



2018 Annual Impact Report

Pangaea Ventures Ltd.



“As a science-focused investor, there is tremendous leverage to deliver positive global impact as adoption of these technologies occurs.”

-Chris Erickson
Founder & General Partner, Pangaea Ventures

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Introduction

Pangaea is excited to share its first Annual Impact Report. For over eighteen years, Pangaea has been committed to investing in advanced materials innovations that make our world better. These innovations are responsible for delivering high impact solutions to important problems faced by the world, in fields ranging from energy and electronics to health and nutrition. Many of these issues are included in the seventeen United Nations Sustainable Development Goals, which formed the inspiration for the development of Pangaea's impact reporting framework.

Pangaea is unlike many traditional impact investors, who generally focus heavily on current environmental, social, and governance performance of portfolio companies. While Pangaea certainly considers these factors as part of its evaluations, it is convinced that the potential impact created by widespread commercial adoption by far exceeds the impact created by the current operating activities of these relatively small organizations. As a result, the Pangaea team has spent time to develop portfolio impact goals for the year 2025. Within this time period, many of Pangaea's portfolio companies or their acquirers will have achieved substantial penetration of these technologies into their respective markets. Of course, Pangaea will also report on current progress within the portfolio and is proud that several of its companies are already having a significant impact in the markets they serve.

The magnitude of the problems being solved by Pangaea's portfolio companies directly corresponds to the existence of very large market opportunities for attractive and scalable solutions. Ultimately, Pangaea sees the impact lens as a market opportunity lens. When its portfolio companies scale their solutions into global markets, Pangaea is confident that it will be well-positioned to deliver outstanding returns to its investors.

Pangaea's Impact lens

When Pangaea began to develop a framework for evaluating portfolio company impact, it looked to the United Nations' Sustainable Development Goals (SDGs) as a framework to help contextualize and prioritize the impact. Since the launch of the SDGs in 2015, they have become a standard framework that is used by organizations globally.



Pangaea's impacts on SDGs

Pangaea is convinced that advanced materials innovation has a strong ability to help meet these goals.

Initially, Pangaea began by mapping out the impact of its existing portfolio companies across the seventeen SDGs. With a portfolio of companies working in the area of energy, electronics, health, and sustainability, Pangaea identified ten of the seventeen goals where its current and future companies would have the greatest potential to deliver substantial impact.



Portfolio's Contribution to the Sustainable Development Goals

Pangaea then distilled this down to a handful of simple and quantifiable metrics that have relevance to the wide number of technologies and markets within its investment scope.

Most of the solutions provided by Pangaea's portfolio companies exist at intersections between several SDG goals. When aligning the goals together based on the companies' activities, four impact metrics can effectively capture a significant portion of the impact created by portfolio companies. As a result, Pangaea selected four key impact metrics: i.) CO₂ reduction, ii.) Lives impacted, iii.) Food production increased, and iv.) Freshwater produced or saved.

Strategic Alignment with UN SDGs



CO₂ Reduction: Pangaea's portfolio companies impact this metric by reducing carbon-based energy consumption, improving energy efficiency or lowering embodied energy.

Lives Impacted: Pangaea targets health innovation companies that can have a significant impact on patient outcomes while also reducing healthcare costs.

Food Production Increased: Companies with technologies that increase food production using existing resources to provide more food to a growing population, while helping to preserve vital ecosystems.

Fresh Water Produced or Saved: Technologies that reduce freshwater consumption or produce freshwater.

UN's Sustainable Development Goals (SDGs)



These four impact metrics allow Pangaea to quantify the impact potential across a wide range of technologies and markets. This is a useful tool to universally understand the impact potential of a wide range of technologies.

Fund-Wide Impact

9 SDGs being addressed by
Pangaea's portfolio

25 Strategic limited partners
connected to start-ups to
help them scale

71% of companies outside of
top 20 cities for VC funding

96 Increase in employees
at active portfolio
companies

47% of portfolio with females
in executive teams

Impact by company

CO₂ Reduction



Aeponyx has developed a high performance and low cost optical switching technology based on a unique planar MEMS and silicon nitride platform. The initial products being produced by the company are tunable transceivers and switches for the optical communications market including the network backbones supporting future 5G rollout. While there is a positive impact on energy consumption, this is small compared to the future impact of the company's technology if used for optical switching in data centers. Currently data centers consume 3% of global electricity and status quo could increase this by 10x by 2025 at current rates of data growth, primarily due to the switching function. However a migration to optical switching could reduce this component down by 10x, resulting in a meaningful potential reduction in energy.

For more information: www.aeponyx.com

CO₂ Reduction



One of the most effective methods of reducing fuel consumption and carbon dioxide emissions in the aerospace industry is to reduce the weight of the structure. This is made possible by the use of composite materials. In its impact estimate, Pangaea only considers the revenue generated by Airborne in the aerospace market, which far exceeds the impact in other sectors today. Airborne is the frontrunner in the automation and digitization of composite manufacturing processes to significantly achieve faster and more reliable product performance. By reducing the costs of production, future weight saving benefits may also be achieved by more cost sensitive markets such as automotive.

For more information: www.airborne.com

Lives Impacted



"Imagine the future where animals are no longer needed for the discovery of new therapeutics, where doctors know how a patient will react to a drug before prescribing it and where life-saving transplant organs are created, not harvested." These are the bold visions of Aspect Biosystems. Operating on the leading edge of 3D bio-printing and tissue engineering, Aspect Biosystems is driving a fundamental shift in life sciences through its development of a 3D bio-printing platform capable of creating living Human Tissues on Demand. These tissues are used for applications in therapeutic discovery and regenerative medicine.

For more information: www.aspectbiosystems.com

Food Production Increased & Fresh Water Saved

CALYSTA.

“Sustainable food sources from methane”

Consumers worldwide want plentiful and sustainable food. However, by 2050, the global population is expected to reach nine billion, with up to 70% more food required. Calysta utilizes industrial scale bacterial fermentation to convert methane into products such as protein. Calysta's *Future Fit Food* (high-value fish, livestock, and pet nutritional products) will improve global food sustainability and security. A 2016 report prepared by The Carbon Trust showed that Calysta's Feedkind™ protein resulted in lower CO₂ emissions than fish meal protein and 14x less water, combined with multiple order of magnitude of less land use than soy protein. Feedkind protein offers a significant advantage as land and water are becoming more scarce as pressure on the food supply increases.

For More Information: www.calysta.com

CO₂ Reduction



“Reducing Carbon Footprint of the Concrete Industry”

Concrete is the most widely used building material in the world and cement production is responsible for over 5% of global CO₂ emissions. For the concrete industry to adopt new technology, it must be simple and not require significant changes in existing processes. CarbonCure enables the production of a stronger concrete using their patented process of injecting CO₂ into the concrete mix. Customers are able to reduce the cement content in their mix, saving them money and also lowering the carbon footprint of the concrete that is produced. CarbonCure has licensed its technology to well over 100 concrete plants worldwide, a list that continues to grow rapidly.

For More Information: www.carboncure.com

CO₂ Reduction



“Carbon nanotubes for better batteries”

Lithium-ion batteries are the most prevalent energy storage technology used in electric vehicles, mobile power, and stationary storage. While they are a fundamental technology in achieving renewable solutions, lithium ion batteries have an environmental footprint of their own. Cnano technology improves the performance of lithium ion batteries without increasing the carbon or water footprint per unit of mass, leading to a net reduction in CO₂ and water intensity of the battery products. In 2017, Pangaea sold its position in Cnano after it had developed a dominant position in the marketplace.

For More Information: www.cnanotechnology.com



*“Flexible,
long-duration
storage via all-iron
flow batteries”*

CO₂ Reduction & Fresh Water Saved

Energy storage demand is growing significantly as the penetration of intermittent renewable energy from solar and wind continues to increase. ESS has commercialized high-efficiency iron-based flow batteries for low-cost, dependable storage of renewable energy. By enabling increased penetration of renewables, less electricity needs to be produced using thermal power generation, resulting in a significant reduction of CO₂ emissions and water usage.

For More Information: www.essinc.com



*“Point of Care
Imaging Powered by
Spatial Frequency
Domain Imaging”*

Lives Impacted

Modulim has developed an optical imaging technology to provide a non-invasive assessment of tissue health. The initial application for the technology is the detection of diabetic foot ulcers (DFUs). The diabetic population in the USA alone is 29 Million and 25% of diabetics will develop DFUs. Studies show that at least 75% of DFUs are preventable if at-risk patients are identified early and provided appropriate treatment. This can have huge positive impact on the patients' quality of life and a reduction in associated health care costs.

For More Information: www.modulim.com



*“Symbiotic bacteria
to improve plant
health and boost
crop yield”*

Food Production Increased & Fresh Water Saved

Feeding a growing population with sustainable agricultural solutions is one of the world's most difficult challenges. NewLeaf Symbiotics is shaping the future of agriculture by creating products that contain natural plant-associated bacteria to help fight plant disease and boost crop yield, allowing farmers to grow more with less. NewLeaf augments naturally occurring bacteria on plants with strains proven to have effects desirable to the farmers. Biologicals are one of the most critical and promising technologies needed to create a sustainable agricultural future. Increasing crop yield not only increases food production but also has tremendous leverage in terms of CO₂ emissions and water usage.

For More Information: www.newleafsym.com



“High resolution Cadmium Zinc Telluride (CZT) semiconductor radiation detectors”

Lives Impacted

Redlen Technologies has refined a difficult manufacturing process for producing a compound semiconductor used for radiation detection. The applications are CT and nuclear medical imaging. As the world's leading manufacturer of high-resolution cadmium zinc telluride (CZT) radiation detectors, Redlen enables a new generation of high-performing imaging equipment for applications such as nuclear cardiology and computed tomography (CT) imaging. Redlen is currently selling products in the cardiology market and is working with many of the world's leading CT imaging companies to bring next generation products to market.

For More Information: www.redlen.ca

CO₂ Reduction & Fresh Water Saved

In the next decade, photovoltaic solar energy is predicted to become the cheapest source of electricity in many parts of the world. The future of this renewable energy is made possible by the decreasing cost of photovoltaics. RSI has developed a technology to manufacture solar modules at lower cost than existing silicon and thin film technologies, while also lowering balance of system costs. RSI was acquired in 2014 and since that time, the acquirer continued to develop the technology; they are in the process of scaling production to the gigawatt scale. As production scales, the resulting solar energy production will lead to a significant reduction of CO₂ emissions and water usage.

For More Information: www.reelsolar.com

CO₂ Reduction

In 2017, transportation overtook power generation in terms of CO₂ emissions and became the largest CO₂ source. Of all auxiliary power requirements in a vehicle, air conditioning has the greatest impact on fuel consumption. SWITCH's active control smart film can reduce the need for energy-intensive air conditioning in vehicles by preventing the build-up of solar heat gain inside the vehicle cabin. By reducing the energy consumed for air conditioning, SWITCH's film can lower the overall vehicle greenhouse gas emissions, and extend the battery range of electric vehicles.

For More Information: www.switchmaterials.com



“Switchable photochromic-electrochromic technology”

CO₂ Reduction



“A New Dimension of Touch”

Tactus has developed a highly impact resistant clear polyurethane film. This breakthrough chemistry allows for the protection of the screens of electronic devices from cracking due to impact. Screen breakage has a meaningful impact on the replacement rate of these devices, all of which have a surprisingly high carbon footprint due to the high embodied energy within these devices. With the estimated increase in mean replacement period for these devices, Tactus will drive a reduction in carbon footprint in this industry.

For More Information: www.tactustechnology.com

CO₂ Reduction & Food Production Increased & Fresh Water Saved



“Peptides as the basis for better pesticides”

The use of toxic pesticides to manage insects is a critical aspect of agricultural production. The agriculture industry will continue to use toxic pesticides to control various pests and disease carriers until safer effective products become available. Vestaron has discovered a solution to replace synthetic pesticide use with insecticides based on the chemistry found in spider and other animal venoms. Vestaron’s bio pesticides can match, and in some cases beat, the performance of toxic synthetic chemical products that are widely used today. The impact Vestaron will have in the industry is far-reaching. While Pangaea does not consider the human health and ecological benefits of safer pesticides, the reduction of CO₂ emissions and fresh water usage enabled by producing more food on less land makes for significant impact.

For More Information: www.vestaron.com

Looking Forward - 2025 Goals

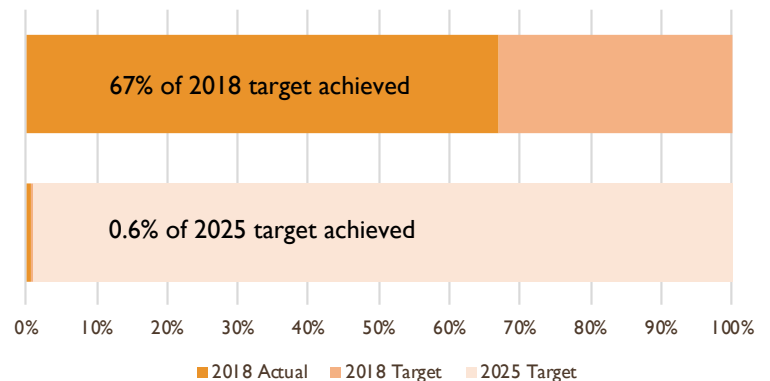


CO₂ Reduction

58M Tons Mitigated by 2025

= 12M passenger cars driven for 1 year

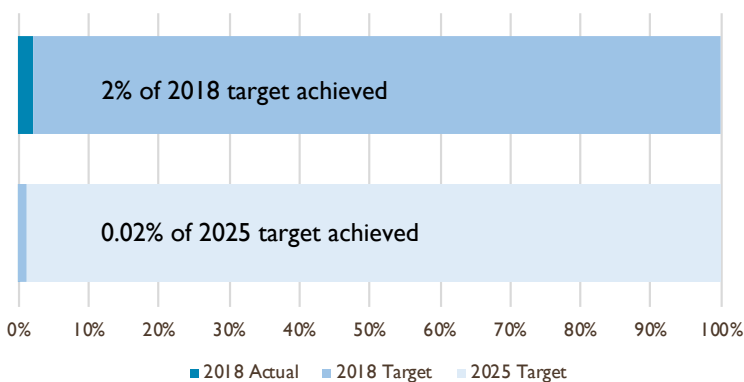
Pangaea's portfolio companies performed strongly in the area of CO₂ reduction, achieving 67% of their cumulative target at the end of 2018, with an estimated 368 kilotons of emissions mitigated. Strong revenue growth at Cnano was the primary contributor to the strong performance while CarbonCure and Airborne also had a meaningful impact. Looking forward to 2019, Pangaea is expecting numerous additional companies within the portfolio to begin meaningful scaling of revenue through 2019, thus increasing the number of companies contributing to CO₂ reduction in 2019.



Fresh Water Saved or Produced

39B m³ Saved or Produced by 2025

= 1 year's water for every household and business in Canada



Pangaea's portfolio companies in the energy and agriculture market drive the majority of the portfolio impact potential in terms of water. Estimated cumulative water savings at the end of 2018 reached 8 million m³, missing the target significantly due to delays in commercial ramps at several existing and past portfolio companies. However, Pangaea is seeing signs of more meaningful scaling of product revenue with several of these companies in 2019.

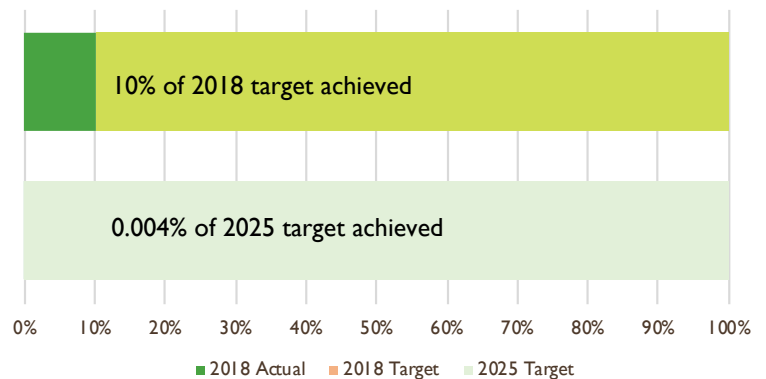


Food Production Increased

7.7M Tons Produced by 2025

= Enough food to feed 220,000 People for a Lifetime

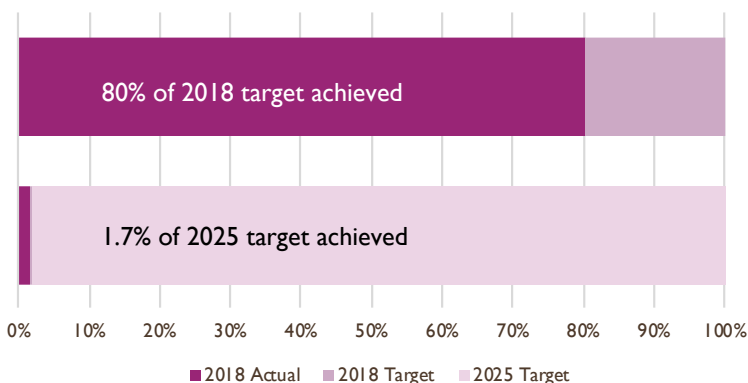
Pangaea's portfolio companies enabled an estimated 300 tons of food production in 2018. While short of the 2018 target, similar to Pangaea's expectations in the water category, there are signs that 2019 will see a product revenue ramp with at least one company that is a strong contributor to the portfolio in this category.



Lives Impacted

10.7M People Impacted by 2025

= Roughly the population of the Czech Republic



The estimated number of lives impacted was 80% of the cumulative 2018 target at 178,000 lives. This was driven primarily by strong performance at Redlen Technologies with their cardiology imaging product. As Modulim enters the market in 2019 with their imaging product for diabetic foot ulcers, Pangaea expects a substantial increase in lives impacted.

Appendix

Pangaea’s Approach

From initial discovery and through the due diligence process, Pangaea evaluates opportunity through an impact lens in order to gain insights into the magnitude of the problem being solved and the scalability of the solutions being developed. Pangaea’s deal analysis includes consideration of impact criteria that the technology must address in order to be approved for investment. In addition to typical investment considerations, impact assessment is used as an integral screening tool. The impact values are not meant to replace financial returns but to provide us with a holistic view of potential investment candidates.

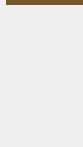


Pangaea’s Deal Evaluation Process

To quantify impact, Pangaea measures the outcome based on the respective impact indicator(s). For each company, impact drivers are identified, and Pangaea has developed an impact quantification model for each relevant impact indicator. An example of the impact drivers for ESS Inc. is described below. Pangaea has developed a target for cumulative impact by the end of of year 2025, and will track progress annually against target goals.



“Low cost energy storage for renewable integration”



Description: Low cost energy storage technology based on all-iron flow battery platform.

Potential Impact: For renewable energy to replace fossil fuel based energy, low-cost, long duration energy storage is needed to provide a consistent supply of energy to meet demand. The main impact driver of storage is reducing the negative impacts of traditional generation which includes significant CO₂ emissions and water usage for cooling.

Impact Indicators:

1. CO₂ Reduction
2. Water Produced or Saved

2025 Impact Model Assumptions:

1. Each kWh of storage replaces one kWh of fossil fuel produced electricity with one kWh of renewable electricity.
2. Each kWh of fossil fuel and renewable energy has an average CO₂ and water use footprint
3. Assume average mix of coal/natural gas and wind/solar.

