Revolutionizing Anti-Bacterial textile coating

H1 2017

Business Plan

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NanoTextile at a Glance

NanoTextile presents the most advanced and innovative anti-bacterial textile coating technology, and the only viable technology to be able to positively address the demands of the Healthcare sector. The technology was developed via a 12m EURO investment by the European Commission's FP7 initiative.

Nano Textile adds anti-bacterial properties to virtually any woven fabric through a patented single-step nano-coating process, with absolutely no damage to the fabric's quality or alteration of the fabric's color. In a roll-to-roll process, the fabric passes through a specially formulated anti-bacterial metal oxide solution in NanoTextile's proprietary sono-chemical reactor. Sound-wave triggered cavitation processes create the anti-bacterial nanoparticles and impregnate them permanently into the fabric.

NanoTextile's initial target market is anti-bacterial textiles for the healthcare sector such as hospitals, nursing homes, etc. due to the acute global demand for advanced technologies in the fight against nosocomial infections (Hospital Acquired Infections).

Other promising anti-bacterial textile opportunities include anti-bacterial textiles for the mass transportation sector, the undergarment market, and the hospitality industry.

NanoTextile's platform technology might also be adapted to provide other functional characteristics to textiles such as fire-resistance, water repellence magnetic and even electro-conductivity—positioning NanoTextile at the core of the fast-growing smart textile market.

The Need for Anti-Bacterial Medical Textiles

A nosocomial, or healthcare-acquired infection (HAI), is a viral, bacterial or fungal infection that was not present prior to the patient's being admitted to the healthcare facility and occurs within 72 hours after admittance. Many of these infections are caused by bacteria that are resistant to antibiotics, such as *Methicillin-resistant Staphylococcus aureus* (MRSA), *Klebsiella pneumonia* and *Clostridium difficile*.[1]

HAI Estimates Occurring in US Acute Care Hospitals, 2011[2]	
Major Site of Infection	**Est. #**
Pneumonia	157,500
Gastrointestinal Illness	123,100
Urinary Tract Infections	93,300
Primary Bloodstream Infections	71,900
Surgical site infections from any inpatient surgery	157,500
Other types of infections	118,500
Estimated total number of infections:	**721,800**
# of HAI patient deaths during hospitalization:	**~75,000**

As shown in the table to the left, HAIs are a serious threat to patient safety in the US. The statistics on patient safety in the EU show similar trends: 1 in 10 patients are affected by HAIs, resulting in more than 10 million additional patient days and 3 million deaths per year.[3]

Campaigns mounted by healthcare systems in the US and Europe to reduce HAIs have had some success. However, with the rise of antibiotic resistance and the growth in elderly populations with age-compromised immune systems and high hospitalization rates, HAIs continue to be a serious healthcare challenge.

With their large surface areas and tendency to retain moisture, textiles are conducive to the growth of microorganisms such as bacteria and fungi. These pathogens are found almost everywhere and, depending on moisture, nutrient and temperature levels, can multiply quickly. Some bacteria populations can double every 20-30 minutes under ideal conditions.[4]

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1 Medical Definition of Nosocomial, MedicineNet
2 HAI Data and Statistics, CDC
3 I. Perelshtein et al, "Making the hospital a safer place by sonochemical coating of all its textiles with antibacterial nanoparticles", Ultrasonics Sonochemistry 25 (2015)
4 DS Morais et al, "Antimicrobial Approaches for Textiles: From Research to Market", Materials, June 2016

It is not surprising, therefore, that the demand for anti-bacterial textiles for use in the healthcare sector has grown considerably over the last two decades. It is estimated that in the year 2000 the production of anti-bacterial textiles was about 30,000 tonnes in Western Europe and 100,000 tonnes worldwide. Since then the production of antimicrobial textiles has increased ~15% per year, making it one of the fastest growing sectors of the textile industry.[5] See *Market Size and Potential* on p. 6 for more detailed information on the size of the anti-bacterial textile market.

Drawbacks of Current Anti-Bacterial Solutions

There are several companies that currently dominate the anti-bacterial textile sector, as described in more detail in *Competitive Landscape*, p. 7. Their products are based on one of the following two methodologies, each of which suffers from well-documented drawbacks:

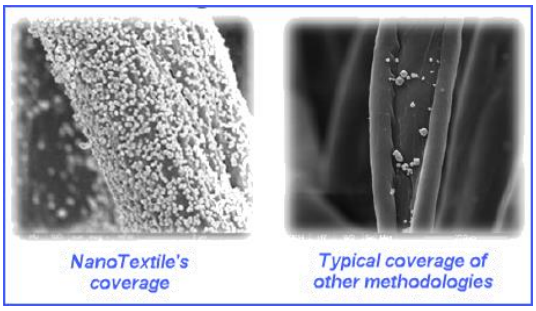
1. **Fiber extrusion**, with anti-bacterial metals (copper, silver) blended into the filament. The key drawbacks of this methodology are:
   - When using Copper, because the anti-bacterial metal particles are clearly visible on lighter colors, the treated fibers are available only in darker colors — which is not optimal for most medical textile products.
   - Can be implemented on synthetic fibers only.
   - Very expensive process (increases the fabric's price by up to 50%).
   - Limited production abilities — poor scalability.
2. **Chemical binding**, that applies the anti-bacterial metals to finished fabrics. The key drawbacks of this methodology are:
   - The lack of binding strength (durability), with the final product unable to maintain its anti-bacterial properties under typical institutional laundering conditions
   - Pollution – one of the main claims against this methodology is the constant pollution of the ground water. With every washing cycle the chemical binder gets released to the washing water, ending up polluting the ground water

A general remark: The majority of the solutions today use Silver as the Antibacterial agent. Silver's safety is very controversial and largely regarded as dangerous, despite the CE/EPA approvals.

NanoTextile's Breakthrough Technology

NanoTextile has developed a novel and cost-effective methodology for adding extremely durable anti-bacterial properties to a wide range of fabrics without changing the nature or the appearance of the fabric.

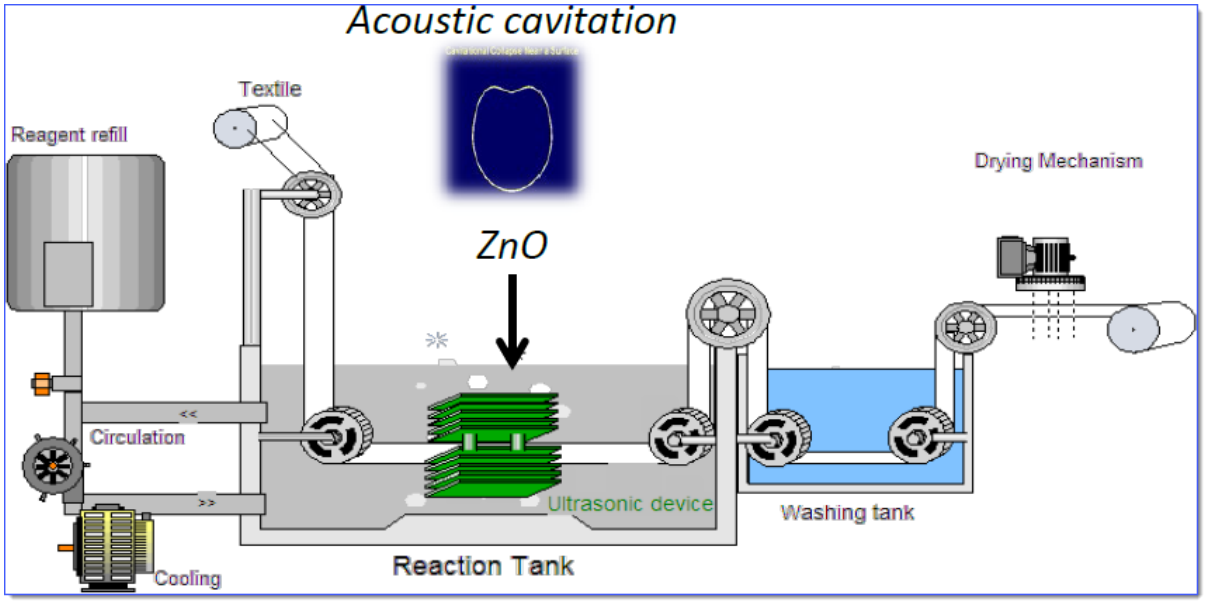
In NanoTextile's Sono-Reactor (see the schematic diagram on the next page) the fabric runs in a continuous process through a reaction tank, a washing tank and a dryer. The reaction tank is filled with a Zinc Oxide (ZnO) solution. An ultrasonic field produces acoustic cavitation. The violent collapse of bubbles produces high temperatures and pressures, sonochemically converting the soluble reagents to solid metal oxide nanoparticles (50-100 nm). The collapse of bubbles on the surface of the fabric results in the formation of microjets that propel the nanoparticles at high speed into the fibers.



[5] http://www.marketsandmarkets.com/PressReleases/antimicrobial-textile.asp

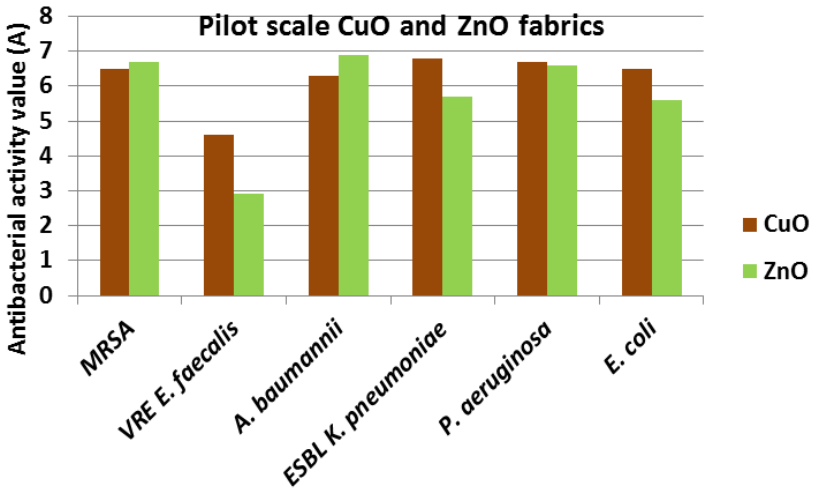
The treated fabric is then washed and dried. Because ZnO is transparent, there is no change to the color of the fabric, which is now an anti-bacterial textile with superior efficacy and durability.

It has been proven that the Antibacterial properties of ZnO nano particles greatly out performs ZnO particles. That, along with a full coverage to the fiber when using Nano Textile's technology (as seen in the comparison pictures above) grants the fabrics with a much stronger antibacterial properties.



NanoTextile's Advantages

The following results were achieved in anti-bacterial efficacy testing conducted on polyester/cotton fabrics treated with ZnO in NanoTextile's Sono Reactor:



This test was done by ATEX:

As seen in the chart the log reduction of bacteria presence between sono-chemicaly Antibacterial treated fabrics and non-treated fabrics was between 3 – 7, with the majority of the shown log reduction exceeding 5.

This means that from miilions of present bacterias on non-treated fabrics only few where found on the treated fabrics.

Table 1. Antimicrobial efficacy testing results for ZnO and CuO impregnated polyester cotton fabric.

	ZnO	ZnO	CuO	CuO
Antibacterial:	A value [a]	% reduction [b]	A value	% reduction*
Acinetobacter baumannii	5.9	>99	5.3	>99
Escherichia coli	5.6	>99	3.2	>99
MRSA	5.7	>99	5.4	>99
Pseudomonas aeruginosa	5.6	>99	5.7	>99
VRE *Enterococcus faecalis*	3.5	>95	3.6	>99
Antifungal:				
Candida albicans			2.8	

[a] Assessment criteria for A values: <0.5 - no antibacterial activity, ≥0.5 to <1.0 - slight activity, ≥1 to <3 - significant activity, ≥3 strong antibacterial activity
[b] % reduction = ((initial concentration – post incubation concentration) ÷ initial concentration) x 100

This test was done by Coventry University:

As seen, there is a very high Anti-bacterial efficiency. More than 3 in A value presents a very strong antibacterial efficiency.

The benefits of NanoTextile's unique technology can be summarized as follows:

Sono-chemical process

- Simple, one step, continuous procedure
- Automated, roll-to-roll process: easily scaled for mass production
- Applicable to all fabric types – fabric type agnostic
- No degradation of the fabric's quality
- Strong impregnation of the fabric with ZnO nanoparticles for exceptional durability**
- Very cost effective: Inexpensive materials, no need for expensive skilled labor and requires minimal production labor
- "Green" coating method: No polluting waist in production and does not pollute the ground water

ZnO

- "GRAS" material (Generally Regarded As Safe by the FDA)
- Environmentally friendly material
- Very strong anti-bacterial properties
- Withstands harsh processing, very durable
- Transparent: does not alter the fabric color

*** Remained 100% effective after:*

- *65 washes at 92°C (Textile Research Institute AITEX)*
- *100 washes at 75°C (Coventry University)*

The Company

Key Management Personnel

Shuki Herchcovici, Founder.

Mr. Shuki Herchcovici is the founder of Shay Sapir Investment and of Nano Textile. He is a serial entrepreneur and capital market expert, specializes in mergers and acquisitions and developing private and public companies, such as Aryt Medical (TASE:SVAS-L), EZ Energy (TASE:EZ-M), Eden Energy (TASE:EDEN) and Yuli Capital Markets (TASE:YULI), D. Medical Industries (Nasdaq:DMED, TASE:DMDC) and Nextgen Biomed (TASE:NXGN).

Raz Gal, CEO.

Raz Gal has extensive legal and business experience. Previous work experience includes: CEO of a not-for-profit foundation, Galil Elyon, that organizes youth sports throughout northern Israel; head of business development for Tawkers, a successful, New York-based mobile messaging application; VP Business Development for Betalin Therapeutics, a Tel Aviv-based biotech company developing a novel

diabetes treatment; litigator in the high tech and sports departments of Zysman, Aharoni, Gayer & Co., a leading international law firm.

Shay Hershcovich, COO.
Shay Hershcovich led the establishment of Nano Textile including: marketing materials, registration, fundraising, recruiting and training key personnel. Assists in defining and executing the company's strategy. Responsible for planning and monitoring operations in Israel, EU and Asia.

Erez Ovdat, CTO.
Erez Ovdat has nearly 30 years of experience in the textile industry, where he worked as a textile buyer, a marketing manager, and a textile technology manager in a variety of textile and apparel companies. He has extensive experience in international textile markets such as China, India, the US, Egypt and Thailand. He worked as a textile technologist in an Israeli company using nano technology to develop composites.

Roy Hirsch, VP Business Development
Roy Hirsch is an expert in strategy and business development with a focus on M&A. He has initiated multiple B2B multi-million dollar transactions and has consulted to emerging startups as well as leading enterprises in the fields of strategy, marketing, deal negotiations and M&A negotiations.

Key R&D and Scientific Personnel

Professor Aharon Gedanken, R&D Lead.
Prof. Emeritus Aharon Gedanken obtained his MSc from Bar-Ilan University and his PhD from Tel Aviv University. After postdoctoral research at USC in Los Angeles, he returned to Bar-Ilan in 1975 as a senior faculty member. He has published 725 peer reviewed manuscripts in international journals and has filed 38 patents. His H-Index is 78 and he is on the editorial boards of 7 international journals. He was a partner in five EC FP7 projects and coordinated the FP7 project (SONO) on which Nano Textile is based. He was the Israeli representative to the NMP (Nano, Materials, Processes) EC FP7 committee. He was awarded the prize of the Israel Vacuum Society and the Israel Chemical Society for Excellence in Research. He currently leads a group of 20 researchers.

Dr. Ilana Perelshtein, Lead Scientific Researcher.
Dr. Perelshtein earned an MSc degree in Physical Chemistry and a Ph D in Chemistry of Materials at Bar-Ilan University under the supervision of Prof. Gedanken. She has developed a one-step process for the synthesis of antibacterial nanoparticles and their subsequent coating on surfaces by a sono-chemical technique. She is the author of 45 scientific publications in peer-reviewed journals and has applied for 2 patents. In 2015 she developed and wrote the *Introduction to Nanotechnology* course for the Open University of Israel.

Intellectual Property

From 2009 to 2013 the Sono-Reactor was developed at a pilot industrial scale with €12 million of funding from the EU FP7 framework. The SONO consortium was comprised of 16 partners from 10 European countries — from fabric manufacturers to medical end users—and led by Prof. Gedanken and Bar-Ilan University, which retained all intellectual property rights.

Following successful conclusion of the SONO project, Prof. Gedanken and Bar-Ilan University filed several patent applications to protect the unique anti-bacterial fabric manufacturing process. In the **US, EU and in Israel** the patents are already granted and they are currently under examination in other strategic locations such as in Japan, China, South Africa and Australia.

Bar-Ilan University has granted NanoTextile exclusive global commercialization rights in exchange for a 3% royalty on sales of products that are based on the patented technology.

Status

With a very successful R&D phase completion, NanoTextile is currently raising capital to establish a manufacturing site and initiate sales & marketing.

Market Overview

Market Size and Potential

NanoTextile's primary target market is anti-bacterial textiles for fabric products in the healthcare setting, such as lab coats, scrubs, patient gowns, privacy/cubicle curtains, bed linens, towels, etc.

The antimicrobial textile market size was estimated at USD 497.4 million in 2015 and is projected to reach USD 1.1 billion by 2026, at a CAGR of 7.4% from 2016 to 2026. The medical segment (Surgical supplies, curtains, beddings, Upholstery items) accounts for the largest share and is expected to experience the fastest growth for the forecast period.[6] Other research study forecasts that the global antimicrobial medical textile market will reach USD 799.7 million by 2024.[7]

NanoTextile forecast that it's cost-effective, scalable and breakthrough anti-bacterial treatment will lead to a significant growth of the antimicrobial textiles market, as there is no viable solution other than Nano Textile's solution to this market today. Once Nano Textile's service (process) will become available, the projection is that antibacterial textile's to the Healthcare sector, and mainly to Hospitals, will become a norm. Today, no hospital in the world, to the best of Nano textile's knowledge, is implementing a full anti-bacterial textile purchasing policy as there is no viable solution available on the market.

With regards to the Total Accesable Market (TAM) of Nano Textile - The global medical textile market was valued at USD 13.94 billion in 2014. This market is typically segmented into implantable goods (stents, meshes, etc.); non-implantable goods (bandages, slings, etc.); healthcare & hygiene products (bedding, gowns, etc.); and others. The two segments most applicable to NanoTextile (non-implantable goods and healthcare & hygiene), together, accounted for over 55% of the market in 2014. In terms of raw materials, woven textiles (vs. non-woven) accounted for ~45% of the market.[8] Thus, **based on current market dynamics**, **NanoTextile's Total Accessible Market (TAM)**, within the medical textile market, can be calculated as follows:

USD 13.94 billion x 55% (for the relevant segments) = **USD 7.67 billion**
x 45% (for the relevant raw material) = **USD 3.45 billion***

*In end customer price

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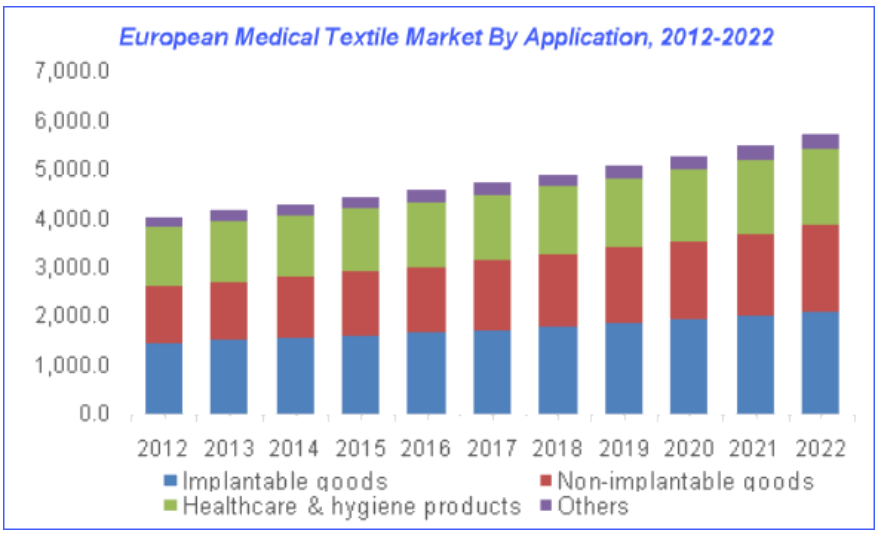
6 Antimicrobial Textiles Market, Markets and Markets, January 2017
7 Antimicrobial Medical Textiles Market Analysis to 2022, Grand View Research, September 2016
8 Medical Textiles Market Analysis to 2022, Grand View Research, May 2016

Market Dynamics and Trends

Europe accounted for ~30% of the medical textile market in 2014, with North America representing another 25%.



As shown in the graph to the right[9], the European medical textile market is expected to grow from USD 4.2 billion in 2014 to USD 5 billion in 2022, a robust increase of ~20%.

This growth rate is applicable to the medical textile market in general, with the key market growth drivers being: the constant struggle against healthcare-acquired infections (HAIs) in developed economies, exacerbated by the spread of antibiotic resistant bacteria; the rapid extension of advanced healthcare services in emerging APAC and Latin American economies; an aging population with high hospitalization rates and high HAI mortality rates.

Competitive Landscape

As seen below in the table, the Anti-bacterial textile industry is very competitive and contains a lot of players, with more players joining in each year. However, non of the below competitors have managed to develop a product which can be fully, massively utilized by the Healthcare industry, thus, they are mostly operating within the private textile sector. The table below shows the prominent players on the market today.

Brand	Location	Technology
DOW	USA	Chemical Binders
Sanitized	Switzerland	Chemical Binders
Microban	USA	Chemical Binders
Sciessent	USA	Chemical Binders
Milliken	USA	Chemical Binders
Noble Biomaterials	USA	Extrusion (polymer fiber)
Purthread	USA	Extrusion (polymer fiber)
Cupron	Israel	Extrusion (polymer fiber)

Please see "Drawbacks of Current Anti-Bacterial Solutions" chapter for the problems associated with the technologies used by the displayed companies above.

[9] Ibid

NanoTextile's Value Proposition

NanoTextile's roll-to-roll, cost-effective, versatile and durable anti-bacterial sono-chemical fabric treatment provides a strong value proposition to textile manufacturers and healthcare facilities alike:

Textile Manufacturers	Healthcare Facilities
• **Convenient**: Fabric rolls are shipped to NanoTextile's treatment center and the treated fabric is then forwarded to the desired destination. • **Versatile**: Works with virtually any woven fabric without changing the fabric's color or other physical properties. • **Cost-effective**: The incremental cost of NanoTextile's treatment is offset by the premium healthcare facilities are willing to pay for proven anti-bacterial protection.	• Highly effective anti-bacterial properties across a wide range of pathogens, including antibiotic resistant bacteria such as MRSA. • Durable anti-bacterial action, unaffected by harsh laundering conditions. • Only safe materials used, no chemical binders required • Anti-bacterial properties can be extended, cost-effectively, to the full range of fabric-based products typically found in the healthcare setting

Business Strategy

Business Model

NanoTextile's business model is of a service company, with the intention to built around the provision of anti-bacterial treatment services to textile manufacturers. Textile manufacturers will ship rolls of fabric to NanoTextile's treatment center/s and NanoTextile will ship the treated rolls of anti-bacterial fabric to any destination specified by the customer. All direct shipping costs will be covered by NanoTextile.

For this service NanoTextile intends to charge USD 1.00 per treated running meter. The direct treatment production cost taken into consideration in the Business Plan was very conservatively estimated at USD 0.30 per running meter (extensive calculations have shown a cost of USD 0.20 per running meter based on Israeli labor costs) and the direct shipping costs at USD 0.10 per running meter. Taking into consideration the 3% licensing royalty to be paid to Bar-Ilan University on gross sales revenues, the total COGS per meter is USD 0.43, leaving NanoTextile with a direct profit of USD 0.57 per meter.

The above direct profit calculation was done on a single operational machine with the process capacity of 3m running meters a year.

The direct production costs are forecasted to be greatly reduced when scaling up.

Market Penetration Strategy

NanoTextile is currently seeking funds to set up its first treatment center in Israel. NanoTextile's direct customers will be current medical textile manufacturers and textile manufacturers that wish to add medical textiles to their offering. NanoTextile will also work to create demand throughout the value chain for its anti-bacterial treatment, targeting manufacturers of products made from medical textile as well as the healthcare facilities that consume those products.

An order for the first Sono Reactor is expected to be placed in April 2017. It will take approximately 12 months to acquire, install and optimize the equipment, after which the Company will have the capacity to treat ~3 million linear meters of fabric (150 cm width) per year.

While the treatment center is being set up, business development, branding, and PR activities will be carried out in order to raise global awareness for the Company and to initiate contact with potential direct customers. It is expected that initial commercial purchase orders will already be in place as the treatment center comes on line in April 2018.

Expansion Strategy

NanoTextile will continue to increase its production capacity through the acquisition of additional IP protected Sono Reactor machines. The annual production capacity targets, in millions of meters, are:

By end of year:	2018	2019	2020	2021
Target:	3	24	72	144

Experienced sales, marketing and support managers will be put in place and the relevant personnel hired in order to address new geographic markets and additional target markets such as: the apparel industry in general and the undergarment segment in particular; bedding and towels for the hospitality industry; and anti-bacterial fabrics for mass transportation.

NOTE: Although NanoTextile's R&D department will be exploring additional functional properties that can be added to fabrics using its sono-chemical approach, the business strategy and cashflow presented in this Business Plan are based solely on the Company's proven anti-bacterial capabilities.

5-Year Cash flow

The following table summarizes the expected cashflow over five years, based on the business model and the market penetration and expansion strategies discussed above.

NANO Textile LTD.
Cash flow forecast
5 year plan
000's USD

		YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5
Revenues		**0**	**%**	**1,400**	**%**	**6,200**	**%**	**31,350**	**%**	**92,400**
YOY %						**343%**		**406%**		**195%**
Total direct costs		**0**	**43%**	**602**	**43%**	**2,666**	**43%**	**13,481**	**43%**	**39,732**
Direct profit		**0**	**57%**	**798**	**57%**	**3,534**	**57%**	**17,870**	**57%**	**52,668**
General & Administration		331	87%	1,221	27%	1,683	10%	3,203	5%	4,481
Sales & Marketing		289	22%	308	10%	602	3%	831	1%	1,231
R&D		216	20%	286	7%	424	2%	508	1%	523
Miscellaneous		185	30%	417	10%	614	3%	1,010	1%	1,355
Total Overhead		**1,021**	**159%**	**2,232**	**54%**	**3,323**	**18%**	**5,553**	**8%**	**7,590**
Operating (Loss) profit		**(1,021)**	-102%	**(1,434)**	3%	**211**	39%	**12,317**	49%	**45,078**
Investments funded by own capital	950									
Loan returns on investments		0	7%	100	7%	441	4%	1,162	1%	1,288
Cash flow	**(950)**	**(1,021)**	-110%	**(1,534)**	-4%	**(230)**	36%	**11,155**	47%	**43,790**
Accumulated	**(950)**	**(1,971)**		**(3,505)**		**(3,734)**		**7,421**		**51,211**

NOTES:

[1] Miscellaneous = 20% out of overhead expenses excluding depreciation

[2] Investment financing:

- The first machine ($850,000) and adjustment of the production site ($100,000) will be purchased with investment capital (cash).
- Subsequent machines cost will be reduced, and will be purchased via Spitzer-amortized bank loans at a conservatively estimated interest rate of prime + 3.1% with a 10 year duration.

The Investment Opportunity

Nano Textile has raised USD 2m from an APAC based strategic investor and is inviting additional financial investors to take up to 30% equity stake.

Nano Textile is currently evaluated at USD 6.7m (As of March 2017).

The key investment merits are:

- Experienced team across all key areas of activity: management, finances, sales & marketing, business development, R&D, production and operations.
- Proven, proprietary disruptive anti-bacterial technology based on extensive R&D by a consortium comprised of academic, industry and healthcare partners.
- Overcomes all the drawbacks of current anti-bacterial textile technologies in terms of scalability, cost-effectiveness, durability of effect, production versatility.
- Does not change the original appearance or other physical properties of the fabric.
- Hold worldwide, exclusive commercialization rights.
- Addresses multiple multi-billion-dollar anti-bacterial textile markets: medical, apparel, hospitality, transportation.
- A powerful sono-chemical platform that can be used to add other functional characteristics to fabrics such as water repellence, fire retarding, conductivity.

Side note: Nano Textile's sono-chemical process is applicable to any kind of substrate. Global Glass enterprises are now showing great interest in the application for Glass. This sector is not the focus of attention by Nano Textile and any progress in this segment will be done by granting usage rights to the global Glass enterprises and would not involve setting up a Glass treatment production site.