

Expanded Graphite for Oil Adsorption

IN  VARTIC
INVESTMENT

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About Inovartic Investment

Inovartic Investment is a technology-driven innovation company based in Abu Dhabi, United Arab Emirates, dedicated to pioneering advancements across key sectors such as advanced materials, intellectual property (IP) commercialization, artificial intelligence (AI), and cybersecurity.

With a strong commitment to research and development, the company focuses on creating cutting-edge solutions that drive progress, sustainability, and economic growth.

By fostering innovation and collaboration, Inovartic investment aims to contribute to global technological progress and support the UAE's vision for a diversified and competitive economy.

Oil spills destroy habitats, contaminate soil and water, and harm wildlife.

The 2010 Deepwater Horizon disaster, for example, released 4.9 million barrels of oil, crippling marine life and local economies.

Clean-up is costly, and industries like fishing and tourism suffer long-term damage.

Problem Statement

Oil is essential in modern life—from the cooking oil we use daily to the crude oil powering industries, fueling vehicles, and producing plastics. However, its critical role also makes oil spills a major environmental and economic threat. Spills from tankers, pipelines, drilling accidents, and illegal dumping have devastating impacts on ecosystems, economies, and communities.

Oil spills destroy habitats, contaminate soil and water, and harm wildlife. The 2010 Deepwater Horizon disaster, for example, released 4.9 million barrels of oil, crippling marine life and local economies. Clean-up is costly, and industries like fishing and tourism suffer long-term damage.

Current spill response methods, such as booms, skimmers, and dispersants, have limitations. Innovative oil absorbent materials offer a more efficient, eco-friendly solution to contain spills and reduce environmental harm. Investing in these technologies is critical to mitigating the lasting impact of oil spills in our petroleum-dependent world.

CHAPTER 01 - INTRODUCTION

Solution

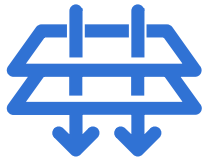
The potential of
expanded graphite as an
oil adsorbent material

Expanded Graphite (EG)

A Game-Changer for Oil Spill Clean-Up

Expanded graphite (EG) is an ultra-light, porous, and hydrophobic material, making it highly effective for oil spill clean-up. It selectively adsorbs oil while repelling water, ideal for marine environments.

Key Takeaways



High Absorption

EG can absorb multiple times its weight in oil, outperforming many commercial absorbents.



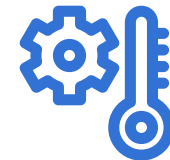
Hydrophobic & Reusable

Selectively adsorbs oil, can be reused multiple times, reducing waste and cost.



Environmentally Friendly

Made from natural graphite, non-toxic, and recyclable.



Thermally Stable

Performs well even in extreme temperatures, unlike synthetic alternatives.

EG's combination of efficiency, sustainability, and reusability makes it a standout solution for oil spill remediation, with the potential to revolutionize spill response efforts globally.



The Abu Dhabi Department of Economic Development (ADDED) is the government agency responsible for driving economic growth and diversification in Abu Dhabi. ADDED plays a key role in regulating business activities, fostering investment, and developing strategic economic initiatives to enhance the emirate's competitiveness.



Sri Lanka Institute of Nanotechnology (SLINTEC) is a leading research and development organization in Sri Lanka, specializing in nanotechnology and advanced materials science.

SLINTEC focuses on innovation-driven research to support industries like agriculture, energy, healthcare, and manufacturing. The institute is known for its work in developing cutting-edge solutions, such as nanomaterials, graphene technologies, and advanced packaging.



Abu Dhabi University (ADU) is a leading institution of higher education in the UAE, offering a wide range of undergraduate and postgraduate programs across various disciplines.

With a focus on academic excellence, innovation, and student success, ADU fosters a dynamic learning environment to prepare graduates for global challenges.



Al Masaood Energy, headquartered in Abu Dhabi, provides energy solutions across the oil, gas, and renewable energy sectors. It offers equipment, engineering support, and project management, partnering with global manufacturers to support the region's energy infrastructure and sustainability goals.

Trusted by some of the industry's major names, Al Masaood Energy has successfully worked with leading clients such as ADNOC, ENOC, ARAMCO, and TotalEnergies.



دائرة التنمية الاقتصادية
DEPARTMENT OF ECONOMIC DEVELOPMENT

JULY 24



The strategic collaboration marks a significant step towards enhancing advanced material manufacturing in the region and beyond. Image Courtesy: ADDED

INVESTMENT

ADDED supports Inovartic Investment to accelerate advanced manufacturing

To establish a facility in Abu Dhabi that will produce graphene and graphene-supported products



Abu Dhabi University Launches Graphene Center to Advance Innovation Capabilities

On the sidelines of ADIPEC 2024, Abu Dhabi University (ADU) in partnership with Inovartic Investment and Sri Lanka Institute of Nanotechnology (SLINTEC) are proud to announce the launch of ADU's first Graphene Center, a dedicated facility to enhancing research and innovation in graphene technology.



NOVEMBER 24

Inovartic and Al Masaood Energy Unveil Groundbreaking Oil Absorption Technology during ADIPEC 2024

With the support of Abu Dhabi University's (ADU) Graphene Center and the Sri Lanka Institute of Nanotechnology (SLINTEC), Inovartic Investment and Al Masaood Energy announced the commercialization of their pioneering oil absorption technology during ADIPEC 2024. This expanded graphite-based solution offers sustainable oil spill management, marking a significant advancement in environmental technology.



NOVEMBER 24



Inovartic Investment and Slintec sign landmark technology transfer acquisition agreement

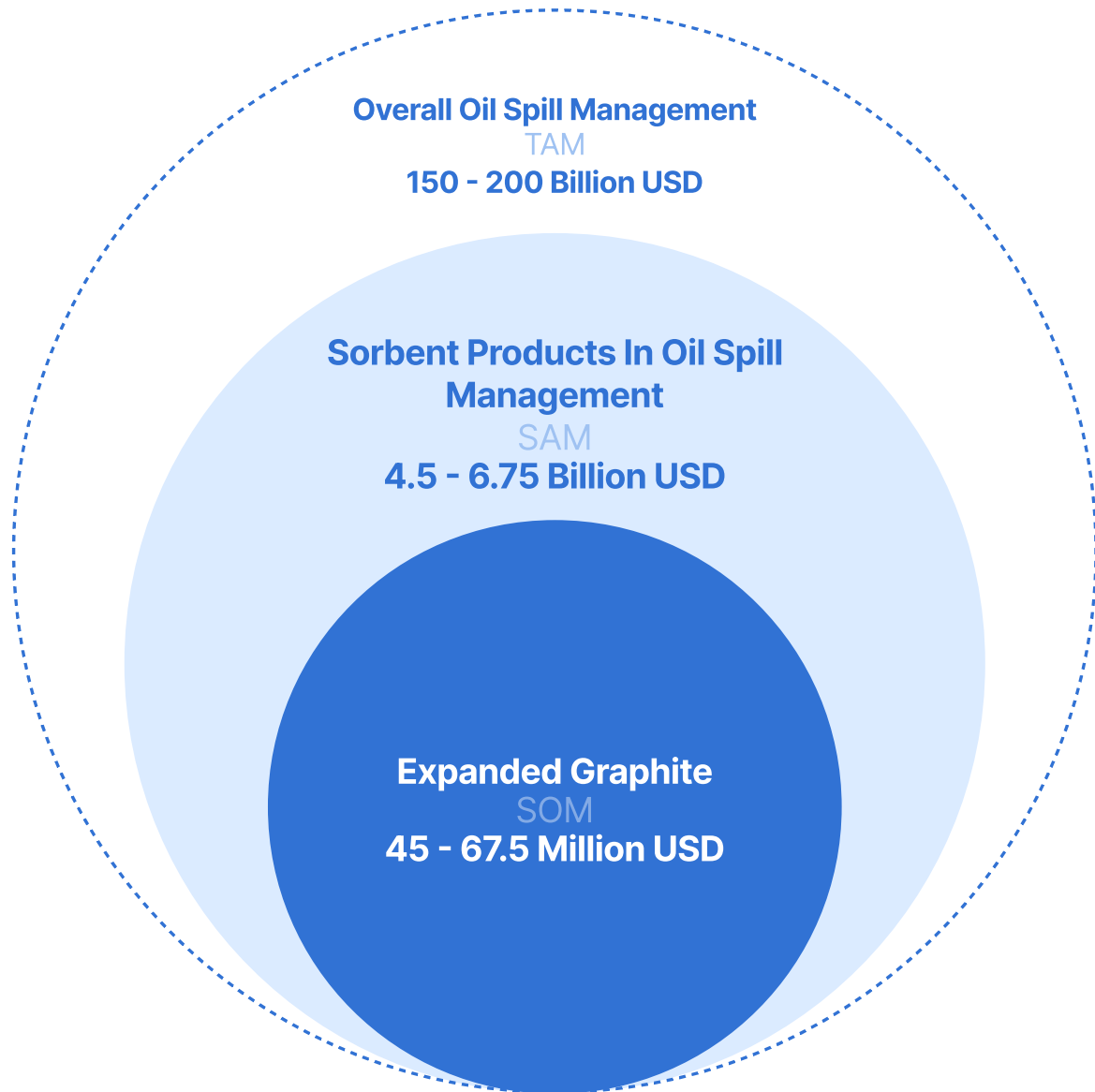
Inovartic Investment and the Sri Lanka Institute of Nano Technology (SLINTEC) have officially signed a groundbreaking technology transfer acquisition agreement in the presence of stakeholders and an official delegate from the Abu Dhabi Department of Economic Development (ADDED) to bring graphite-based oil adsorption technology to the global market. This strategic collaboration underscores the partners' shared commitment to sustainability, innovation, and the advancement of cutting-edge solutions for environmental challenges.



CHAPTER 03

Market Segmentation

TAM = Total Addressable Market
SAM = Serviceable Available Market
SOM = Serviceable Obtainable Market



Graphite In Sri Lanka

Sri Lankan Vein Graphite: A Unique & High-Value Resource

Sri Lanka's vein graphite, also known as lump graphite, is one of the purest forms of natural graphite, with carbon content often exceeding 90-95%. It is globally renowned for its quality, surpassing graphite produced in most other countries, which primarily mine lower-grade flake or amorphous graphite. Sri Lanka is the only country in the world that produces commercial quantities of vein graphite.

Historical Significance

Sri Lanka has mined graphite for over 200 years, making it one of the oldest graphite producers globally. Its high-quality vein graphite was essential in the industrial revolution and remains crucial for advanced technologies today.

Mining Locations

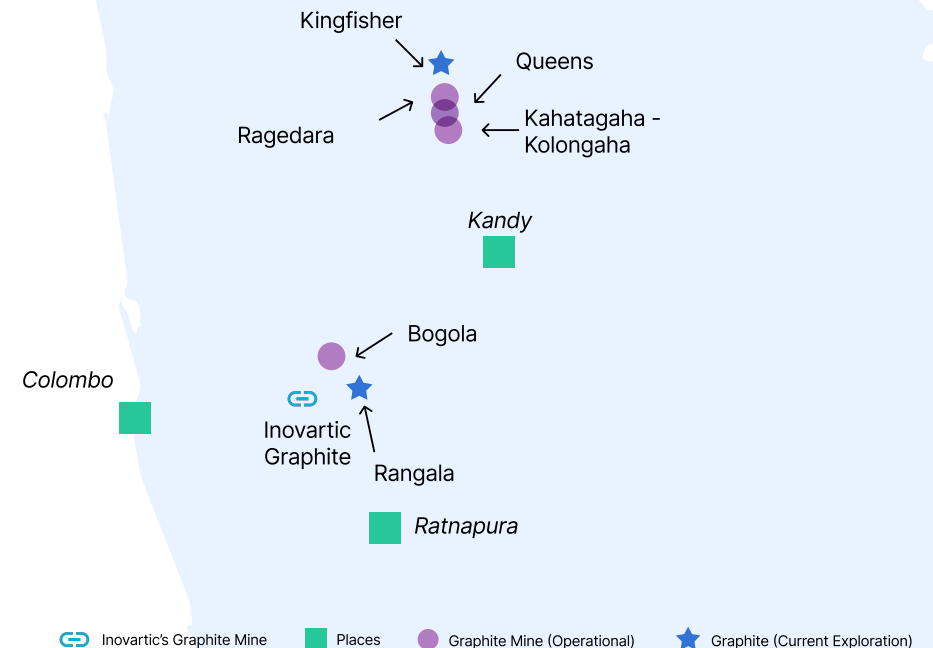
Bogala, Kahatagaha, Ragedara

Global Comparison

Sri Lanka's vein graphite is higher in purity and conductivity compared to flake graphite from China, Brazil, and Canada, which often requires more processing.

Strategic Importance

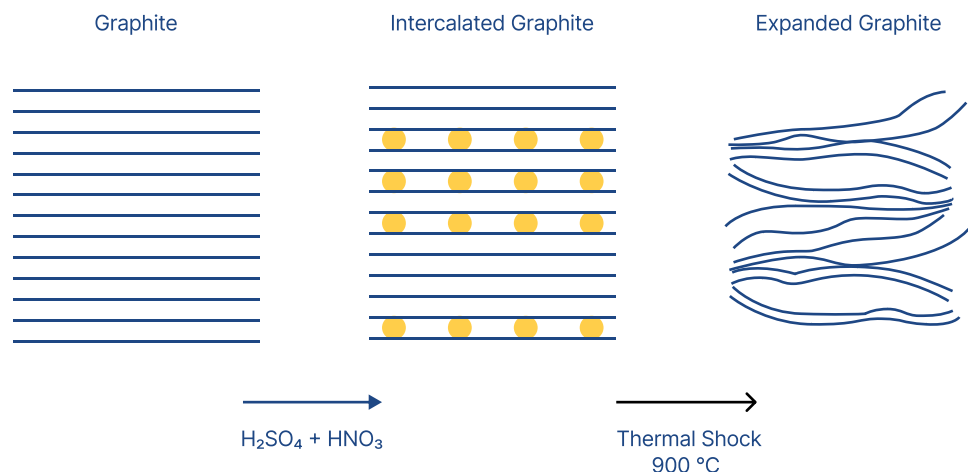
Rising demand for EV batteries and renewable energy technologies increases the global significance of Sri Lanka's graphite supply.



Expanded Graphite Technology

A Versatile Material for High-Impact Applications

The structural changes in graphite during heat exposure is schematically represented in Figure 2 below.



Expanded graphite, derived from natural graphite, is lightweight, porous, and offers excellent thermal stability, conductivity, and adsorptive properties.

It is produced through various methods, including chemical, electrochemical, and thermal expansion.

Key Properties

- High thermal and electrical conductivity
- Lightweight and highly adsorptive
- Chemically inert and corrosion-resistant

Applications

Energy Storage

Lithium-ion batteries, supercapacitors

Environmental

Oil spill clean-up, wastewater treatment

Thermal Management

Heat dissipation in electronics, fireproofing materials

Composites

Enhancing mechanical and thermal properties

Continuous innovation in production methods is unlocking new potential for expanded graphite across industries.

Oil Adsorption & Reusability of Expanded Graphite

Expanded graphite demonstrates strong oil adsorption capacities for diesel, engine oil, and burnt engine oil. It was tested over four reuse cycles using dichloromethane for oil extraction and regeneration.

Solvent Choice

Dichloromethane, a non-polar and volatile solvent, was used to recover oil from expanded graphite, enabling its reuse.

Reusability

Oil adsorption capacity decreased with each cycle, but expanded graphite remained effective across multiple uses.

Other volatile non-polar solvents can also be used for oil recovery, offering flexibility in reusability strategies.

Oil Adsorption & Reusability of Expanded Graphite

Adsorbent	Cycle	Diesel Oil Adsorbency Ratio (g/g)	Engine Oil Adsorbency Ratio (g/g)	Burnt Engine Oil Adsorbency Ratio (g/g)
Expanded Graphite	1	24.01 ($\pm$ 0.92)	42.60 ($\pm$ 1.41)	26.07 ($\pm$ 2.01)
	2	12.04 ($\pm$ 0.46)	28.20 ($\pm$ 0.91)	18.24 ($\pm$ 2.30)
	3	11.15 ($\pm$ 1.13)	19.82 ($\pm$ 1.13)	14.04 ($\pm$ 0.09)
	4	10.17 ($\pm$ 0.56)	9.80 ($\pm$ 1.53)	13.03 ($\pm$ 0.33)

Packaging Expanded Graphite for Optimal Oil Adsorption

To enhance oil absorption, we package expanded graphite using hydrophobic, permeable materials. Currently, non-woven polypropylene is the preferred choice due to its excellent oil retention and permeability.

Material Considerations

PVC & PTFE

Both considered for packaging, though polypropylene remains superior in permeability and cost-efficiency for current applications.

Non-Woven Polypropylene

Effective at absorbing and containing oil while allowing permeability.

By optimizing packaging with advanced materials, we can further improve the effectiveness of expanded graphite in oil spill remediation.

Polypropylene vs EG

Polypropylene is a material that is often used to absorb oil spills and other liquids because of its chemical resistance, durability, and mechanical stability. However, Polypropylene causes severe environmental impacts.

Polypropylene (PP) has a significant environmental impact due to its production, disposal, and use:

Disposal



PP is not biodegradable and can take 20–30 years to break down in landfills. As it breaks down, it can release toxic chemicals into the environment, contaminating soil and groundwater.

Marine pollution



PP is a common form of marine debris and can harm marine life. Animals can ingest PP, which can cause blockages in their digestive systems and ultimately lead to death.

Recycling



PP recycling rates are low due to inadequate recycling infrastructure and public awareness.

Burning



If burned, PP can discharge toxins and vinyl chloride, posing a severe environmental threat.

Current Commercially Available Oil Adsorbent Material

Oil absorbents play a critical role in mitigating the environmental and economic damage caused by oil spills. Designed with oleophilic and hydrophobic properties, they absorb and contain oil, preventing further spread and aiding clean-up efforts.

Natural Absorbents

(e.g., straw, sawdust, peat moss, coconut husk)

Eco-friendly, cost-effective, but less efficient for large spills.

Synthetic Absorbents

(e.g., polypropylene, polyurethane)

Superior absorption, widely used, but non-biodegradable and environmentally challenging to dispose of.

Hybrid Solutions

(e.g., graphene-based, aerogels)

High absorption capacity, reusable, but expensive and not yet widely adopted.

Advanced Materials

Combine natural and synthetic components for improved efficiency and sustainability.

Ongoing innovation is vital to developing more effective, sustainable solutions for oil spill response.

Other Expanded Graphite Applications

Lithium ion battery electrodes

Sodium and aluminium battery electrodes

Conductive inks

Fire retardant coatings

Expanded graphite (EG) has the potential to be environmentally friendly due to its ability to absorb large amounts of oil without causing serious pollution:

Oil Absorption

EG's porous structure and oleophilic nature allow it to absorb and retain large amounts of oil relative to its own weight. It can quickly draw in oil upon contact, minimizing the spread of the spill and reducing further contamination.

Biodegradable

EG is biodegradable and naturally degrades over time.

Recyclable

EG can be recycled, which promotes sustainability & reduces waste.

Inhibits fire hazard

EG can inhibit the fire hazard of dust layers by generating compact char layers with low thermal conductivity.

CHAPTER 06

Commercialization & Production Timeline

2024

November

Launch of Abu Dhabi
University Graphene Centre

2025

April

Expanded Graphite Processing
Facility setup in Abu Dhabi

May

Trial Run & Final POC Testing

July

Market-Ready for Launch

Proof Of Concept Phase

Capex Costing (From Europe)	125,000 USD
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Opex Costing (For 6 months @ \$50k per month)	300,000 USD
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To meet the following expenses

- Raw materials
- Travel, salary and local accommodation for technical staff for 6 months)

Total Estimated Expenses	425,000 USD
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Project Cycle

Project Implementation Stage	3 Months
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- (Raising capex PO, getting the machines to UAE, set-up of the facility)

Production Test Run	3 Months
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Investment Options

Option 1 (Fixed return Investment)

Nature of funding:	1 year fixed return loan
Role of the investor	Lender
Period of investment	1 year
Rate of return	30% per annum

The funds would be paid into Inovartic Investments LLC.

At the end of 1 year:

- Refund of the full investment
- Returns at the agreed rate, as above

Option 2 (Seed funding round)

Nature of funding:	Seed funding round
Role of the investor	Seed investor
Fixed yearly return for year 1	10% per annum

The funds would initially be paid into Inovartic Investment LLC (IIL)

Investment Options

After successful completion of the POC phase:

An ADGM SPV would be set-up, initially with the following Founding Shareholders:

IIL	70%
Technical partners	30%

The Founding partners will then dilute their stakes in the ADGM SPV to a strategic investor at a valuation and terms to be mutually agreed upon at the time.

The seed investor would be brought-in as shareholders in the ADGM SPV. Shares would be allotted from IIL's share in the entity. Shares amounting to 2X return to be allocated to the seed investor.

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