar-04-2021, bio-based plastic panel, et al.

⁵² <https://ncrarecycles.org/2019/03/oregon-composters-push-back/>

⁵³ <https://www.hindustantimes.com/mumbai-news/india-recycles-90-of-its-pet-waste-outperforms-japan-europe-and-us-study/story-yqphS1w2GdlwMYPgPtyb2L.html>

⁵⁴ <https://www.hbmedia.info/petplanet/2021/04/06/groundbreaking-inauguration-of-recycling-plant-in-indonesia/>

⁵⁵ <https://www.linkedin.com/pulse/how-two-indonesian-entrepreneurs-keeping-100-million-plastic-kaplan>

⁵⁶ Bank of America 2021 Global Agriculture & Materials Conference, Mar-04-2021, bio-based plastic panel, et al., CTP Phil Van Trump explains that carbonated beverages are not a suitable application for PHA.

⁵⁷ <https://archive.ellenmacarthurfoundation.org/explore/plastics-and-the-circular-economy>

⁵⁸ <https://ellenmacarthurfoundation.org/videos/plastic-vision-point-4>

⁵⁹ <https://emf.thirdlight.com/link/86tanzqdbppx-8rdpns/@/preview/1?o>

volume of plastic in packaging, and specifically targets items like straws and single use bags for elimination.⁶⁰

Regulatory – Consumer Behavior Risks

There is a growing concern that consumers will misunderstand what biodegradability means and this will lead to increased littering, resulting in more products ending up in the rivers and oceans. In the US, the states of California, Washington, and Maryland have increased regulation of biodegradability claims on product labels. Even TUV, the body which gave DNMR its biodegradability certifications, recognizes the potential problem of consumer confusion about its OK biodegradable certification and labels leading to increased littering.⁶¹ WinCup Phade straws' packaging notes the product is not intended for sale in the states of Maryland (MD) or Washington (WA).⁶²

⁶⁰ <https://archive.ellenmacarthurfoundation.org/explore/plastics-and-the-circular-economy>

⁶¹ <https://www.tuv-at.be/green-marks/certifications/ok-biodegradable/>

⁶² During our investigation, we found WinCup released two versions of its box packaging for the phade brand straw. One available for purchase directly from WinCup is emblazoned with the terms “OCEAN FRIENDLY”, “MARINE BIODEGRABALE” in multiple places as well as a dolphin logo, but lacks the TUV “OK biodegradable marine” cert. We posit that the biodegradable claims are made based on the use of DNMR PHA in its formula alone and that the end product was not tested or did not pass testing prior to its market release. This package includes the disclaimer “NOT LABELLED FOR SALE IN MD AND WA.” The other package for sale on WalMart and Amazon websites completely omits the unsubstantiated marine biodegradable claims.