PROJECT OVERVIEW - HOW IT WORKS:

Subsea energy storage spheres

At the heart of the StEnSea system are hollow concrete spheres equipped with submersible pumps that are placed on the seabed at depths of 600 to 800 meters. These spheres act as both the energy storage units and the mechanisms for generating electricity. The ocean depth is crucial because the high pressure at these depths allows for efficient energy storage.

Storing energy: water removal during low demand

When electricity demand is low (e.g., at night or during periods of high renewable energy generation), the system stores energy by pumping water out of the spheres. Pleuger’s specially designed submersible pumps are used to empty the water from the spheres, a process that consumes electricity. This creates a vacuum inside the sphere, with the energy now stored as potential energy.

Step 1: The submersible pump, powered by surplus electricity from renewable sources like wind or solar, removes water from the sphere.

Step 2: As the water is pumped out, it creates a pressure difference, storing energy in the form of potential energy.

Energy release: Water inflow during peak demand

When electricity demand is high, the stored energy is released. To generate power, the system allows seawater to flow back into the spheres, utilising the pressure of the surrounding ocean. As the water rushes in, it turns the pump system into a turbine, converting the stored potential energy back into electricity.

Step 3: The water is allowed to flow back into the empty sphere under high ocean pressure.

Step 4: As the water flows in, it spins the turbines within the pump, converting the kinetic energy of the inflowing water into electricity.

Power Generation and Grid Supply

The electricity generated by the spinning turbines is then fed back into the power grid to meet demand during peak periods. This process mirrors how traditional pumped-storage hydropower works on land but adapts it to the subsea environment, making use of the high pressure found at great ocean depths.

Step 5: The electricity generated is transferred to the grid, supplying energy to homes, businesses, or even entire cities during periods of high demand.

#### Global Application Potential

The system is highly scalable and can be deployed in various subsea environments around the world, including offshore coastal regions and deep artificial lakes such as flooded open-pit mines. By utilizing existing ocean depth and pressure, the StEnSea system avoids many of the geographical and environmental constraints faced by traditional energy storage technologies like batteries and onshore hydropower.

* Locations: The technology is particularly suited to coastal regions with deep waters, such as Norway, Portugal, the U.S. East and West Coasts, Brazil, and Japan.

#### Key Advantages of the StEnSea System

* Environmental efficiency: The system takes advantage of natural ocean pressure, reducing the need for large-scale infrastructure and avoiding the use of critical materials needed in battery storage systems.
* Scalability: The modular nature of the hollow spheres allows for scalability, meaning the system can be adapted to various regions and different scales of energy storage needs.
* Long-duration storage: Unlike batteries, the StEnSea system is designed for long-duration energy storage, making it ideal for balancing grid supply over extended periods.

Company Profiles:

Pleuger Industries: Pioneers in Submersible Pumps and Renewable Energy Solutions

Pleuger Industries is a global leader in the design, manufacturing, and servicing of high-performance submersible pumps, motors, thrusters, and plunger pumps. With over a century of engineering excellence, Pleuger has earned a worldwide reputation for reliability and durability in industries such as energy, water management, and natural resource extraction. The company’s products are renowned for their ability to operate in some of the most demanding applications and harshest environments.

Founded a century ago, Pleuger Industries has become a trusted provider of mission-critical equipment for global mining and water management projects. Specializing in submersible pumps, Pleuger offers German-engineered, high-efficiency solutions that play a pivotal role in large-scale dewatering operations in mining, as well as in vital water supply, irrigation, and wastewater applications.

Headquartered in Miami, USA, with manufacturing facilities in Hamburg, Germany, and Orleans, France, along with a service center in Torrington, USA, Pleuger maintains a global presence to support its diverse customer base. Since becoming part of Flacks Group in 2018, the company has expanded its international reach while staying true to its heritage of quality, innovation, and customer-centric engineering.

From that time onwards, Pleuger Industries has embraced a forward-looking strategy with a strong focus on renewable energy. Anton Schneerson has significantly reduced the company’s reliance on traditional oil and gas markets and spearheaded Pleuger’s first renewable energy project. This marks a major turning point for the company, as it increasingly aligns itself with global trends toward sustainability and clean energy solutions. Part of the strategy is to further diversify Pleuger’s renewable energy portfolio, positioning the company as an emerging leader in the green energy space.

Pleuger’s high-efficiency submersible pumps and motors are increasingly being utilized in renewable energy projects, including geothermal and hydropower applications. This not only broadens Pleuger’s scope but also underscores its commitment to sustainability and environmental stewardship.

In summary, Pleuger Industries continues to lead the way in submersible pump technology while making significant strides in the renewable energy sector. With a century of expertise, world-class engineering capabilities, and a clear vision for a sustainable future, Pleuger is well-equipped to deliver innovative, reliable solutions to its clients around the world.

Sperra: Innovating Marine Renewable Energy with Advanced Construction Solutions

Sperra is a leader in developing cutting-edge infrastructure for renewable energy projects in marine environments. Based in Boulder, Colorado, with 3D printing facilities in Los Angeles and Rochester, New York, the company designs and manufactures advanced structural systems for offshore and aquatic renewable energy projects. Utilizing 3D concrete printing (3DCP), Sperra offers a unique approach that reduces both costs and carbon emissions by using locally sourced materials for clean energy infrastructure.

Sperra’s product portfolio includes specialized anchors for offshore wind and solar, fixed-bottom foundations, canal solar solutions, and subsea energy storage technologies. These innovative structures are designed to withstand harsh marine conditions while providing enhanced sustainability and durability. By leveraging a patented design process and automated construction techniques, Sperra ensures minimal material waste and a significant reduction in carbon emissions compared to traditional cement and steel-based systems.

One of the company's standout features is its ability to lower costs and embodied carbon emissions throughout the manufacturing, transportation, and installation phases. Furthermore, Sperra incorporates nature-inclusive designs to support marine biodiversity alongside clean energy projects.

As a forward-thinking company, Sperra is committed to delivering environmentally friendly, cost-effective solutions that promote the global transition to sustainable energy, all while enhancing the efficiency and viability of renewable energy systems in marine environments.

Fraunhofer IEE: Pioneering Research and Innovation in Energy Technology

The Fraunhofer Institute for Energy Economics and Energy System Technology (Fraunhofer IEE), based in Germany, is a leading applied research organization dedicated to advancing energy technology. It plays a crucial role in the innovation process by prioritizing research in key future technologies, focusing on enhancing efficiency, sustainability, and reliability in energy systems.

Fraunhofer IEE conducts cutting-edge research in areas such as renewable energy integration, energy storage systems, smart grids, and energy efficiency technologies. By developing innovative solutions, the institute aims to strengthen Germany's position as a global hub for industrial activity while benefiting society through sustainable energy practices.

A significant focus of Fraunhofer IEE is on integrating renewable energy sources into existing systems. The institute explores advanced methodologies to optimize energy generation from solar, wind, and biomass, ensuring that these technologies effectively meet future energy demands. Additionally, its research on energy storage solutions enhances the reliability of renewable energy systems.

Collaboration is key to Fraunhofer IEE’s mission. By partnering with industry stakeholders, policymakers, and academic institutions, the institute transfers research findings into practical applications, accelerating the commercialization of new technologies. This collaborative approach enhances the competitiveness of the energy sector both in Germany and internationally.

Fraunhofer IEE also engages in education and knowledge transfer initiatives, sharing its expertise with students, professionals, and the public. This commitment fosters awareness about energy technology advancements and encourages informed discussions on the future of energy.

In summary, the Fraunhofer Institute for Energy Economics and Energy System Technology is at the forefront of research and innovation in energy technology. By focusing on key future technologies and fostering collaboration, Fraunhofer IEE is actively contributing to the energy transition and shaping a sustainable energy future for society.

Biographies:

**Anton Schneerson**

CEO Pleuger 2023 - 2024

Anton became part of PLEUGER following its acquisition by Flacks Group in 2018, taking on a series of senior leadership roles. By 2022, he was named the Managing Director of PLEUGER Hamburg, and in January 2023, he was promoted to CEO of the Pleuger Group. Anton’s leadership strategy at PLEUGER Industries was characterized by a strategic yet hands-on approach, with a steadfast commitment to prioritizing customer satisfaction and maintaining the highest standards of quality as the cornerstone of the company’s success.

[**Sebastian Rose**](https://www.pleugerindustries.com/en/company/leadership/sebastian-rose)

[Head of Engineering at Pleuger](https://www.pleugerindustries.com/en/company/leadership/sebastian-rose)

Member of the PLEUGER team since 2006. Head of the technical department since the beginning of 2024, focusing on delivering high quality products through leadership and technical skills.

In his 18 years at Pleuger in Hamburg, Germany, Sebastian has held various positions in R&D and engineering. In particular, the implementation of complex projects with ever new and challenging tasks as well as motor and pump development are his focus.

As head of the engineering team at Pleuger headquarters, he takes care of global challenges in the field of submersibles, shipbuilding and special applications.

**Edris Faez**

Team Leader Engineering (R&D)

Edris Faez joined Pleuger Industries in 2017 and has led the Research and Development sub-department for five years. With strong leadership and technical expertise, he and his team drive innovation, consistently delivering high-quality, next-generation pumps and motors that align with evolving market demands.

**Dr. Ilva Bönicke**

Head of Quality, Safety, Health & Environment

After 15 years as project manager in the engineering department, since 2023 Dr. Ilva Bönicke drives Pleuger as the Head of Quality, Safety, Health & Environment forward.