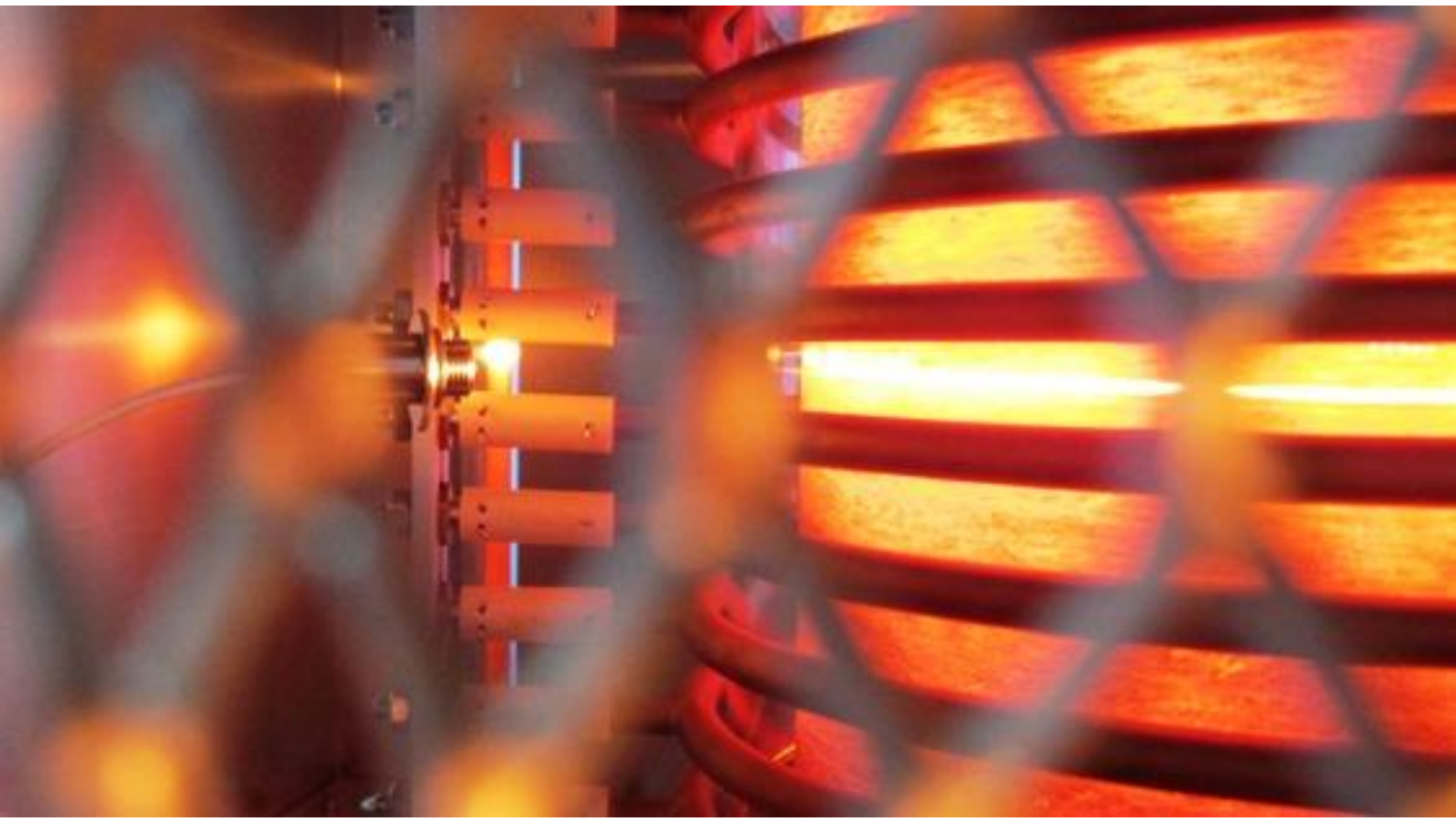

epiluvac

An excellent investment opportunity

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Executive summary

Epiluvac offers a great opportunity to invest in an exciting high-tech company in an emerging and quickly growing industry which is an important enabler for future clean and fossil-free energy and transportation systems. Epiluvac provides equipment for production of the new semiconductor materials replacing silicon in many game-changing electronic applications like electric vehicles and solar power. Silicon Carbide (SiC) and Gallium Nitride (GaN) are the main materials now rapidly being introduced to replace Silicon (Si) and Epiluvac offers equipment for both. To meet the increasing demand the company has developed a new generation of Chemical Vapor Deposition (CVD) systems for making epitaxial layers of SiC and GaN. Deliveries of the new CVD systems have just started.

Key investment highlights

Everything from a laptop charger to a renewable power plant or an electric vehicle requires conversion of electricity by power electronics based on semiconductor materials. Silicon (Si) has so far been the dominating semiconductor material, but it is generally predicted that new semiconductors like Silicon Carbide (SiC) and Gallium Nitride (GaN), both so called wide bandgap (WBG) semiconductors, will take over from Silicon due to their ability to enable lighter, smaller and more efficient power converter systems. A recently published example of products utilizing these new materials is the EV Tesla 3, which uses SiC transistors in its main converter. Others are solar power converters and laptop chargers. Each converter contains transistors and diodes which are made from layered structures grown on wafer substrates by so called epitaxial growth in equipment often referred to as reactor systems. Epiluvac makes reactor systems which are specifically designed for such epitaxial growth of WBG semiconductor material like SiC and GaN. The company also offers crystal growth furnaces for making the wafer substrate material itself.

Epiluvac presents a unique opportunity to invest in a highly qualified and experienced team with already a proven operation, sophisticated products and buying customers in a future-oriented industry which will reshape all our lives by new intelligent ways to control electrical power and energy.

More highlights

- Two product lines, CVD reactors and crystal growth furnaces, with unique features covering essential steps in the process for manufacturing of SiC and GaN semiconductor devices.
- The new CVD reactor platform is future-proof for next generation of 200 mm (8”) and larger wafer material and has the potential to become the next standard for epitaxial growth of high quality WBG semiconductor materials.
- The team is internationally well known in the SiC community for excellent designs.
- Strong technical competence and track record in its field.
- Existing revenue stream.
- Well positioned to take market shares.
- Only few steps left to profitability.
- Excellent growth potential with customers in the EU, North America, Japan, China, Korea and Taiwan.
- Attractive valuation.

Background of the offer

The company has so far been financed mainly by loans from ALMI and loans from the founders. Partial pre-payment, often 40%-50%, has been used to finance the major part of material needed to build the sold equipment. Hereby the company has so far managed its growth and maintained its liquidity. However, to fully utilize the large potential of the newly developed reactor platform the company is now seeking funding to enable the accelerated activities. These include:

- Intensified sales and marketing
- A demo reactor
- New patents
- Improved IT-infrastructure
- Secure the employee succession

Introduction to Epiluvac

Epiluvac AB, was founded 2014 in Lund, Sweden and develops and manufactures Chemical Vapor Deposition (CVD) reactors for manufacturing of epitaxial layers and Physical Vapor Transport reactors for bulk crystal growth of wide band-gap (WBG) materials such as Silicon Carbide (SiC) and Gallium Nitride (GaN). The Epiluvac team has delivered state-of-the-art CVD reactors since 1993 to more than 30 organizations all over the world. Also today targeted customers are industrial companies, universities and research institutes worldwide.

Epiluvac offers equipment which enables production of WBG semiconductor material with superior quality and yield, but still at a low cost of operation and ownership.

This is made possible by maintaining technical excellence in high temperature and vacuum systems and more specific Chemical Vapour Deposition (CVD) and Physical Vapour Transport (PVT) systems.

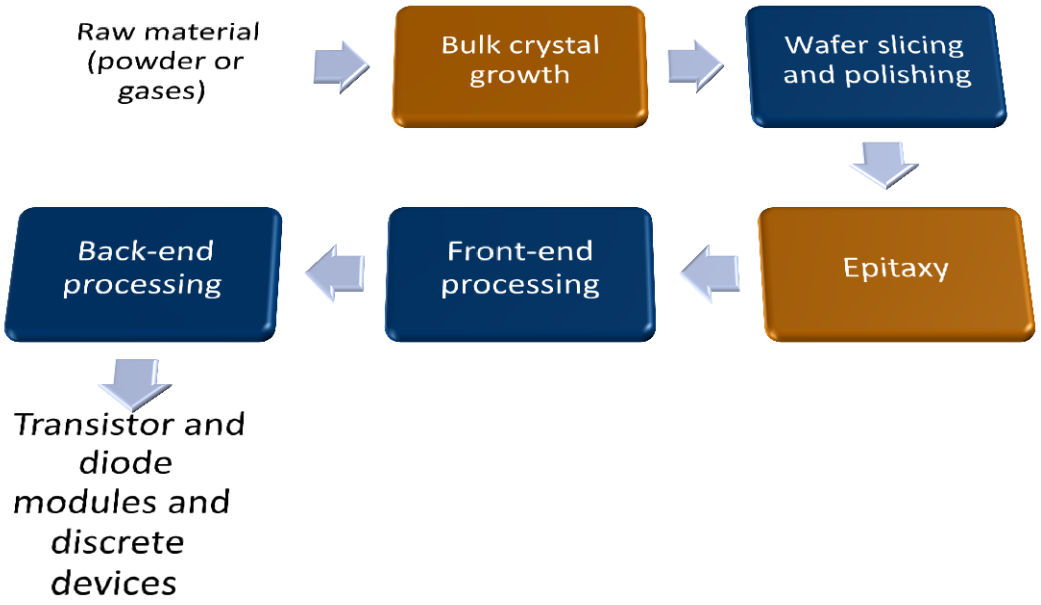

Fig 1. Typical manufacturing process for SiC and GaN semiconductor devices. Epiluvac offers equipment for Bulk crystal growth and Epitaxy.

Main product applications and their needs

The targeted applications relate to so called wide bandgap (WBG) semiconductor epitaxy and SiC bulk growth, mainly for R&D and small to medium scale production for power electronics and advanced optoelectronic applications like micro-LED's. Epiluvac does not target the general lighting LED device manufacturing dominated by multi-wafer MOCVD (Metal Organic Chemical Vapor Deposition) equipment for GaN-on-Sapphire deposition for blue LED's.

Target applications and their requirements:

Epitaxy of WBG semiconductors (GaN, SiC, AlN etc) ***for manufacturing of components for Power Electronics and advanced optoelectronics***:

- Uniformity (doping and thickness) and high quality epitaxial materials
- Flat wafers (Silicon Carbide or Silicon)
- No particles (formed in the gas phase)
- Accurate run repeatability
- High wafer throughput
- Large wafer size capability
- Flexibility for R&D and early production
- Low cost of operation and ownership
- Safety

SiC bulk growth for SiC wafer manufacturing.

- Low equipment cost is essential due to low capacity per system
- Stable temperature control
- State-of-the-art design
- Easy handling (loading/unloading)

Technology and products

Epiluvac's offering and its features and benefits:

Epitaxy: Hot-wall CVD single wafer reactors for process temperatures up to 1800 °C and wafer diameters up to 200 mm. Features for excellent wafer uniformity and flatness include multi-zone temperature fine tuning, wafer rotation and controlled pre-heating and post-cooling of wafers.

To meet requirements for high growth rates reactors are offered for processes based on chlorinated chemistry. High throughput is achieved by offering automation solutions for automatic hot-wafer loading and cassette handling as well as process-optimized geometries.

The recently introduced ER3 reactor platform holds all the above features as well as a new and innovative process chamber design which is free of quartz to avoid the silicon contamination in the grown layer which is a common challenge when growing for example GaN. It is also the first commercial reactor to offer 200 mm capability for SiC epitaxy.

In-situ measurement is provided as an optional feature together with a multi-zone heater to control chamber temperatures even more accurate.

The reactors have a small footprint vs warm-wall multi-wafer system offered by competitors.

Low cost of operation is achieved due to long lifetime of consumable parts and long run time between each cleaning/maintenance. The new ER3 reactor also offers in-situ cleaning for high repeatability and extended intervals for manual cleaning.

Epiluvac epitaxy reactors offer high flexibility and controllability (temperature, gas flow, process steps, run-to-run stability).

Single wafer reactors with automatic loading of the type Epiluvac is offering, have attained a lot of interest from the power market due to high uniformity and low cost of ownership. Some market players also consider single wafer reactors for cluster solutions.

Epiluvac CVD reactors of today are designed for R&D and demanding low/medium volume production but there are no major technical barriers preventing designs also for volume production. The fact that device manufacturers aim for larger and larger wafers fits well to how Epiluvac's brand new reactors are built and could well be a strong driver for sales of Epiluvac systems.

Bulk growth: Cost efficient PVT furnaces for parallel operation and smallest footprint. Epiluvac offers a proven modular solution open for customization.

CVD reactor for epitaxy

Graphite cell for epitaxy

Gas handling system for an epitaxy reactor.

Fig 2. Examples of Epiluvac reactors and parts

Patents

Epiluvac protects its innovations by patents and the company already has a few granted patents as listed below as well as additional pending applications. The company also has exclusive access to certain patented reactor technology developed by SweGaN AB (a spin-off from LiU) through separate agreements.

Patents assigned to Epiluvac AB:

- SE 541039 - CVD Reactor With A Multi-Zone Heated Process Chamber
- JP 6180439 - Silicon Carbide Crystal Growth in a CVD reactor using Chlorinated Chemistry
- US 10017877 - Silicon Carbide Crystal Growth in a CVD reactor using Chlorinated Chemistry
- SE 536605 - Odling av kiselkarbidkristall i en CVD-reaktor vid användning av klorineringskemi

Team

The founder team has a background from Epigress, the Swedish pioneer in SiC epitaxy by hot-wall CVD (became later a part of German Aixtron for some years) and carries decades of experience from research and development of such reactors. The team holds excellent competence in high temperature solutions, high vacuum and demanding gas systems.

Bo Hammarlund, Chairman and one of the founders has a background in epitaxy and also a broad network in the WBG community and long experience of start-ups and serial entrepreneurship. His first SiC related company, TranSiC, was sold to Fairchild Semiconductors, USA in 2011. Other of Bo's co-founded SiC related companies are SenSiC, Ascatron and SiCify.

In June 2018 the company appointed a new CEO, Per Zellman, with global business experience and background as CEO of Norstel AB, the Swedish SiC wafer manufacturer recently acquired to 55% by STMicroelectronics at a company valuation of $ 137.5 million. Per is also board director of Ascatron AB, a Swedish SiC semiconductor device company.

The board of directors

The board of directors consists of three of the founders; Bo Hammarlund (chairman), Roger Nilsson and Richard Spengler. Roger Nilsson is a serial entrepreneur in the semiconductor industry and was once a founder of the above mentioned Epigress company. Richard Spengler has a long background in industrial management and engineering at companies like Tetra Pak.

Partnerships

Linköping University (LiU) and its spin-off SweGaN AB are two important cooperation partners to Epiluvac. These partner teams are among the worldwide leaders in developing WBG materials of highest quality. Epiluvac's team of engineers have since mid-1990's provided customized reactor solutions to LiU and recently also to SweGaN, and is in return receiving advice and simulation services to optimize the reactor designs as well as WBG material feedback.

Apart from the above mentioned partners, Epiluvac also has cooperation projects with research institutes and leading companies worldwide.

Targeted Markets

Everything from a laptop charger to a renewable power plant or an electric vehicle requires conversion of electricity by power electronics based on semiconductor materials. Silicon has so far been the dominating semiconductor material, but it is generally predicted that new semiconductors like Silicon Carbide (SiC) and Gallium Nitride (GaN), both so called wide bandgap (WBG) semiconductors, will take over from Silicon due to their ability to enable lighter, smaller and more efficient power converter systems. SiC is considered as best suited for high power electronics with voltages of 1,200 to 20,000 V while GaN offers great benefits in high frequency applications for 20 GHz and higher for telecom and radar applications, but also for low power applications. The market for WBG epitaxy and SiC bulk growth is hereby largely driven by new emerging power, sensor and optical technologies and the main foreseen growth applications utilizing WBG semiconductors are:

- GaN and SiC power electronic devices
- 5G RF power devices
- Micro LEDs (next generation of ultra-high resolution TVs and VR goggles).
- 3D-LIDAR (sensing)

Fig 3. GaN & SiC Power Electronics Market Opportunities. Note that GaN-on-SiC means GaN epitaxy on SiC wafer etc (Source: Yole Développement)

Market size

In a recent report Gartner Dataquest (Market Share: Semiconductor Wafer Fab Equipment, Worldwide, April 2018) estimated the 2017 total MOCVD equipment market to USD 320 million. This figure also includes equipment for the general LED (blue-LED) market which today is not considered as an addressable market for Epiluvac. Based on public reports, competitor presentations and own research, Epiluvac therefore estimates that based on the present product range the total addressable market 2019 is 100 MUSD and will grow to 200 MUSD in 2022 with ~25% CAGR. For the longer term very few outlooks are available but a presentation 2018 by Veeco Instruments estimates the power MOCVD reactor market only to grow by 80 % CAGR to USD 500 million in 2022, mainly driven by automotive applications. Semiconductor manufacturing is very capital intense and typically a CVD

reactor means a multimillion dollar investment, so the market estimates are based on a rather limited number of reactors sold, typically a few hundred annually.

Geographic markets

The biggest geographical markets for semiconductor manufacturing equipment in general are South Korea, China and Taiwan followed by Japan and North America. Equipment for SiC and GaN semiconductors has though historically mainly been used in Japan, North America and Europe and only in recent years China, Taiwan and South Korea has entered this field in large scale. Presently China and Taiwan are considered to be the fastest growing market for products offered by Epiluvac.

Sales process

The reactor market is characterized by cautious technical evaluations and long lead times between first contact and order. Deliveries normally take place not earlier than 9-12 months after order and partly pre-payment is normal.

Epiluvac presently targets research institutes and universities as well as industrial R&D and small-scale manufacturing. By this approach a market share of 5-10% should be reachable within a few years. Long term the company aims to reach also higher volume industrial manufacturing. Sale is done directly from Sweden and through sales agents and distributors in Asia and North America. Marketing efforts are concentrated to conferences/exhibitions, press releases and advertising in semiconductor magazines and forums.

Fig 4. SiC device players (Source: HIS Markit 2019)

Fig 4. GaN device players (Source: HIS Markit 2019)

Competition

The market for WBG semiconductor reactors is led by a few large players in the USA (Veeco), Germany (Aixtron) and Japan (Taiyo Nippon Sanso) which all have their base in MOCVD reactors for GaN-LED manufacturing or conventional Silicon and have a broad portfolio of MOCVD reactors, primarily of cold-wall and warm-wall type. There are also some smaller competitors with a narrower approach than the former ones, for example Italian LPE which offers a hot-wall reactor of a type earlier made by Epiluvac, Japanese Tokyo Electron offering multi-wafer hot-wall reactors and NuFlare, Japan which offers a vertical type of CVD reactor. Only a few manufacturers offer reactors for Silicon Carbide due to its requirement for high process temperatures. Apart from Epiluvac these are Aixtron, LPE, NuFlare and Tokyo Electron. In general, the cost of operation is higher for competitor reactors compared to Epiluvac. Notable is that the LPE reactor is based on the pioneering designs made by the founders of Epiluvac back in the 1990's in the company Epigress.

Comparison:

- In hot-wall reactors (Epiluvac's design) there is no temperature gradient inside the volume for deposition of SiC or GaN. Quality, uniformity over the wafer and run-to-run stability can be optimized. Growth temperatures range from +1200 deg C for GaN to +1800 deg C for SiC. The hot-wall principle is mainly used for single wafer growth. Heat is normally generated by RF power, but can also be provided through resistive heating.

- With warm-wall reactors, usually for multi-wafer reactors, there is a great temperature difference over a short distance (50 mm). It is difficult to get high uniformity over the wafer and between runs. It is used a lot for today's GaN-LEDs where uniformity is not so important. Aixtron and Tokyo Electron are two of the leading vendors offering this type.

- Cold wall reactors – MOCVD (Metal Organic Chemical Vapor Deposition) only for low temperature operation such as max 1200 deg C for SiC on Si-wafers or GaN on SiC- or Si-wafers. Veeco is one of the vendors. Uniformity performance is questionable.

In bulk growth equipment for monocrystalline SiC there are only a few established competitors; PVA Tepla in Germany and GTAT in the US are two. Both offer similar functionality and performance as Epiluvac, but at a substantially higher price than Epiluvac since their machines are of old designs and not cost optimized. SiC growth furnaces based on PVT are used by all major manufacturers of SiC wafers, but the majority of furnaces used so far has been designed and built internally by the wafer manufacturers themselves. Also a number of Chinese vendors have emerged in recent years, offering low cost PVT equipment. Epiluvac though expects that with more players entering the SiC wafer market, there will be new opportunities to sell "off-the-shelf" solutions to save time for the wafer manufacturers in their ramping of capacity.

Strategy and Business model

The business of Epiluvac is primarily "CVD/MOCVD systems for wide bandgap (WBG) semiconductors." To gain market shares the company aims for the following strategy:

Offering

Epiluvac offers standard or customized reactors and related service and maintenance including on-site installation and repairs. The products and services provided by Epiluvac should provide the following in relation to competitors:

- High performance in terms of uniformity and yield.
- Low cost of operation and maintenance.
- Future-safe in terms of readiness for new chemistries and larger wafers.
- Customization options.

Sales channels and market approach

- Develop selected sales agents and distributors in the US, Japan, China, Taiwan and South Korea.
- Go for direct sales in Europe.
- Evaluate brand-label opportunities with major equipment suppliers without WBG epitaxy systems.
- The company considers it necessary to apply aggressive but still profitable pricing initially to get references. By its new technical solutions the company expects to later be able to increase its pricing as soon as more proofs of superiority is available.

Operations

Design and final assembly is done by Epiluvac with manufacturing of major parts being outsourced. This makes it easy for the company to ramp up capacity. A high level of outsourcing enables a profitable upscaling and flexible downscaling.

Financial plan

Results so far and present status

The previous financial year May 2017 to April 2018 ended with revenue of 11 MSEK and a zero net result. The current FY is expected to end with revenue in line with previous year, but with small negative result, see P&L table below.

Already today (April 2019) Epiluvac has a list of clients with a business potential of at least 100 MSEK over the coming years.

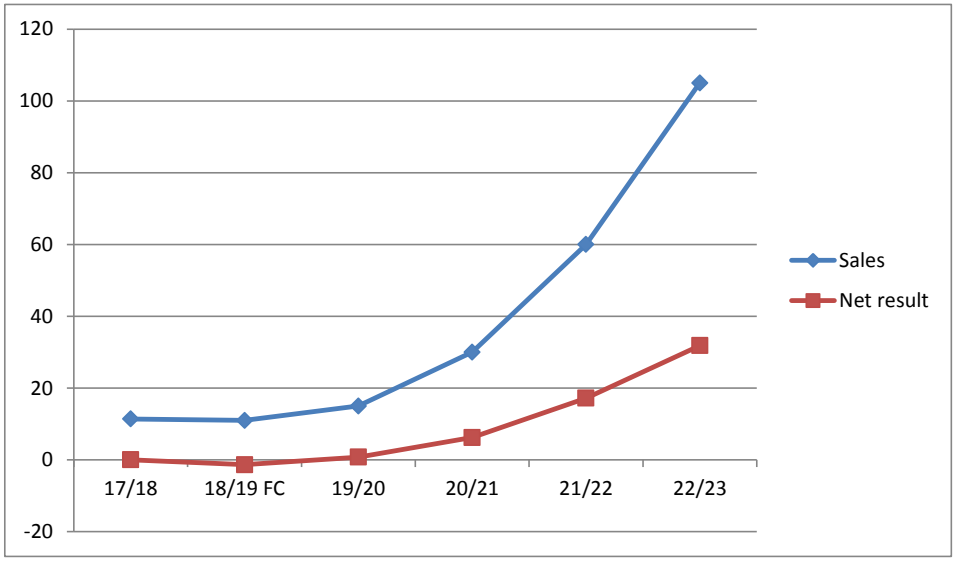

Fig 4. Sales and Net Result scenario

	17/18	18/19 FC	19/20	20/21	21/22	22/23
Number of systems sold	0,5	0,5	1	2	4	7
Sales	11	11	15	30	60	105
Material	-5,3	-5,7	-6,5	-12,9	-25,8	-45,2
Direct Labour	-1,6	-1,2	-1,6	-3,2	-6,3	-11,0
Gross profit	**4,5**	**4,1**	**7,0**	**14,0**	**27,9**	**48,8**
GM%	**40%**	**37%**	**47%**	**47%**	**47%**	**47%**
Fixed Labour (Admin, CEO, R&D, sales)	-2,5	-2,6	-3,1	-4,4	-5,8	-7,3
Facility	-0,8	-0,8	-0,9	-0,9	-2,0	-3,0
Sales & Marketing	-0,3	-0,3	-0,5	-0,7	-0,9	-1,3
Other fixed costs	-0,4	-0,6	-1,2	-1,2	-2,0	-3,0
EBITDA	**0,6**	**-0,2**	**1,4**	**6,9**	**17,2**	**34,2**
EBITDA %	**5%**	**-2%**	**9%**	**23%**	**29%**	**33%**
Depreciations	-0,4	-0,4	-0,6	-0,7	-0,8	-1,0
Financial costs	-0,1	-0,1	-0,2	-0,2	-0,4	-0,4
Net result	**0,0**	**-0,7**	**0,6**	**6,0**	**16,0**	**32,8**

Table 1. P&L scenario including actual FY17/18 and forecast FY18/19

Balance sheet	IB 2018-05-01	Change	OB 2019-03-31
Assets			
Non-current assets	3 270 657	590 421	3 861 078
Current assets	2 554 529	-265 461	2 289 068
Total assets	**5 825 186**	**324 959**	**6 150 146**
Equity and liabilities			
Equity	-667 494	-525 379	-1 192 873
Non-current liabilities	-1 630 287	-755 185	-2 385 473
Current liabilities	-3 527 405	955 605	-2 571 800
Total equity and liabilities	**-5 825 186**	**-324 959**	**-6 150 146**

Table 2. Financial position as of 31 March 2019 (Unaudited numbers)

Present shareholders and financing

100% of the shares of Epiluvac are owned by the nine founders, of which five are actively working in the company, and three external investors.

The company has so far been financed mainly by share capital, loans from ALMI and loans from the founders. Partial pre-payment, typically 40%-50%, has been used to finance the major part of material needed to build sold equipment. Hereby liquidity due to sales growth has so far not been an issue for the company.

Where to use the capital received

Since the recently introduced new CVD reactor platform is designed with future needs in mind, it is expected to form the backbone of the company for many years ahead. It has already been delivered in a first version, but even so the company foresees that extensions and new features will have to be developed to meet customer requests and competition moves and to fully utilize the potential of the platform. Hereby sufficient R&D resources and funding has to be secured.

As a small company Epiluvac also has several areas which have to be improved as soon as sufficient financial resources are in place. For example Epiluvac can today not offer a demonstration reactor, but has to rely on customer references and their goodwill. It would therefore be preferred to always have one reactor available, either in-house or by easy access to a reactor under our control at a university or research institute.

Other areas to address are as follows:

- IP-rights. Epiluvac, as a high-tech innovator needs to protect its innovations and designs by patents and with more innovations to come it is expected to apply for more patents in the coming years.
- Marketing. To better utilize the market opportunities it is required to intensify marketing activities through sales channel development, conference participation, social media, advertisement and customer interaction.

- IT-infrastructure. The company today has well functional, but limited IT resources. To manage the expected growth there will be needs for investments in IT. Examples are an improved ERP system and better CRM functionality.
- Personnel. Two to three new engineers will be needed the coming year to work with our team of senior engineers and long term take over key responsibilities today held by the founders. Additionally a dedicated own sales person will be needed within 1-2 years.

Future Exit

There are many potential buyers. Among equipment manufacturers there are several well-known companies which could have interest in accessing new leading CVD technology or just expanding their technical portfolio. Also producers of advanced material or devices with a strategy of vertical integration could be interested in investing in reactor technology. Examples of potential buyers could therefore be Aixtron, AMEC, Applied Materials, , ASM International, CVD Equipment, Kokusai Semiconductor Equipment, Lam Research, NuFlare Technology, PVA Tepla, Samco, Taiyo Nippon Sanso, SVCS, Tokyo Electron, Ulvac , Veeco Instruments and Wonik.

Appendix: Additional market information

The SiC and GaN device markets

The SiC market for switching transistors is going to take off around 2020 according to the market analyst Yole Developpement (www.Yole.fr). Yole predicts a $ 1.5 billion market in 2023, with a 31 % CAGR between 2017 and 2023. The main driving application is electric vehicles. A driveline with SiC-based devices is much better than one with Si-based electronics. A SiC-based driveline is smaller, lighter and has no need for separate radiator or separate cooling system.

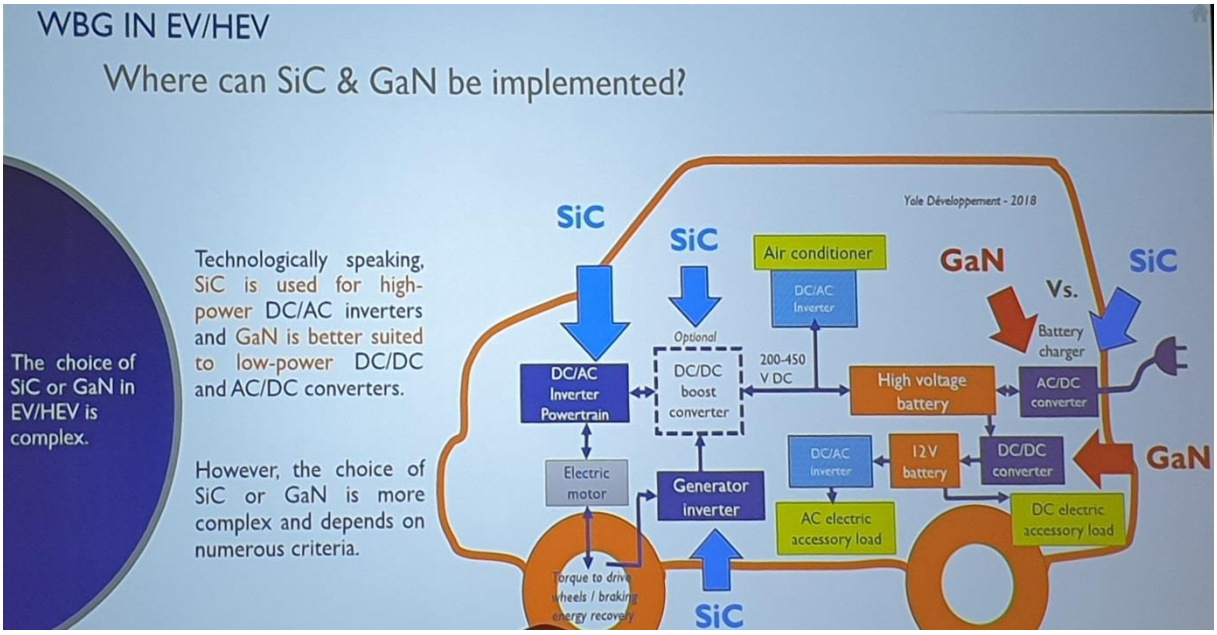

Fig A1. Source: Yole Développement, Power Electronics for Electric & Hybrid Vehicles 2018

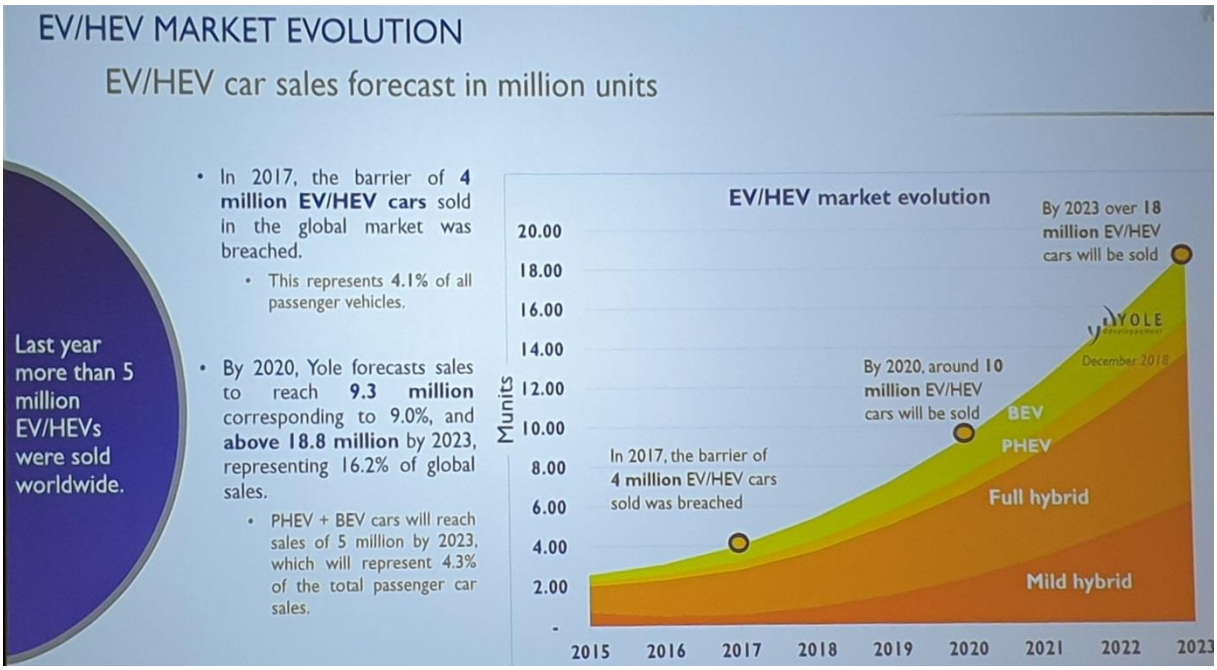

Fig A2. Source: Yole Développement, Power Electronics for Electric & Hybrid Vehicles 2018

Many of the new transistors are designed with a sophisticated topology to achieve the needed performance and hot-wall single wafer reactors are well suited and proven to grow such structures.

For medium voltage (3.5 – 15 kV) switching transistors now being developed, there is a need to grow a low-doped and dislocation free drift region with a thickness of 35 – 175 um. The hot-wall CVD reactor is capable of growing these thick layers.

These two examples show why hot-wall single-wafer reactors, as offered by Epiluvac, are needed in the future power electronic supply chain.

The GaN market: There is now intensive research to master the manufacturing of new power devices based on GaN on Si-wafers. In its recent report "Power GaN", Yole Développement forecasts a CAGR of 55% to 93% to a market of potentially 450 MUSD coming from various charging and power supply applications in automotive and telecom. The GaN power technology can also be applied in home appliances, air conditioners and other applications. A limitation is its voltage capability which normally is claimed to be in the range of maximum 600-1000 volts.

An emerging application for GaN is micro-LED's which could provide outstanding brightness and clarity in applications like displays, TV-sets and VR/AR goggles. In CES 2019 Samsung demonstrated a 75 inch TV with micro-LED's. See https://www.youtube.com/watch?v=x15L6bFygwY Micro-LED's are very small and the production hereby requires accurate and uniform semiconductor layers which makes the Epiluvac reactors suitable.

Another very important market is GaN for RF power devices for 5G wireless systems and high power radar systems where the technology offers lower weight, smaller dimensions, lower energy consumption or higher performance not possible with other materials.