RECOVER REUSE REGENERATE

WE SUPPORT



Sustainable Solutions Winner 2022



2024

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Sustainable Solutions Winner 2022

Asia) Pte Ltd

LowCarbonSG

WE DO WHAT WE DO TODAY BECAUSE WE BELIEVE IT'S BEST FOR THE ENVIRONMENT TOMORROW

You have the very first ESA's Magazine we named NEWGEN in your hands. Meet a company specializing in sustainable and innovative waste management solutions. The mission is our guiding principle: Giving Industrial Waste a second life.

In 2023, ESA has grown very rapidly, not only within the organization but also in the technological development of waste treatment and regeneration technology. Smart solutions and an eye for detail made us grow from a waste treatment supplier to a sustainable solution supplier.

ESA's approach to waste management transcends the conventional 3Rsreduce, reuse, and recycle—by incorporating additional strategies to maximize sustainability and minimize environmental impact.

Rethink: ESA is committed to helping you find effective solutions for managing the end-of-life stage of materials, ensuring they are given a second life. Our goal is to consistently discover innovative ways to extend the usability of these materials.

Reuse: We integrate these materials into our own circular production systems. This reduces the need for virgin resources and promotes a closed-loop economy, conserving natural resources and minimizing waste.

Recover: ESA is focused on transforming waste into valuable products. Through advanced recovery techniques, we extract and repurpose materials that would otherwise be discarded. This not only reduces the need for new mining but preserve natural resources, turning potential waste into a valuable asset.

Regenerate: Our cutting-edge processes allow us to convert various types of waste into sustainable materials. By giving waste a second life, we prevent it from ending up in landfills and contribute to the creation of new, high-quality products.

Through these strategies, ESA not only manages waste more effectively but also turns it into an asset, supporting a more sustainable and circular economy. Join us in rethinking waste management for a better future.

> Quek Leng Chuang CEO



RETHINK. RECOVER. REUSE. REGENERATE. INDUSTRIAL WASTE.

NASDAQ: ESGL

DRIVEN BY NET ZERO CAPACITY



HERE TO STAY: NET ZERO WASTE MANAGEMENT

One of Singapore's Largest Sustainable Chemical Waste Management Facility

How we make a difference



We make Circular Products from your Chemical Wastes



We treat your Chemical Wastes making them safe for the environment



We are a Net Zero Energy Facility <image>

In 2024, we now have 24,000 Tons NET ZERO Annual Capacity to treat your chemical wastes and to manufacture circular products, using only Solar Energy harnessed from our facility.

"24,000 Tons NET ZERO Annual Capacity"

Our HDPE Reactors utilizes advanced physical and chemical methods to neutralize and synthesise hazardous industrial liquid waste, converting them into circular products. Designed for durability and corrosion resistance, it offers precise control, scalability, and safety features, ensuring effective sustainable waste management.

BEING AT THE FOREFRONT OF INNOVATION IS AN R&D COMMITMENT

>>> INNOVATING WITH THE BEST

ESA thrives on innovation. By being at the forefront of new technology, we continue to improve and contribute to a more sustainable world. We do almost everything from our own facilities, and there are also collaborations with various startups, universities and knowledge institutes. Together we develop the tools for the future.



stainable carbon nanotubes

THE FUTURE OF WASTE PLASTICS MANAGEMENT

"We're thrilled to partner with ESGL in a joint development agreement. Together, we aim to leverage our technology strengths for sustainable plastic waste recycling, contributing to a circular economy in Singapore and the broader ASEAN region. " Dr. Andrei Veksha, Co-Founder and Director of Nanomatics

CARBON NANOTUBES REVOLUTION

NEWNANO are multi-walled carbon nanotubes regenerated from waste plastics by Nanomatics and Environmental Solutions Asia. It is an alternative to fossil-derived carbon canotubes, used in advanced materials engineering.

These innovative nanotubes offer a sustainable and eco-friendly solution, addressing both waste management and the need for highperformance materials. By transforming discarded plastics into valuable resources, NEWNANO not only reduces environmental pollution but also contributes to the circular economy.

SUSTAINABLE BUILDING MATERIALS: WITH REGENERATED CALCIUM FLOURIDE

>>> THE GOAL? A CLOSED CIRCULAR LOOP

Up until now, sludge from semiconductor plants has been disposed of in landfills, putting strain on Singapore's limited offshore landfill at Pulau Semakau. Our objective was to develop a method to transform this sludge into materials suitable for construction and road applications.

After extensive research and experimentation, we discovered an innovative process By treating the sludge with a combination of heat and chemical additives, we were able to stabilize its composition, reducing harmful contaminants and enhancing its structural properties.

10 MILLION SUSTAINABLE BRICKS ANNUALLY

"SCP's collaborative R&D efforts with ESA over the past few months have been instrumental in exploring the potential of NEWSPAR as an alternative material in brick manufacturing" Mr. Tan Kuang Yoa, CEO of Sentosa Clay Products Sdn Bhd.

>>>> THE NEWSPAR OUTCOME

ESA NEWSPAR is a circular product made from waste sludges, produced with renewable energy for sustainability. It reduces strain on Pulau Semakau, offers a green alternative in construction, and cuts carbon emissions.

Future plans involve scaling production and collaborating with construction firms to use this recycled material in projects, promoting environmental friendliness and resource transformation. This initiative reflects Singapore's dedication to sustainability and innovation, setting a benchmark for other industries.

circular newspar

MINING AVOIDANCE THROUGH METALS Recovery: Advanced Synthesis

>>> CAN WE PLAY A PART IN REDUCING ENVIRONMENTAL DAMAGE?

As we developed a recovery system to extract metals from waste solutions, we pondered the crucial question. Traditional mining methods are resource-intensive, impacting the environment and displacing communities. By focusing on recovering metals from used metallic solutions, we aim to reduce the need for additional mining. For every ton of metals we recover, we prevent 90 tons of mining activity.

This innovative approach not only conserves natural resources but also mitigates the detrimental effects traditional mining has on ecosystems and human habitats. Our technology relies on advanced chemical processes and state-of-the-art filtration systems to ensure the highest purity and efficiency in metal recovery. Furthermore, by collaborating with industries that produce metal-rich waste solutions, we create a sustainable loop that benefits all stakeholders involved.

The implications of this method extend beyond environmental conservation. Economically, it offers a cost-effective alternative to mining, reducing expenses associated with extraction, transportation, and waste management. Socially, it represents a commitment to ethical practices by minimizing the disruption of local communities and preserving natural landscapes.

As we continue to refine our methods, we envision a future where the demand for virgin mining diminishes, replaced by a thriving market for recycled metals. This paradigm shift not only supports the circular economy but also aligns with global efforts to combat climate change and promote sustainable development. By investing in such innovative technologies, we take significant strides toward a greener, more equitable world.

FOR EVERY TON OF METALS WE RECOVER, WE AVOID 90 TONS OF MINING ACTIVITY.







RECOVER.

THE SUSTAINABLE PRACTICE OF RECYCLING Industrial Acids: Myth or reality



In today's rapidly evolving industrial landscape, sustainability isn't just an option—it's a necessity. At Environmental Solutions Asia, we're leading the charge in transforming industrial practices through innovative acid recycling solutions. Our cutting-edge technologies help industries manage waste efficiently and significantly reduce their carbon footprints.

The Carbon Footprint of Fresh Acid Production

The production of industrial acids like sulfuric acid, hydrochloric acid, and hydrofluoric acid is energy-intensive and contributes heavily to global carbon emissions:

- **Sulfuric Acid**: Producing 1 ton emits up to 1 ton of CO₂.
- Hydrochloric Acid: Producing 1 ton releases about 0.3 tons of CO₂.
 Hydrofluoric Acid: Producing 1 ton results in approximately 1 ton of CO₂ emissions.



The Benefits of Acid Recycling

At Environmental Solutions Asia, we're redefining sustainability with our acid recycling processes:

Sulfuric Acid Recycling: Cuts emissions to 0.3 tons of CO_2 per ton, saving up to 0.8 tons of CO_2 per ton.

Hydrochloric Acid Reclamation: Reduces emissions to 0.15 tons of CO_2 per ton, saving up to 0.15 tons of CO_2 per ton.

Hydrofluoric Acid Recycling: Reduces emissions to 0.5 tons of CO_2 per ton, saving up to 0.5 tons of CO_2 per ton.

Making a Monumental Impact

With a capacity to recycle up to 24,000 tons of industrial acids annually, we achieve substantial carbon savings: Sulfuric Acid: Up to 19,200 tons of CO₂ reduced per year. Hydrochloric Acid: Up to 3,600 tons of CO₂ saved annually. Hydrofluoric Acid: Up to 12,000 tons of CO₂ reduced per year.

That's a total reduction of up to 34,800 tons of CO₂ equivalent annually!

WITH A CAPACITY TO RECYCLE UP TO 24,000 TONS OF INDUSTRIAL ACIDS ANNUALLY, WE HELP ACHIEVE A TOTAL REDUCTION OF UP TO 34,800 TONS OF CO₂ EQUIVALENT ANNUALLY!



INVESTING IN OUR FUTURE

ALLIANCE

TO END

PLASTIC WASTE

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YOUTH LEADING THE CHARGE IN PLASTICS RECYCLING

>>> THE QUESTION: HOW TO DRIVE CHANGE?

In our quest to accelerate plastics recycling, we asked ourselves a pivotal question: how can we influence the most influential group of people to drive this change? The answer lay in empowering the youth, who have the unique ability to create a ripple effect and influence a generation of stubborn non-recyclers to adopt sustainable habits.

In collaboration with the Alliance to End Plastic Waste, we embarked on an ambitious one year program targeting schools. This initiative aimed to foster positive recycling habits and significantly boost recycling rates. Through this program, we engineered a group of super youth recyclers, equipping them to lead and own a series of plastics recycling campaigns. These young leaders not only influenced their peers but also set an example for the broader community.



>>> BUILDING LONG-LASTING IMPACT

The results have been remarkable. Our program reached 44 primary and secondary schools, impacting over 25,000 students. Together, they collected more than 7,000 kg of recyclable plastic waste. Our efforts extended beyond the classroom, as we visited schools to deliver engaging sustainability talks and hosted students at our advanced plastics waste recycling facility. These experiences were designed to leave a lasting impression, inspiring students to become champions of plastics recycling in Singapore.

We are proud to witness the enthusiasm and commitment of these young recyclers. Their actions today are shaping a greener tomorrow, and we are confident that they will continue to lead the charge in promoting sustainable practices.

Our goal is to make youth the heroes of tomorrow, and with initiatives like this, we are well on our way to achieving it.



October 2024 N EWGEN SUPPLEMENT FLUORIDE SEQUESTRATION



CIRCULAR ECONOMY REVOLUTION: TURNING FLUORIDE WASTE INTO SUSTAINABLE SOLUTIONS





What if waste from semiconductor plants could be recycled into sustainable materials? ESA is at the forefront of this transformation, using solar-powered and bio-mass technology to recycle fluoride waste and repurpose it into eco-friendly minerals for construction. This forwardthinking process not only reduces carbon emissions but also fuels a circular economy, where waste becomes a resource. Explore how ESA is driving innovation for a cleaner, greener tomorrow.

CALCIUM FLUORIDE'S HIDDEN IMPACT

REIMAGINED

Calcium fluoride may seem like an unassuming mineral, but it's crucial in many industries, from aluminum production to refrigerants. Unfortunately, traditional mining of Calcium fluoride carries significant environmental costs, including both high carbon emissions and the release of harmful fluoride into ecosystems. The mining process consumes vast energy, destroys ecosystems and fluoride end of life often ends up in landfills, potentially harming the environment.



DISCLAIMER

THE INFORMATION IN THIS ARTICLE IS BASED ON DATA PROVIDED BY ESA AND INDUSTRY REPORTS. WHILE EVERY EFFORT HAS BEEN MADE TO ENSURE ACCURACY, ACTUAL FIGURES FOR CARBON OFFSETS AND FLUORIDE SEQUESTRATION MAY VARY DUE TO PROCESS EFFICIENCY, TRANSPORTATION LOGISTICS, AND ENVIRONMENTAL FACTORS. THIS ARTICLE IS FOR INFORMATIONAL PURPOSES AND SHOULD NOT BE CONSIDERED A DEFINITIVE ENVIRONMENTAL ASSESSMENT. ESA ASSUMES NO LIABILITY FOR ANNY DISCREPANCIES OR OMISSIONS IN THE INFORMATION PROVIDED.

IT'S ALL ABOUT CARBON FOOTPRINT

>>> TRADITIONAL MINING'S EXCESSIVE CARBON FOOTPRINT



Mining operations typically generate high emissions due to the energy needed for extraction, processing, and transportation. According to a World Resources Institute (WRI) report, mining activities account for approximately 300 kg CO2 per ton of fluorspar extracted.

- **Extraction**: Mining Calcium fluoride involves heavy machinery and explosives, contributing approximately 150 kg of CO2 per ton of fluorspar extracted.
- **Processing**: Crushing and refining further adds about 75 kg of CO2 per ton.
- **Transportation**: Moving Calcium fluoride from mines to processing facilities racks up another 75 kg of CO2 per ton.

(*Source: World Resources Institute on Mining Emissions*)

ESA'S GAME-Changing Fluoride Waste Recycling



RECYCLED FLUORIDE (NEWSPAR) IS MORE CARBON EFFICIENT

Collection (Equivalent to Mining Extraction): ESA's collection process results in 30 kg CO2 per ton, compared to mining's 150 kg CO2 per ton.

Processing: ESA's processes produce 70.83 kg CO2 per ton, compared to mining's 75 kg CO2 per ton.

Transportation: With optimized transport routes, ESA's recycled fluorspar generates 12 kg CO2 per ton, far less than the 75 kg CO2 per ton in traditional mining.

Renewable Solar Offset: ESA's renewable energy efforts contribute a 16.75 kg CO2 per ton offset.

Recycling fluoride wastes significantly reduces the emissions compared to traditional mining. By implementing solar energy offsets, ESA has reduced emissions to a total of 96.08 kg CO2 per ton. This is an impressive reduction compared to the 300 kg CO2 per ton for mining

SEQUESTERING RECYCLED FLUORIDE (NEWSPAR) IN BUILDING MATERIALS

ESA's approach doesn't stop with carbon reduction. Through partnerships, NEWSPAR is repurposed into building materials such as bricks and road construction aggregates. Here, it safely sequesters fluoride, preventing the potential harm it could cause in landfills. Fluoride sequestration in durable products ensures that it remains locked away in a way that poses minimal environmental risk.



WHY ESA'S APPROACH IS A GAME-CHANGER

ESA's fluorspar recycling initiative hits multiple sustainability goals head-on:

- Drastically Reduced Emissions
- Fluoride Sequestration
- Supporting the Circular Economy

Referencing the principles of a circular economy, where waste is reduced and resources are continually reused. According to the Ellen MacArthur Foundation, circular economy strategies can reduce carbon emissions by up to 45% globally. ESA's approach to recycling industrial waste, reducing emissions, and producing valuable construction materials perfectly aligns with this vision of sustainability.



November 2024 NEWGEN SUPPLEMENT <</pre> SUPPLEMENT <</pre>



CIRCULAR ECONOMY REVOLUTION: IS REGENERATING THE KEY TO UNLOCKING SULFURIC ACID'S POTENTIAL FOR CARBON REDUCTION?

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Sulfuric acid, one of the most widely used chemicals in the world, is integral to producing fertilizers, refining metals, and many other industrial processes. But producing sulfuric acid through traditional means carries a substantial environmental cost, emitting significant carbon dioxide  $(CO_2)$  into the atmosphere. By reclaiming and regenerating used sulfuric acid instead of creating it from scratch, industries can dramatically cut emissions. So, can regenerating sulfuric acid truly unlock meaningful carbon savings?

#### CARBON FOOTPRINT OF TRADITIONAL SULFURIC ACID PRODUCTION

REIMAGINED

Sulfuric acid production, typically via the Contact Process, begins with the combustion of sulfur to form sulfur dioxide  $(SO_2)$ , followed by further chemical reactions to create sulfur trioxide  $(SO_3)$  and, eventually, sulfuric acid. This process is not only energy-intensive but also releases substantial  $CO_2$ . For every ton of new sulfuric acid produced, an estimated 1.5–2.0 tons of  $CO_2$  are emitted, depending on the source of energy used in production. Given that millions of tons of sulfuric acid are produced globally each year, the environmental impact is staggering, contributing to the carbon footprints of sectors worldwide.



DISCLAIMER: THE DATA AND INSIGHTS PRESENTED IN THIS ARTICLE ARE BASED ON INDUSTRY STUDIES AND APPROXIMATE VALUES. RESULTS MAY VARY DEPENDING ON SPECIFIC PROCESSES, EQUIPMENT, AND ENERGY SOURCES. READERS ARE ENCOURAGED TO CONSULT WITH INDUSTRY EXPERTS AND CONDUCT THEIR OWN ASSESSMENTS TO DETERMINE THE IMPACT OF SULFURIC ACID REGENERATION WITHIN THEIR OPERATIONS.

## **REGENERATING SULFURIC ACID CAN OFFSET CARBON EMISSIONS**>> TRADITIONAL MANUFACTURING'S EXCESSIVE CARBON FOOTPRINT



Sulfuric acid regeneration involves reclaiming spent sulfuric acid, purifying it, and restoring its concentration, all without the need for raw sulfur or high-temperature sulfur combustion. According to data from the International Sulphuric Acid Association (ISAA), regenerating sulfuric acid can reduce emissions by up to 50 - 70% per ton (ISAA, 2023). This means that regenerating 10,000 tons of sulfuric acid instead of producing it from scratch could prevent the release of approximately 15,000 tons of  $CO_2$  annually. For perspective, this reduction is equivalent to removing 3,000 passenger vehicles from the road or offsetting the energy consumption of over 1,500 homes each year (EPA, 2023).

#### WHY WE CHOOSE TO REGENERATE SUFURIC ACID?

REGENERATING 10,000 TONS OF SULFURIC ACID INSTEAD OF PRODUCING IT FROM SCRATCH COULD PREVENT THE RELEASE OF APPROXIMATELY 15,000 TONS OF CO<sub>2</sub> ANNUALLY. THAT'S LIKE REMOVING 3,000 PASSENGER VEHICLES FROM THE ROAD

#### >>> ESA'S ROLE IN REGENERATING SULFURIC ACID

At Environmental Solutions Asia (ESA), we are committed to implementing sustainable solutions that help reduce industrial carbon footprints. As part of this mission, ESA has developed advanced capabilities in sulfuric acid regeneration. By leveraging our proprietary technology and expertise, ESA's regeneration process enables us to significantly reduce emissions while producing high-quality regenerated sulfuric acid for industrial use. With ESA's commitment to green practices, we not only help industries recycle sulfuric acid but also support them in achieving their carbon reduction goals and sustainability targets.

As industries seek meaningful ways to achieve carbon neutrality, regenerating sulfuric acid offers a promising solution. Reducing emissions by up to 70% compared to conventional production, sulfuric acid regeneration stands out as a high-impact strategy that lowers carbon footprints and aligns with sustainable, circular practices. This will help industries make a tangible difference in their emissions profiles and pave the way for a greener, more sustainable future.

#### SUPPORTING A CIRCULAR ECONOMY WITH SULFURIC ACID REGENERATION

Sulfuric acid regeneration aligns with the principles of a circular economy, where resources are kept in use as long as possible. Regenerating sulfuric acid not only keeps this vital resource circulating within the industry but also reduces the need for fresh production, keeping emissions low. Companies adopting regeneration practices are better positioned to meet increasingly stringent sustainability targets, reinforcing their role as environmentally responsible leaders (<u>Circular</u> <u>Economy Institute, 2023</u>). For industries with large carbon reduction goals, sulfuric acid regeneration provides a measurable and impactful path forward.

## REDUCED RESOURCE EXTRACTION AND LOWER ENERGY DEMANDS

Beyond direct carbon savings, sulfuric acid regeneration reduces the need for sulfur mining and extraction, which are themselves carbon-intensive. Mining and transporting raw sulfur compounds release additional CO<sub>2</sub>, so regeneration amplifies its environmental impact by minimizing these activities (<u>UNEP</u>, 2023). Moreover, regeneration generally requires less energy as it avoids the initial combustion process, making it a less resource-demanding solution.



RECOVER.

**REGNERATE**.

RESUE.

## Sustainability REPORT 2023



**CARBON** TRANSPARENCY

ESA is now part of the LowCarbonSG capability-building programme enabling local businesses in Singapore to monitor and, where possible, reduce their carbon emissions. Helmed by Carbon Pricing Leadership Coalition (CPLC) Singapore, the decarbonization arm of the UN Global Compact Network Singapore (GCNS), the LowCarbonSG programme is supported by the National Environment Agency (NEA), and Enterprise Singapore (ESG).







**SOLAR POWER GENERATION** 

3M



**LITRES FOSSIL FUEL DIVESTED** 

5.4M



#### REDUCTION **OF GREENHOUSE**

In 2023, we successfully doubled our 4R capacity from 24,000 tons to 48,000 tons per annum, marking a significant milestone in our sustainability strategy. Our increased capacity not only enables us to serve the industry but also fosters innovation and development





Sustainable Solutions Winner 2022

## Sustainable Circular Products We Make from your WASTE in 2024







# ESG DECARBONISED SO YOU CAN DECARBONISE

#### RETHINK | RECOVER | REUSE | REGENERATE **NASDAQ: ESGL**







**REGULATORY LICENSES: NEA HAZARDOUS SUBSTANCES** NEA TOXIC INDUSTRIAL WASTE FACILITY **NEA GENERAL WASTE COLLECTOR NEA GENERAL WASTE FACILITY** 

**ENVIRONMENTAL SOLUTIONS (ASIA) PTE LTD UEN199902448E** 101, TUAS SOUTH AVENUE 2, SINGAPORE 637226

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