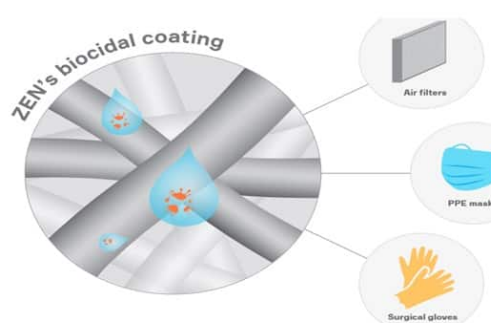


# Driving to deliver on their 800M mask coatings per month demand, ZEN Graphene up 746% over the past year

ZEN Graphene Solutions Ltd. (TSXV: ZEN) ('ZEN') continues to move at a rapid pace with demand for their graphene biocidal coating through the roof. Following successful product and cytotoxicity trials demand for ZEN's graphene biocidal coating is coming from personal protective equipment (PPE) and air filtration manufacturers.

## ZEN's biocidal coating method, applications, & quick facts



**ZEN's biocidal coating** is hydrophilic. The bacteria or virus-laden water droplets activate ZEN's coating which deactivates the pathogen (including the COVID-19 virus) with 99% efficiency.

**Quick Facts:**

Patent pending, antiviral, antibacterial graphene-based coating	Third-party performance validation at Health Canada accredited facilities	100% Canadian solution
99% effective against the COVID-19 virus as well as gram-positive and gram-negative bacteria in accordance with ISO testing protocols	Hydrophilic (water attracting) coating that adsorbs water droplets	Mask material treated with coating 98% effective against COVID-19 after 108 days

Source

## March was a super busy month for ZEN

On March 2, 2021 ZEN announced successful Phase 2 cytotoxicity testing results. The announcement was excellent news stating: "Nucro-Technics recorded no adverse effects after seven days of repeated dosing with concentrations many thousands of times higher than those found to be 99.9% effective against viruses, bacteria, and fungi."

On March 3, 2021 ZEN reported: "ZEN Graphene Solutions and

Trebor Rx Corp. announce successful Health Canada testing requirements of surgical masks.”

Equally as spectacular news came on March 17, 2021 when ZEN announced successful testing of its graphene compound against antimicrobial-resistant bacteria. ZEN stated:

**“Successful testing results of its patent-pending graphene-based compound against four gram-positive and nine gram-negative bacteria with antimicrobial-resistance (AMR),** including multidrug-resistant variants like methicillin-resistant staphylococcus aureus (MRSA). Testing was completed under the direction of Dr. Tony Mazzulli, MD, FRCPC, FACP, Microbiologist-in-Chief and Infectious Disease Specialist at University Health Network/Mount Sinai Hospital, following initial breakthrough results demonstrating that the compound is 99.9% effective against viruses, bacteria, and fungi.....Dr. Mazzulli, MD, commented: “The test results indicate that ZEN’s Graphene Compound (GC) at very low concentrations is capable of inhibiting a variety of gram-positive and gram-negative antimicrobial-resistant (AMR) aerobic bacteria. These pathogens are associated with a number of difficult-to-treat clinical infections including those involving the respiratory tract, urinary tract, skin and soft tissues, and bacteremia....The relatively low concentrations of this GC required to achieve an antimicrobial effect is also promising.”

**Translation of the above news releases:** ZEN’s graphene biocidal compound is highly effective, even at low concentrations, and there are no adverse side effects (at least based on the studies to date).

**ZEN is supply constrained as demand is through the roof**

Demand is way more than what ZEN can supply right now. Somewhat like Tesla with their revolutionary electric vehicles being supply constrained. ZEN is already partnering with

Trebor on a 100M mask agreement, with ZEN supplying their biocidal coating and Trebor manufacturing the masks.

To meet surging demand, ZEN announced on March 24, 2021, their biocidal coating production plans. ZEN stated:

“ZEN successfully transitioned from bench scale to pilot scale and has begun investing in additional pilot-scale capacity to help meet immediate demands. This intermediate step will significantly increase our current capacity to supply the demand from Trebor RX and provide product for new customers while the design and construction of our industrial-scale expansion continues with our engineering firm, Bantrel.”

But wait it gets even better. ZEN published their proposed 2021 ‘monthly’ production numbers as shown below. If all goes to plan, ZEN plan to be producing their biocidal coating for a staggering 800 million masks a month by November 2021.

<b>Timing</b>	<b>Monthly Coating Capacity</b>	
Current	Pilot Scale	4 million masks
June	Multiple Pilot Scale	32 million masks
November	Industrial Scale	800 million masks

#### Source

ZEN is currently raising C\$3M to help fund their rapid expansion. The offer is at C\$2.50 per unit, with a unit including one share and one warrant exercisable at C\$3.00 per share for a period of 24 months from the date of issuance.

In a final piece of good news from March, ZEN announced on March 4: “ZEN Graphene Solutions and Constance Lake First Nation sign implementation agreement for Albany Project development.” The agreement is another important milestone in the development of ZEN’s Albany Graphite Deposit.

## Closing remarks

We are living in truly remarkable times with COVID-19 now claiming 127,794,740 confirmed cases and 2,796,727 deaths. Thank goodness companies such as ZEN Graphene Solutions are working so fast to help protect the world from COVID-19 and other terrible infectious diseases.

ZEN Graphene Solutions (market cap C\$218M) is up 746% over the past year, but if they can deliver on their 800M mask coatings per month and other opportunities, then the market cap and stock price could potentially move significantly higher. Stay tuned to this great story in 2021.

*Disclosure: The author is long ZEN Graphene Solutions.*

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# **Moving forward with Trebor on their 100M mask agreement, ZEN achieves positive initial phase 2 cytotoxicity results**

ZEN Graphene Solutions Ltd. (TSXV: ZEN) ('ZEN') continues to innovate and rapidly progress. Initially a graphite junior, then a graphene producer, then a co-producer of graphene-silver materials for COVID-19 protection (masks, gloves etc), and now a potential graphene-based biocidal product developer. It has been an incredible past 9 months for ZEN Graphene Solutions as shown on the chart below. The upward move started after mid-2020 and after ZEN gained a Letter of Intent (LOI) for their COVID-19 virucidal graphene-based composite ink for face masks and other protective clothing. It is not at all

surprising that ZEN was recently named in the TSX Venture top 50.

Below I take a look at the latest developments with this most exciting company.

**ZEN Graphene Solutions stock price has surged on the back of tremendous company news and progress the past 9 months**



Source

ZEN describes themselves as:

“A next gen nanomaterials company developing graphene-based technology that helps protect people, the environment and makes existing products better. ZEN is currently focused on commercializing a **patent-pending graphene-based coating with 99% biocidal activity, including against COVID-19** and the potential to use this graphene compound as a **pharmaceutical product against infectious disease.**”

Dr. Francis Dubé, ZEN Executive Chairman, stated:

“The company continues to make positive progress towards our

patent-pending, biocidal compound being considered as a pharmaceutical agent. Health safety evaluation in preclinical models is the most important consideration at this stage – and with the high dose (1,000 mg/kg) in this study being 20,000 times higher than the Minimum Inhibitory Concentration from the Mount Sinai study – we are incredibly encouraged. We will continue to move this new potential therapeutic towards Phase 1 human trials as quickly as possible pending the final report from Nucro-Technics.”

A translation of the above is that thus far ZEN’s graphene based graphene-silver product is proving to be extremely safe, but there is still a way to go. We already know from previous studies that the product is **99.9% effective** against aerobic bacteria (gram-positive and gram-negative), fungal and viral activity, including COVID-19.

Greg Fenton, ZEN CEO, commented:

“This broad-spectrum compound is a novel solution that could have an impact on infectious disease management. It has the potential to act as a targeted treatment for multi-drug resistant organisms (MDR) as well. As in previously released results on the effectiveness of a similar compound against COVID-19, this graphene-based treatment could be against viral infections. We will be exploring its use not only in the fight against the current global pandemic, but also against numerous other pathogens....Based on this breakthrough and an urgent need for such treatments, we will seek immediate collaborations with potential pharmaceutical partners to optimize the delivery mechanisms to target infections in general and especially those common in the respiratory tract.”

**ZEN’s graphene products have enormous potential applications from fighting pathogens to air and water filtration to better batteries and many more**



- Potential medical breakthrough treatment for human-contracted pathogens with far-reaching and extremely positive impacts for society
- Biocidal coating on PPE helps protect people against pathogens, like COVID-19



- Graphene has shown significant promise for water filtration given its permeability properties



- Potential for graphene to be used in solar cells and next generation batteries for energy storage



- Pure graphene is 200 times stronger than steel. Graphene-enhanced aluminum and concrete can lead to stronger and more sustainable form of building materials and infrastructure development



- Graphene-based coating on air filtration media has the potential to reduce human contact with pathogens
- Graphene has shown significant promise for water filtration – and potentially waste management – given its permeability properties



- Graphene-enhanced applications can allow countries to strengthen infrastructure and resilience against climate-related hazards
- Potential for enhanced and cleaner energy solutions and more sustainable infrastructure development can allow countries to implement and meet more aggressive emission and climate policies and targets

Graphene is a next gen nanomaterial with enormous potential to help protect people, the environment and help us make meaningful progress toward the UN's sustainable development goals<sup>1</sup>.

*We are just scratching the surface on graphene's potential to make the world **safer, cleaner and more efficient***

3

Source: ZEN's corporate presentation

## ZEN's latest successes

- Jan. 13, 2021 – ZEN reported positive news on the use of their graphene-silver coating for masks. Filter material flow rates and pressure drop were not affected by the application of the coating and treated mask material achieved excellent dispersion and coverage. ZEN stated: "Both findings help validate that ZEN's coating does not inhibit breathability in polypropylene mask material or flow rates in air filtration media." This is another significant step towards successful adoption and commercialization of ZEN's graphene-silver coating. Recall that ZEN previously announced a contract in Canada to supply their graphene-silver coating to TreborRx ('Trebor') for 100 million masks.
- Jan. 18, 2021 – ZEN's announced that they had reached an agreement with Trebor for the application of their coating on nitrile gloves sourced or produced by Trebor. ZEN will provide Trebor with a distribution agreement for Canada, the USA and Mexico (Territory). Trebor agrees to use the coating on all gloves sold and will

pay ZEN a royalty per glove coated, with a minimum first year guarantee of 100 million gloves. George Irwin, Trebor CEO, commented, **“We are excited to bring another game changer to the PPE Industry.** We believe Zen’s biocidal coating on gloves gives front line responders and health care associates in all medical and non-medical situations additional protection for both the patient and health care worker. This coating can be used on gloves in food processing and agriculture as well. Trebor and Zen have a unique relationship with the goal of making safer PPE. Trebor looks forward to supplying the biocidal gloves within the 1<sup>st</sup> half of 2021.”

### **Next steps for ZEN**

ZEN’s engineering company will design and source the equipment for the production of the proprietary graphene-silver formula on an industrial scale. The equipment will be assembled and installed in ZEN’s new industrial facility in Guelph, Ontario. We will also need to wait to see what happens with Trebor’s application for an amendment to Health Canada to include ZEN’s coating on their already approved masks. There will also be further results and trials for ZEN’s biocidal product for human use.

### **Closing remarks**

ZEN Graphene Solutions currently has a market cap of C\$242 million. The Company has had a stunning past year and management is to be congratulated. Further upside remains should they achieve commercialization success in either of their current main projects (graphene-silver coating for personal protective equipment and successful trials and approval of their biocidal agent).

This is an amazing story from an amazing company. Stay tuned in 2021.



- Dr Dube & Greg Fenton on ZEN's potential graphene-based antibiotic, antiviral & antifungal compound (video)

*Disclosure: The author is long ZEN Graphene Solutions (TSXV: ZEN)*

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## **Dr Dube and Greg Fenton on ZEN's potential graphene-based antibiotic, antiviral and antifungal compound**

In a recent InvestorIntel interview, Peter Clausi speaks with Dr. Francis Dube, Executive Chairman, and Greg Fenton, CEO and Director of ZEN Graphene Solutions Ltd. (TSXV: ZEN), about ZEN Graphene's potential graphene-based antibiotic, antiviral and antifungal compound which could be a medical breakthrough in the treatment of numerous human-contracted pathogens including COVID-19.

In this InvestorIntel interview, which may also be viewed on YouTube (click here to subscribe to the **InvestorIntel Channel**), Greg went on to say, "We unfortunately had to shut down most of our research and development due to COVID-19." He continued, "Fortunate for us, we had just opened up our own research lab in Guelph. **We joined together with our research partners and tested to see if there was anything we could do to help beat this virus.**"

Dr. Dube told InvestorIntel that ZEN Graphene has already filed patent for a graphene-based virucidal ink to be used in masks, PPE and the HVAC (Heating, ventilation, and air

conditioning) sector. He added that the company is now exploring graphene's use in the fight against the current global pandemic.

On December 22, 2020, ZEN Graphene Solutions announced that it had developed a potential graphene-based antibiotic, antiviral and antifungal compound. Commenting on this news release Greg said, "The versatility of this product is way beyond anything even we could have imagined. Not only the range of pathogens that it is effective against, but how it can be deployed and utilized. **It went from us simply talking about bringing our product into coating, to us talking about actually bringing it into the body.**"

To watch the full interview, [click here](#)

#### **About ZEN Graphene Solutions Ltd.**

ZEN is a graphene technology solutions company with a focus on the development of graphene based nanomaterial products and applications. The unique Albany Graphite Project provides the company with a potential competitive advantage in the graphene market as independent labs in Japan, UK, Israel, USA and Canada have independently demonstrated that ZEN's Albany Pure™ Graphite is an ideal precursor material which easily converts (exfoliates) to graphene, using a variety of mechanical, chemical and electrochemical methods. ZEN is focused on commercializing a patent pending graphene-based coating with 99% viricidal activity against

To learn more about ZEN Graphene Solutions Ltd., [click here](#)

**ZEN Graphene Disclaimer:** The Company is not making any express or implied claims that its product has the ability to eliminate, cure or contain the COVID-19 (or SARS-2 Coronavirus) at this time. The company must receive Health Canada or FDA approvals for any of the products or solutions discussed.

**InvestorIntel Disclaimer:** ZEN Graphene Solutions Ltd. is an

advertorial member of InvestorIntel Corp.

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# The marvels of graphene technology kick off 2021 with ZEN focused on our health

While we were getting ready for Christmas, on December 22, 2020, ZEN Graphene Solutions Ltd. (TSXV: ZEN) made my head explode.

Well, almost – and there is probably a cure for that (ultimately). But in the meantime, the company's announcement has rocked ZEN shareholder's world with a share price increase of just over 50% in a matter of days.

In case you missed it, the press release is [here](#) (and watch a great interview with senior management [here](#)) as the company reveals the potential blockbusting impact of its graphene science. You might recall that ZEN is working on a virucidal ink for coating masks, but the most recent news is yet another example of the marvels of graphene technology.

Many people know of graphene for its strength (200 times stronger than steel) and ability to conduct heat (10 times more effective than copper) and conduct electricity (1,000 times better than copper), but the world is just coming to understand the biomedical attributes of the diamond that didn't grow up.

Graphene is a two-dimensional, single layer "crystal" of pure carbon, which is inert. Attaching minute amounts of active "ingredients" to the graphene has resulted in a potential new

compound which could be used as an antibiotic, antiviral or antifungal treatment.

That bears repeating, because this is potentially a huge breakthrough.

**An alternative that could be used as an antibiotic, antiviral or antifungal treatment.**

Recently received testing results from the University Health Network/Mount Sinai Hospital Department of Microbiology in Toronto indicate that this patent pending formulation could be a medical breakthrough in the treatment of numerous human-contracted pathogens.

The company commenced cytotoxicity (toxicity to cells) studies in lab animals in October 2020, with results expected in January 2021. Pending the outcome of the testing to demonstrate the safety of the graphene compound, upon successful completion the company will then seek to move immediately to human trials in 2021 with one or more pharma partners.

Immediate and obvious uses for a successful graphene compound product would be the potential use to treat infection of upper and lower respiratory tract – where COVID-19 is a major contributor – via a dry-powder inhaler or a nasal spray to maximize local concentrations directly at the site of infection. Other immediate obvious uses are the potential role in ear, eye, and fungal infections treatments.

**If the graphene compound is shown to be safe and effective in human trials, subject to regulatory approvals, it would also provide a viable alternative to many of the antibiotic-resistant super-bugs.**

Think about that – we all know someone who has had an issue with this and it is becoming unfortunately more common in hospital care.

The potential impact of this discovery and breakthrough should not be underestimated. The world has thus-far mostly focussed on the mechanical and physical aspects of using graphene as an enhancer. A new potential medical treatment? Antibiotic, antiviral or antifungal all in one?

Boom – just made my head explode....again!

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## **ZEN Graphene set to supply a virucidal coating for a minimum 100 million masks**

This week ZEN Graphene Solutions Ltd. (TSXV: ZEN) (“ZEN”) and Trebor RX Corp. (“Trebor”) signed a Binding Letter of Intent (LOI) that includes the initial purchase of ZEN’s patent pending graphene based virucidal coating for **a minimum of 100 million masks/filters** with pricing of these mask/filters being variable based on a number of factors.

This news follows the highly successful testing of ZEN’s graphene based silver colloidal coating announced on September 22, 2020. Some of the announcement highlights are shown below:

- ZEN’s Virucidal ink is **99% effective against the COVID-19 virus**.
- ZEN’s Virucidal ink was still 99% effective a minimum of 35 days after application to N95 mask material.
- ZEN is now developing plans to expedite commercialization of this product, pending regulatory approval.
- ZEN has filed a provisional patent for this graphene-based virucidal product.....

- Very significant virucidal activity was recorded and reported, achieving 99% inactivation of the virus for both samples in 3 separate tests each and verified through a second round of testing...”

But back to the latest potentially game changing news for ZEN of the LOI for a minimum of 100 million masks/filters from Trebor. An order of this size for a relatively small company like ZEN is highly significant. Greg Fenton, ZEN’s Chief Strategy Officer, commented (Nov. 9, 2020):

“This is a historic day for ZEN. **The signing of this significant commercial agreement is a watershed moment for our organization.** Moreover, it is an honour for ZEN to partner with a Canadian company like Trebor and develop a 100% Canadian solution in the fight against the COVID-19 pandemic. The innovation of the Trebor Pro+ Respirator Mask will set a new standard in the mask industry and, combined with our viricidal coating, will bring a new level of safety for our front-line workers....”

Trebor’s CEO George Irwin agreed stating: “This is truly a game changer in the PPE space....”



**PRO+ Respirator Mask**

It looks like the market also agrees with ZEN, up 358% over the past 1 year, and up 293% since I wrote “ZEN Graphene Solutions moves towards commercialization of virus-killing mask” back on September 8, 2020.

**ZEN Graphene Solutions stock price is up 358% over the past 1 year, and up 293% since September 8, 2020**



Source

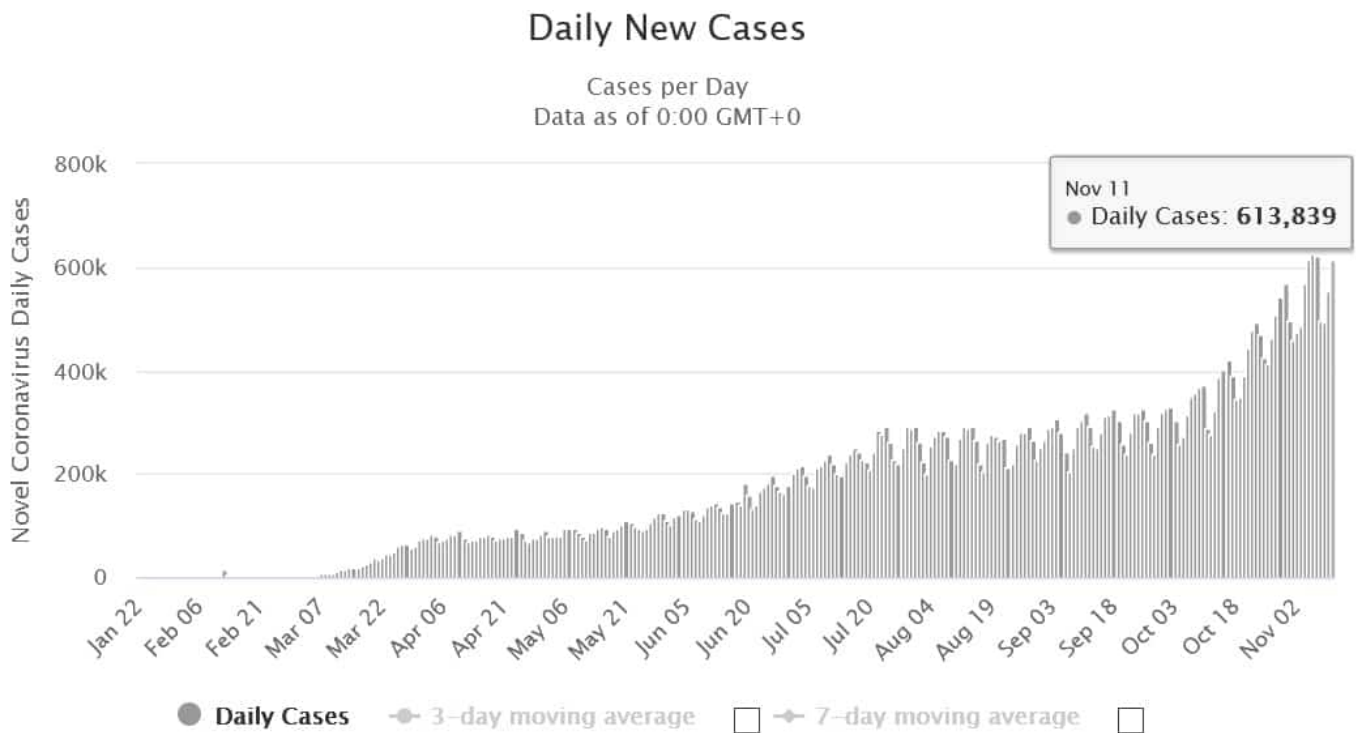
What we know so far is that ZEN and Trebor have signed a LOI and that Trebor is a Canadian personal protective equipment mask manufacturer with an initial production facility located in Collingwood, Ontario, Canada. The announcement on the binding LOI includes several key points:

1. Initial first year production is planned to use ZEN's patent pending graphene based viricidal coating for a **minimum of 100 million masks/filters.**
2. Pricing of these mask/filters being variable based on a number of factors.
3. This initial minimum order is for the first year and is **subject to Health Canada approvals.**

- ZEN's viricidal coating will be used on Trebor's patent pending Pro+ Respirator Mask (Pro+) N95 mask and also on their 3-ply surgical mask.

For now, we can only speculate on what the commercial terms would be and what other agreements may follow. What we do know is that the global market demand for face masks is enormous, certainly in the billions. Some have even called the face mask 'the world's most valuable commodity'. It is estimated that production of the highly protective N95 face masks in the United States alone will increase to 180 million units per month by the end/winter months of 2020.

**Demand for face masks is only increasing as global new COVID-19 cases continue to accelerate higher**



Source

Under a Biden presidency it looks highly probable that face masks will be viewed more positively than what happened under Trump. Back in June 2020, CNN quoted: "Biden says he would make wearing face masks mandatory for Americans amid coronavirus pandemic." This week Biden has announced a new



COVID-19 taskforce to begin work immediately and continue after he is sworn in as president on January 20.

Global daily new cases of COVID-19 have been accelerating and are now averaging **a staggering 600,000 new cases per day**, for a total of over 52 million cases now globally.

All of this should lead to very strong demand for face masks in the year ahead.

Beyond COVID-19 ZEN has many other potential areas and deals to commercialize their graphene. Some recent deals include a collaboration agreement on Carbon Aerogels with German Aerospace Centre and a partnership with the Royal Canadian Navy and Evercloak to test Graphene Oxide Dehumidification Membrane Technology.

To meet all this new demand ZEN has had to double their lab space starting January 1, 2020 and announced this week that ZEN will lease a 25,680 square feet space in Guelph, Ontario to become ZEN's new manufacturing facility and corporate headquarters. ZEN stated: "The company expects to begin initial production in Q4 2020 for incorporation into masks, other PPE and for HVAC filters and prefilters."

## A summary of ZEN Graphene Solutions

### WHO WE ARE

A 100% Canadian nanomaterial sciences company focused on graphene production and intellectual property development and acquisition

Graphene sourced from wholly owned, unique microcrystalline Albany graphite deposit located in Ontario, Canada

Well positioned to benefit from the fight against Covid-19, the emerging green economy and to improve existing old-world technologies

Our vertical integration strategy includes utilizing our Albany Pure™ Graphite to produce graphene along with the development of an intellectual property portfolio which put us in a leading position in this industry



## Source

### Closing remarks

ZEN Graphene Solution's management is doing a tremendous job. Pivoting in 2020 to produce a viricidal graphene coating was a genius move. Of course COVID-19 will come and eventually go, but demand for industry leading graphene products looks set to boom this decade as the world learns more about the wonders of graphene.

ZEN Graphene Solutions has a market cap of C\$139M and right now appears to have the world at their feet.

*Disclosure: The author is long ZEN Graphene Solutions Ltd. (TSXV: ZEN).*

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## **Dr. Dube on competitive graphene technology and the recent testing partnership between ZEN, the Royal Canadian Navy and Evercloak**

In a recent interview with **InvestorIntel**, Tracy Weslosky speaks with Dr. Francis Dube, CEO and Director of ZEN Graphene Solutions Ltd. (TSXV: ZEN) about their partnership with Royal Canadian Navy and Evercloak to test graphene oxide dehumidification membrane technology.

In an InvestorIntel interview that can also be viewed on our InvestorIntel YouTube channel, Dr. Dube said, "We can make

a membrane that is based on our graphene oxide and that material now enables a new technology that filters out moisture in air before this air gets into an air conditioning unit.” He added that by removing moisture from air, the air conditioning unit uses less energy and requires less maintenance. “We can reduce air conditioning energy requirement by 75%...” Dr. Dube claimed.

Dr. Dube also provided an update on ZEN’s graphene oxide production method and the competitive environmental advantages of this technology.

To watch the full interview, [click here](#)

To learn more about ZEN Graphene Solutions Ltd., [click here](#)

*Disclaimer: ZEN Graphene Solutions Ltd. is an advertorial member of InvestorIntel Corp.*

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## **Dr. Francis Dube on the advancement of mask technologies and ZEN’s graphene based virucidal ink with 99% efficacy**

InvestorIntel’s Tracy Weslosky speaks with Dr. Francis Dube, CEO and Director of ZEN Graphene Solutions Ltd. (TSXV: ZEN), about ZEN’s novel graphene based virucidal ink. “We have come up with a coating that can be applied to masks and filter membranes to deactivate the COVID-19 virus,” Dr. Dube told

InvestorIntel. “It has been proven at plus 99% efficacy through Western University’s ImPaKT facility which is a Biosafety Level 3 lab.”

In an InvestorIntel interview that can also be viewed on our InvestorIntel YouTube channel, Dr. Dube went on to say, while the current mask technologies are only meant to filter out particles, masks sprayed with ZEN’s graphene-based virucidal ink remains 99% effective in killing COVID-19 virus even after 35 days.

To watch the full interview, [click here](#)

To learn more about ZEN Graphene Solutions Ltd., [click here](#)

*Disclaimer: ZEN Graphene Solutions Ltd. is an advertorial member of InvestorIntel Corp.*

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**Lab tests show ZEN Graphene’s virucidal ink 99% effective against COVID-19; patent applied for**

**Optimization, production scale-up and commercialization planned**

Another month deeper into the global COVID-19 crisis and the world is still looking for effective tools to combat the pandemic. Virus testing is still both not widespread nor accurate enough, and a vaccine still eludes us. Governments

and businesses are grimly contemplating the consequences of a second (or is it the third or fourth?) wave and the potential for another economy-crippling, government-sanctioned lockdown. In the meantime, we are all looking for ways to avoid the virus and keep ourselves healthy.

On September 22, 2020, ZEN Graphene Solutions Ltd. (TSXV:ZEN | OTC:ZENYF) announced that after 5 months of optimization, it has **developed and successfully tested a novel graphene-based virucidal ink with 99% effectiveness against COVID-19**. The ink, used as a coating or protective layer on masks and other PPE, was shown to be 99% effective against the COVID-19 virus and significantly was **still 99% effective a minimum of 35 days after application** to N95 mask material. The company is now developing plans to expedite commercialization of this product, pending regulatory approval, and has filed a provisional patent for this graphene-based virucidal product and is beginning antibacterial and antifungal tests utilizing its proprietary virucidal ink formulation.

ZEN Graphene followed up this announcement with more news on September 28, 2020 that the University of Guelph has filed a **provisional patent** regarding an electrochemical exfoliation process to produce graphene oxide (GO) from Albany Pure Graphite. The exfoliation method is designed to be a scalable, low cost, low energy and environmentally friendly method of producing graphene oxide, a key ingredient in ZEN's proprietary virucidal ink.

A virucide is any physical or chemical agent that deactivates or destroys viruses. This differs from an antiviral drug, which inhibits the proliferation of the virus. Virucides are not intended for use inside the body, but they are effective on surfaces outside the body.

In the recent results from Western University's ImPaKT facility Biosafety Level 3 laboratory, two ZEN Graphene graphene-based ink samples at different concentrations were

applied to N95 mask filtration media and then exposed to the SARS-CoV-2 virus that causes COVID-19 and tested for antiviral properties. Very significant virucidal activity was recorded and reported, **achieving 99% inactivation of the virus** for both samples in 3 separate tests each and verified through a second round of testing. Of significance, the antiviral effect of the second round of testing was on material that was prepared 35 days earlier demonstrating the ongoing virucidal activity of ZEN's proprietary ink.

The research and development of this antiviral ink formulation was conducted entirely by ZEN's research team at its Canadian facility using a graphene product that was **produced from its Albany mine graphite**.

The significance of the ZEN Graphene virucidal ink is based on the physical characteristics of graphene. Graphite flakes extracted from the ZEN Albany mine in Ontario to convert to graphene are approximately 9 microns (9,000 nanometers) making conversion to graphene very cost effective. Graphene is 200 times stronger than steel, conducts heat 10 times more than copper and conducts electricity 1,000 times better than copper according to ZEN Chairman and CEO Dr. Francis Dubé.

In other words, you soon could be wearing a mask with the ZEN virucidal ink on it and would not know the difference between that and a non-coated mask. Except to know that you are now actually wearing something that actually kills the coronavirus as it passes through your mask.

There are still multiple steps for ZEN to go through before the virucidal ink is publicly available on personal protective equipment, but this is a big step forward towards commercialization as technology brings society closer to a coronavirus solution. In the meantime, ZEN intends to continue to move rapidly towards optimization, production scale-up and commercialization of its graphene-based ink.

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# ZEN Graphene Solutions moves towards commercialization of virus-killing mask

**ZEN is collaborating with partners to develop virucidal face masks and PPE**

Back in May 2020 InvestorIntel wrote about the very exciting development of masks and other personal protective equipment (PPE) that not only protect the wearer, **but actually kill viruses on contact**. to help . Since then the development of a “graphene virucidal ink face mask” and PPE has been progressing nicely in the fight against COVID-19.

In late July 2020 ZEN Graphene Solutions Ltd. (TSXV: ZEN) (“ZEN”) reported that research teams at a number of personal protective equipment (PPE) manufacturers are collaborating with ZEN to incorporate ZEN’s virus-killing graphene ink into commercial products, including masks, gloves, gowns and other clothing. This follows ZEN’s promising testing results from the University of Western Ontario’s ImPaKT Facility, biosafety Level 3 lab.

ZEN has synthesized a ‘silver nanoparticles functionalized graphene oxide ink’ that has been documented by previous researchers to kill earlier versions of coronavirus. Silver is well known to be a potential virucidal agent.



**Photo: iStock**

In July ZEN reported in a news release that the company “continues to optimize its proprietary formulation for dosage

and delivery mechanism for highest antiviral impact. **The next phase of testing is currently underway** at the ImPaKT Facility and includes a preferred mask fabric, from one of our collaborators, coated in ZEN's virucidal ink exposed to and tested against the COVID-19 virus."

Dr. Francis Dubé, CEO of ZEN, commented that "Based on results so far and our discussions with the team at Western, we are quickly moving to integrate our material into commercial products with partners who wish to increase the level of COVID-19 protection their products currently offer."

Given the world needs at least 3.5b N95 face masks to fight COVID-19, the potential demand for ZEN's graphene based virucidal ink face mask could be enormous. If the new virucidal mask captured just 10% market share of the 3.5 billion masks needed that would mean manufacturing and selling ~350 million masks. Or even if just made mandatory for health care workers globally, the market would be very large, as there is an estimated 59 million health care workers worldwide. Each health care worker would need a number of masks per year. The revenue opportunities could be enormous if ZEN's graphene based virucidal ink is licensed on a per unit basis. Added to this would be the potential for use in other PPE. For a small company such as ZEN the potential revenue upside could be highly significant.

Tests are still underway to improve and prove the effectiveness of the virucidal masks, but CEO Dubé's public comments about integrating ZEN's material into commercial products with partners indicates a positive outcome is looking increasingly possible.

Last week ZEN announced that it will "report shortly on significant progress being made in multiple programs, one of which has resulted in the preparation of a patent filing that is central to ZEN's business plan." Zen also announced receiving **significant funding grants**: "two NSERC Alliance



COVID-19 project grants, a Mitacs Elevate Postdoctoral Fellowship grant, and two Mitacs Accelerate grants for a total of \$355,000 to its university collaborators,” which increased ZEN’s total research and development budget for the next 12 months to over \$1.4M.

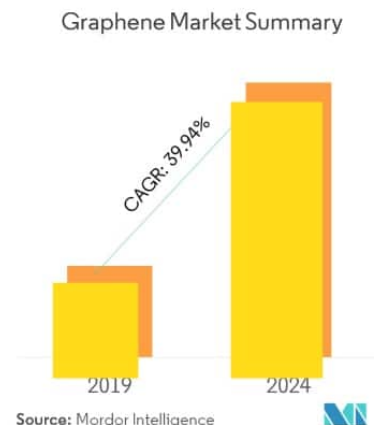
## **Graphene’s potential**

Graphene is a new wonder material with incredible potential to be commercialized in a huge number of products. These are as diverse as graphene coatings that can greatly improve corrosion resistance, increase strength, reduce friction and can be hydrophobic reducing ice formation (aerospace and aircraft industries). As a diesel/jet fuel additive it can improve fuel economy and reduces greenhouse emissions. It is also useful in electromagnetic shielding and electrostatic dissipation, desalinization membranes and low-energy dehumidification, heavy metal scavenging and removing industrial contamination, photovoltaics, displays & biomedical applications using graphene quantum dots, virucidal inks, as a material enhancement (clothes, tire strengthener, concrete additive), hydrogen storage and production, and advanced batteries. Samsung is developing an advanced graphene phone battery. Graphene is super lightweight and also strengthens aluminum, rubber, plastics and other materials, making its list of applications almost endless.

**The graphene market is forecast to grow at a 39-45% CAGR this decade**

## A high value growth industry over the next decade

- The 2019 Canaccord UK\* research report estimates worldwide graphene sales are likely to take off over the next few years reaching \$4.8B USD by 2030
- Graphene's commercial potential lies in its ability to enhance and improve existing materials at a very low load factor making it a viable solution in the cost/benefit calculation for commercial applications
- Markets in which graphene is already competing with other additives amount to more than \$150B in value
- Canaccord's central case implies a Compound Annual Growth Rate (CAGR) of 45% in revenue over a decade 2030E from current levels



Source: Company presentation

## Closing remarks

In addition to its advanced application projects, **ZEN owns a graphite mine** and has commenced small scale graphene production from their facility in Canada, and has numerous other potential uses to commercialize their graphene product. At the current market cap of just C\$31m the stock is not yet pricing in any chance of significant success in the virucidal mask and PPE market, or in the larger graphene market. This is good news for investors looking for underappreciated and early stage stocks. If ZEN is able to successfully commercialize its viricidal mask/PPE or other graphene products, it would be a game-changer.

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# Scaling up graphene production to meet forecast

# demand, ZEN Graphene shares double since April

In recent years we have heard that graphene can be the next super material due to its immense strength and electrical conduction properties. The next step is for large scale, low cost, graphene production to occur so as to supply the market demand. It looks like graphene's time has now come.

A 2019 Canaccord UK research report estimated worldwide graphene sales were likely to take off over the next few years reaching US\$4.8 billion by 2030, growing at a CAGR of 45%. That is a huge forecast demand increase, effectively forecasting in the next 2 years graphene demand will double, then double again, and so on.

## Graphene – Properties, Facts, and Applications

Properties	Facts	Applications
Strength	200 x stronger than steel	Composite materials & alloys - rubber, plastic, aluminum & concrete
Flexibility	Can bend & stretch to 120% of original size	Coatings, additives & wearable technologies.
Thermal Conductivity	10 x conductivity of copper	Composite materials - concrete, coatings, polymers etc.
Impermeability	Hydrogen atoms cannot penetrate its structure	Filters, water purification, gas storage and hydrogen fuel cells
Electrical Conductivity	1000 x current capacity of copper	Longer battery life, semiconductors
Electronic behaviour	Electrons can move at near light speed through it	Improved speed / efficiency for computer chips
Optical Properties	Allows more light through than glass	Thinner, lighter screens and transparent tensile coatings

### Source

One company is currently scaling up their graphene production from their new facility in Canada to meet what should be extremely strong demand this decade. That company is ZEN Graphene Solutions Ltd. (TSXV: ZEN) ("ZEN").

ZEN is an emerging graphene technology solutions company with

a focus on the development of graphene-based nanomaterial products and applications. ZEN sources its graphite to make graphene from its 'unique' Albany Graphite Project. I say unique because independent labs in Japan, UK, Israel, USA and Canada have independently demonstrated that ZEN's Albany Pure™ Graphite is an ideal precursor material which easily converts (exfoliates) to graphene using a variety of methods.

Some of the numerous applications for ZEN's graphene include:

- **Aerospace and aircraft** – Graphene coatings that can greatly improve corrosion resistance, reduce friction and can be hydrophobic reducing ice formation. Graphene composites also help to increase strength and flexibility while potentially reducing overall weight.
- **Fuel Additive** – Graphene oxide in diesel/jet fuel improves fuel economy and reduces greenhouse emissions.
- **Electromagnetic shielding** and electrostatic dissipation.
- **Desalinization membranes** and low-energy dehumidification.
- **Heavy metal scavenging** – Graphene quantum dot/nanocellulose membranes are a recyclable material capable of removing industrial contamination.
- **Photovoltaics, displays, biomedical applications** using graphene quantum dots. Graphene based virucidal inks embedded in protective clothing to fight COVID-19 are another useful application right now.
- **Material enhancement** using graphene. Graphene is also useful to boost tires strength and performance as well as a concrete additive to boost performance. Graphene can also be used to strengthen clothing for military applications. Graphene also strengthens aluminum, rubber, plastics and other materials.
- **Hydrogen storage and production** – Graphene is an ideal catalyst for water splitting (10x more efficient than platinum catalysts) and can store hydrogen in a solid state.

- **Advanced batteries** –Anode energy densities are 1500mAh/g in graphene-enhanced aerogels and 840mAh/g with reduced graphene oxide. Graphene has greater conductivity and improves cold weather performance. Samsung is developing an advanced graphene phone battery.

## **ZEN Graphene Solutions Guelph, Ontario facility is scaling up graphene production in 2020**

The Guelph graphene facility opened in March 2020 and is now scaling up graphene production to sell to the many potential buyers as discussed above.

### **New Guelph facility - next phase of development & scale up**



- Grand Opening March 3, 2020
- Access to 2,000 Square Foot Lab Space
- Small-scale graphite purification & graphene production facilities
- E-commerce Store Launch February 27, 2020
- Graphene products available for R&D and commercial use

#### **Source**

In addition to ZEN's Guelph facility ramping up production, ZEN announced in July 2020 a new partnership with Evercloak and NGen for a 'Graphene in Cleantech Manufacturing Project'. The announcement states:

"The project entitled "Advancing Large-Scale Graphene and Thin-Film Membrane Manufacturing" will support the scale up of graphene oxide (GO) production by ZEN to supply GO to Evercloak for their scale up and optimizing activities."

For ZEN this is another significant endorsement and step

forward along the pathway of commercializing their graphene. Evercloak is commercializing a manufacturing platform for producing continuous, large-area, monolayers of exfoliated 2D nanomaterials, including graphene, graphene oxide, molybdenum disulfide, and carbon nanotubes. These films are increasingly used for a wide range of applications such as energy storage, smart packaging, electronic devices, corrosion inhibitors, and membranes. Evercloak's initial focus is on manufacturing graphene-based membranes for dehumidification to significantly reduce the energy use and associated greenhouse gas related with building cooling.

ZEN's CEO Francis Dubé commented: "ZEN is pleased to support Canadian graphene-based innovations and Evercloak is a wonderful example of what can be achieved with nanomaterials and Canadian entrepreneurship. NGen supports the accelerated development of high potential technologies such as our graphene collaboration. We look forward to helping Evercloak bring breakthrough technology to everyday life."

### **Closing remarks**

Success in the manufacturing sector is about collaboration with your supply chain. ZEN continues to win interest in their graphene products and continues to develop a supply chain, on this latest occasion with Evercloak.

A recent C\$2 million capital raise means ZEN has cash to accelerate their near term expansion activities, which will include funds for the Albany Graphite Project, further graphene research, graphene production scale up, COVID-19 initiatives, and other graphene applications development. Also the recent engagement of Hybrid Financial to help market ZEN should boost the number of eyes on the stock.

Combine the above with continuing commercial success selling graphene products and 2020 should see a successful year for ZEN. Late 2020 and 2021 should start to see revenues coming in

and a lot more interest in both graphene and ZEN Graphene Solutions. Despite the stock price more than doubling since April 2020, the stock still looks reasonably priced trading on a market cap of C\$57 million.

