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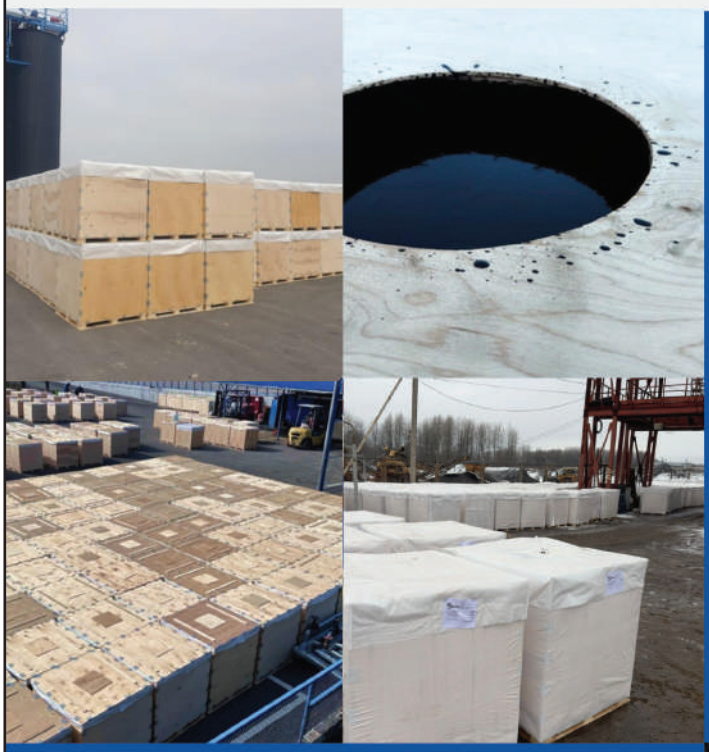

The dimensions of the container when assembled are 1060x1060x1095 mm. The capacity is up to 1040 kg of hot bitumen of various thicknesses. The heat resistance of the package is up to 200 degrees. The container is made only of glued material — FC plywood, glued in a checkerboard pattern. This eliminates the need to process and install the ISMP15 stamp during export. Storage is allowed in 4 tiers on a flat surface. The assembly is carried out using special keys in 3 minutes. When disassembled, the euro trolley holds 350 sets.

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EDITOR'S MESSGAE

With a decade of activity in the bitumen and petroleum derivatives industry in the field of printing and publishing specialized news and selected scientific articles from conferences, symposiums, research centers and universities, and introducing brands and companies producing petroleum and bitumen, the World of Petroleum and Bitumen Journal has been able to gain the trust of more than 6000 permanent audience in such a way that they would like to receive the print version of the journal every month.

Ali farjam

Contact us:

Iranian The World of Petroleum and BitUMEN jOURNAL

Phone: +98 2633524014 – +98 2166988059 – +971 562634384

Managing Editor
Alireza farjam
Master's degree in structural engineering
Email: farjam@bitumenmag.com

Commercial Manager
Hoda Khoeiniha
Email:hkhoeiniha@bitumenmag.com

www.bitumenmag.com

+44 7831423117

To receive the journal monthly, please contact us through the following:
Email

info@bitumenmag.com

Asian Bitumen Supply to Expand, While Demand Remains Uncertain

The availability of bitumen in Southeast Asia is set to increase in 2025, largely due to a surge in exports from southern China. However, a significant rise in consumption is expected only in select Asian economies next year.

Delayed infrastructure projects from 2024 may fuel short-term purchasing activity. Adverse weather conditions and funding limitations caused setbacks in key markets such as Vietnam, Indonesia, and China last year, with some Indonesian projects being scrapped entirely. Australia's bitumen demand also remained sluggish due to financial constraints amid high inflation.

In the third quarter of 2024, import costs climbed as demand exceeded supply, further straining the market. Rising prices for high-sulfur fuel oil (HSFO) and shrinking export margins led to a decline in bitumen production across major exporting nations, including Singapore, South Korea, and Thailand, from the second quarter onward.

Production Recovery Expected in 2025

Market insiders familiar with refining operations in Southeast and Northeast Asia anticipate a return to more stable production levels this year. Increased exports from southern China, particularly from Chambroad's 80,000 b/d refinery in Hainan, are

expected to curb the need for bitumen imports from other regions. Market sources estimate that the Hainan refinery plans to ship out between 400,000-500,000t of bitumen in 2025.

Additionally, a 270,000 b/d refinery in peninsular Malaysia, which halted bitumen production in mid-2024, is likely to restart operations. Thailand's 175,000 b/d Map Ta Phut refinery, which prioritized fuel oil output last year, is also set to ramp up bitumen production in 2025, adding to overall supply.

"Given that HSFO and bitumen prices are currently nearly identical, refiners have little incentive to cut bitumen output," a Southeast Asian trader noted. "However, if demand fails to keep up with supply, adjustments to production might be necessary."

Meanwhile, Vitol's bitumen storage facility in Tanjung Bin, Malaysia, with a capacity of 50,000-70,000t, is projected to become operational in 2025. This development is expected to facilitate increased imports and enhance inter-regional trade. However, whether the inventory will primarily serve Asian markets remains uncertain.

Demand Trends Vary Across the Region

Bitumen consumption projections in China present a mixed outlook. As the country enters the final year of its current five-year economic plan, infrastructure investment—historically a driver of bitumen demand—is expected to be a government focus. Recent monetary policy changes could further support demand. However, uncertainty remains about whether these

measures will be sufficient to stabilize the real estate sector. Higher domestic bitumen output is also likely to reduce import requirements.

Vietnam is poised for a significant rise in consumption in 2025, as funding issues that delayed numerous projects in 2024 begin to ease. Some importers predict a 20-30% increase in demand, bringing total consumption to approximately 1.2mn-1.3mn t.

In contrast, Thailand and Malaysia are expected to maintain steady demand levels, with project volumes and government policies remaining largely unchanged from 2024. New Zealand's bitumen consumption is anticipated to grow by at least 5% year-on-year. However, in Australia, importers foresee a 10% decline due to a lack of large-scale projects and ongoing financial constraints limiting infrastructure maintenance to minor road repairs.

Indonesia is also unlikely to see an increase in bitumen consumption, as infrastructure funding remains tight. Traders indicate that the newly elected government will continue prioritizing social and financial support programs over large-scale construction projects.

Logistics Challenges to Persist

Limited availability of bitumen-carrying vessels in late 2024 is expected to continue into the first quarter of 2025. Weak demand and reduced production in the latter half of 2024 led to lower liquidity, prompting some vessels to shift operations to other regions.

However, shipping constraints are expected to ease in the latter half of 2025. Market participants report that multiple new vessels, including several 8,000 dead weight tonne (dwt) carriers and a few larger 16,000-17,000 dwt ships, are scheduled for delivery this year. In contrast, there are significantly fewer orders for smaller 5,000 dwt ships, signaling a potential shift toward larger-capacity vessels for transporting bitumen across Asia.

THE MOST URGENT ISSUE FOR THE SHIPPING SECTOR IN 2025

DECARBONIZATION:

WPB: In recent years, major carbon-emitting industries have observed the emergence of strategies to cut emissions, with financial institutions playing a crucial role in linking producers and consumers of low-emission fuels. These connections facilitate the swift expansion and widespread implementation of cleaner energy solutions.

Industries with high emissions, particularly shipping, contribute nearly 40% of global CO_2 output. Although no single remedy can fully address the decarbonization challenge for such industries, a series of targeted initiatives can collectively drive a large-scale transition away from fossil fuels.

Various methods contribute to this shift, including adding ethanol to gasoline, incorporating recycled cooking oils or plant-derived oils into diesel, adopting renewable energy sources in place of conventional power, and utilizing gases derived from organic waste.

As regulatory frameworks tighten and public scrutiny intensifies, two industries that emit substantial greenhouse gases—shipping and aviation—face particularly significant hurdles in reducing their carbon footprint.

Constraints related to weight, volume, and long-distance travel make battery-powered alternatives impractical for large cargo ships and commercial aircraft. Although smaller-scale innovations such as algae-based biofuels and vessels powered by hydrogen or ammonia exist, they either suffer from limited scalability or require costly retrofitting, making widespread adoption challenging.

Can Biomethane Be the Ideal Solution?

Among the various low-carbon fuel alternatives for shipping, biogas-derived fuels are gaining traction. According to The Maersk Mc-Kinney Møller Center, biogas fuels could account for between 19% and 37% of deep-sea shipping's total fuel mix by 2050. One of the most promising candidates in this category is biomethane and its marine fuel derivatives.

Biomethane, produced from methane present in organic waste, shares a nearly identical chemical structure with natural gas. It can be seamlessly integrated into existing gas grids and then processed into hydrocarbons tailored to specific industrial needs. The fuel has negligible sulfur content and can even exhibit negative carbon intensity, making it a highly attractive low-emission alternative.

Infrastructure and Logistics Benefits

A significant advantage of biomethane is its logistical compatibility with existing infrastructure. Ports are often

situated near urban centers, making it easier to link them with existing gas networks. This eliminates the necessity for dedicated Natural Gas Liquids (NGL) supply chains for fueling stations, significantly enhancing the scalability of biomethane production.

Although the technology behind biomethane is not groundbreaking, its on-site production potential makes it a much more cost-effective alternative than other competing low-carbon marine fuels.

Offsetting Carbon Emissions

The International Energy Agency (IEA) forecasts that by 2050, alternative fuels—including biofuels, hydrogen, ammonia, and methanol—will constitute 85% of the shipping sector's total energy use.

However, until these fuels become a dominant component of daily operations, the industry must confront its current carbon footprint.

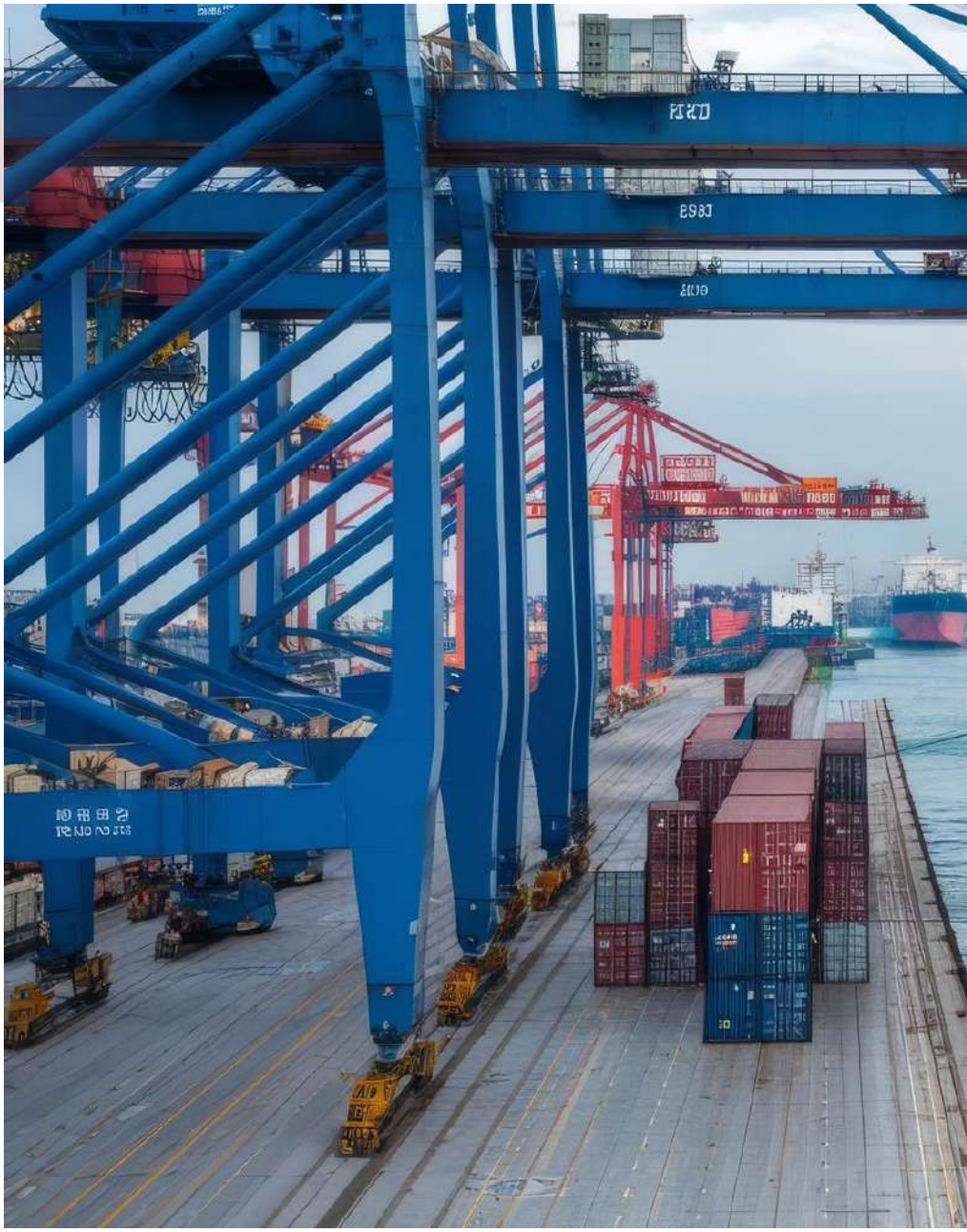
Companies that have access to non-fossil energy sources are likely to transition towards them—either due to regulatory obligations, pressure from investors, or corporate sustainability commitments.

For operators without immediate alternatives, carbon offsetting remains an essential strategy. This involves funding carbon capture projects to neutralize emissions and claiming net-zero status despite continuing fossil fuel use.

Regulatory Challenges and the Transition to Cleaner Shipping

CSC Commodities, a subsidiary of Marex, has been engaged in oil derivatives trading and emissions management for over a decade. The firm anticipates that carbon markets are approaching a critical turning point, with significant shifts in supply and demand dynamics.

A major regulatory milestone is the FuelEU Maritime directive, which came into effect on January 1, 2025. This legislation mandates gradual reductions in greenhouse gas emissions from shipping fuels, starting with a



2% reduction in 2025, and progressively tightening to an 80% reduction by 2050.

Additionally, ships—particularly container and passenger vessels—must utilize onshore power sources or zero-emission technologies while docked. This policy is expected to accelerate investment in low-carbon fuels and supporting infrastructure, increasing interest in alternatives like biomethane.

Simultaneously, the inclusion of shipping in the EU Emissions Trading System (ETS) introduces dual pressures on shipowners. They must adopt cleaner fuel options while simultaneously managing the financial burden of purchasing emissions allowances.

The industry recalls the disruptive impact of the IMO 2020 regulations, which enforced strict sulfur limits on marine fuels. The International Maritime Organization (IMO) has so far allowed individual regions to decide whether to incorporate shipping into carbon trading and emissions reduction programs.

However, given the growing climate crisis and heightened public awareness, it is only a matter of time before the shipping industry faces mandatory carbon offset requirements. These new obligations will likely include:

- Adoption of zero-carbon fuels
- Implementation of an emissions tax under the ETS
- Mandatory participation in carbon offset schemes

A Path to Compliance Through Biomethane

Navigating the evolving regulatory landscape will be a formidable challenge. However, the incorporation of biomethane as a marine fuel presents a viable route toward regulatory compliance and environmental sustainability.

In this context, ongoing conversations surrounding shipping's emissions reduction efforts remain crucial.

Major Iraq deal: BP Puts $25 Billion on the Table

A senior Iraqi petroleum official has predicted that British Petroleum (BP) may invest up to $25 billion over the lifespan of a redevelopment project for four petroleum and gas fields in Kirkuk.

If a deal is signed between the two parties—something that, according to the official, could happen in the coming weeks—it would mark a significant step forward for Iraq, whose petroleum production has long been plagued by war, corruption, and other challenges.

The Iraqi official stated that BP is set to invest between $20 billion and $25 billion in a profit-sharing agreement that will last over 25 years. The value of this contract had not been previously disclosed.

BP declined to comment on the latest developments but referred to a statement released last month, in which it noted significant progress in discussions with the Iraqi government to support the operator of several Kirkuk petroleum fields in an integrated development project.

Following the $27 billion deal with TotalEnergies, Iraq's upcoming contract with BP would be the second-largest agreement between Baghdad and an international petroleum company in recent years.

Iraq's domestic energy needs

BP's agreement will focus on rebuilding infrastructure across four petroleum fields and developing natural gas production to support Iraq's domestic energy needs.

The official stated that technical and financial negotiations are progressing well and that final contracts could be signed by the end of this week.

According to the source, BP plans to increase crude oil production from the four Kirkuk fields by 150,000 barrels per day (bpd), bringing the total output to at least 450,000 bpd within two to three years.

Three officials from Iraq's state-run North Oil Company (NOC) confirmed that this would be a substantial increase from the current production capacity of 300,000 bpd.

The senior petroleum official also explained that under the proposed profit-sharing model, BP would be able to recover its costs and generate profits once production surpasses current levels.

According to a Reuters report, BP has extensive knowledge of the Kirkuk fields. The company was part of the consortium that discovered petroleum in Kirkuk in the 1920s and estimated that the region contains approximately 9 billion barrels of recoverable petroleum.

Destruction of energy trade; power struggle between two economic giants intensifies

Broader consequences of the trade war

Following Beijing's retaliatory response to Donald Trump's tariffs, trade in crude oil, liquefied natural gas (LNG), and coal between the U.S. and China is effectively coming to a halt.

China, the world's largest importer of these three energy commodities, imposed a 15% tariff on U.S. LNG and coal, as well as a 10% tariff on crude oil and agricultural equipment. This move by Beijing came after the Trump administration imposed a 10% tariff on all Chinese imports to the U.S.

Although the 10% tariff was lower than the 60% Trump had threatened during last year's election campaign, it was still sufficient to prompt an immediate response from China. China's reaction increases the risk of further U.S. actions, escalating trade tensions between the world's two largest economies.

There is a risk that a series of retaliatory measures could slow global economic growth and drive up inflation, as countries would be forced to reorganize supply chains and deal with increasing disruptions in industries such as manufacturing and construction.

However, the immediate impact of China's actions on imports of U.S. crude oil, LNG, and coal is likely to be limited. According to commodity analysts at Kepler, China imported 5.99 million barrels of crude oil from the U.S. in January. This figure, equivalent to about 193,000 barrels per day, accounts for less than 2% of China's total imports.

The January imports were indicative of recent monthly volumes; however, China has occasionally imported more U.S. crude oil. For example, in June 2023, its imports reached 948,000 barrels per day—the highest level in two years.

China's LNG imports from the U.S. have also been low in recent months, decreasing from 220,000 tons in December to 190,000 tons in January.

The volume of LNG imports has been relatively volatile, reflecting the spot-market nature of U.S.-China trade. However, in October last year, imports surged to 780,000 tons—the highest level in two years.

China's total LNG imports have recently averaged around 6.5 million tons per month, suggesting that the U.S. supplies between 4% and 12% of China's total LNG imports.

According to Kepler, China imported 1.34 million tons of coal from the U.S. in January, marking the strongest monthly record in two years, surpassing the previous record of 1.55 million tons in August last year. Official customs data shows that China's total

monthly coal imports in 2024 have averaged 45.2 million tons, making the U.S. a relatively small supplier.

Broader consequences of the trade war

Given that both China and the U.S. will likely be able to adapt to Beijing's energy import tariffs without major disruptions, the question arises: does this really matter?

The answer is yes. These tariffs intensify tensions and accelerate the growing division of the world into two trade blocs—one aligned with Trump's America and its allies, and the other favoring China and what is described as the Global South.

There is a risk that Trump will continue using tariffs as part of his "America First" policy, targeting not only traditional rivals but also longstanding allies. This approach could push more commodity producers toward the emerging BRICS trade bloc.

> "China's total LNG imports have recently averaged around 6.5 million tons per month, suggesting that the U.S. supplies between 4% and 12% of China's total LNG imports."

China is also flexing its muscles in the commodities sector by imposing new export controls on five critical minerals used in defense industries and the energy transition. These controls, which take immediate effect, cover the export of tungsten, tellurium, bismuth, indium, molybdenum, and related products.

According to Reuters, these measures will likely drive Western countries to intensify efforts to find and develop alternative sources. As a result, they will have to engage more with companies and governments in Africa, Asia, and Latin America—many of whom have been affected by U.S. tariffs and cuts in financial aid.

Saudi Arabia grants Pakistan a one-year extension for petroleum debt payment

Pakistan has signed an agreement with the Saudi Fund for Development to defer the payment of $1.2 billion for petroleum imports from Saudi Arabia by one year.

Prime Minister Shehbaz Sharif's office welcomed the signing of this financial relief package, stating that the initiative would ensure a stable supply of petroleum products while easing immediate financial burdens and strengthening Pakistan's economic resilience.

Since 2022, Pakistan has been grappling with an economic crisis characterized by high inflation, mounting debt, job losses, and financial difficulties. At one point, the country faced a severe shortage of foreign exchange reserves and the risk of defaulting on its debt

obligations.

Three years ago, Pakistan set a goal to replace two-thirds of its petroleum imports with cheaper Russian crude. However, due to foreign exchange shortages and limitations in refining and port infrastructure, it failed to meet this target. Facing a liquidity crunch, Pakistan became a buyer of Russian petroleum after Moscow began offering discounts on its Urals crude in response to Western sanctions.

Previously, Pakistan's Petroleum Minister, Musadik Malik, revealed that the country had, for the first time, paid for Russian petroleum imports using Chinese currency. According to Malik, this government-to-government purchase involved 100,000 tons of crude oil.

The decision to use the Chinese yuan instead of the U.S. dollar came after Russia announced that it would no longer accept U.S. dollars for its energy exports, opting instead for transactions in Chinese and Emirati currencies. Moreover, extensive Western sanctions over the Ukraine war had cut Russia off from global payment systems dominated by the U.S. dollar.

According to Oil Price, in addition to these challenges, Pakistan incurs significantly higher transportation costs for Russian crude oil. However, it still prefers Russian petroleum over Saudi crude, as Saudi Arabia's light crude costs Pakistani refineries $10 to $11 per barrel more than Urals crude.

DEVELOPMENT OF POLLUTANT REMOVAL SYSTEMS FROM INDUSTRIAL EMISSIONS IN IRAN

A memorandum of understanding has been signed between industrial sectors and a knowledge-based company to design and implement a chemical gas purification system for the compound unit.

During the first technology exchange event in the petroleum, gas, petrochemical, and power plant sectors—held at Iran's Innovation and Prosperity Fund—this agreement was signed between Ghaed Basir Petrochemical Products Company (GBPC) and a knowledge-based company to address technological needs using domestic products.

The primary objective of this agreement is to facilitate collaboration and consultation between GBPC and the knowledge-based firm, utilizing innovative ideas, solutions, and research-based products for implementing required projects and providing technological services in designing and executing the chemical purification system for gas emissions from the compound unit.

THE KNOWLEDGE-BASED COMPANY

In this collaboration, GBPC announced its readiness to outline priorities, specify requirements, provide technical documentation, and engage in research cooperation for the design and implementation of technological projects. It also committed to facilitating site visits for the installation and commissioning of pilot systems and equipment and pledged to finalize the status of the memorandum of understanding and determine the framework for interaction with the knowledge-based company to meet its technological needs.

The knowledge-based company, in return, expressed its willingness to collaborate in providing ideas, solutions, and proposals tailored to the stated requirements, as well as a final research product sample for evaluating the memorandum's objectives to explore potential future interactions.

The chemical purification system for exhaust gases in the compound unit is a method for removing harmful pollutants from industrial emissions, particularly in the petrochemical, polymer, and plastics industries. This system generally includes the following stages:

Chemical Absorption: Exhaust gases react with specific chemical solutions such as alkaline solutions (e.g., sodium hydroxide) or acidic solutions (e.g., sulfuric acid) to neutralize pollutants.

Oxidation and Reduction: Certain compounds, such as sulfur and nitrogen compounds, undergo oxidation and reduction processes to convert them into harmless substances.

Filtration and Separation: In some cases, solid compounds are separated from the exhaust gases and precipitated.

Catalytic Bed Reactors: To break down volatile organic compounds (VOCs) or other resistant pollutants, catalytic beds such as metal-based catalysts are used.

These systems help reduce pollutants such as sulfur dioxide (SO_2), nitrogen oxides (NOx), volatile organic compounds (VOCs), and particulate matter, thereby minimizing the environmental impact of industrial operations.

Catalytic Bed Reactors: To break down volatile organic compounds (VOCs) or other resistant pollutants, catalytic beds such as metal-based catalysts are used.

Colombian president orders termination of petroleum partnership with U.S. company

Colombian President Gustavo Petro has cancelled the joint venture between the state-owned company Ecopetrol and the American company Occidental Petroleum over environmental concerns related to the hydraulic fracturing (fracking) technique.

Petro expressed his concerns on national television, stating his opposition to the recent contract extension between Ecopetrol and Occidental Petroleum because it involves fracking, which contradicts his energy policy focused on transitioning away from hydrocarbons toward alternative energy sources.

During a live-streamed cabinet meeting, the Colombian president declared: "I want this joint venture to be sold, and the money invested in clean energy. We oppose fracking because this method means the death of nature and humanity."

The request to dismantle the joint venture came just a day after Ecopetrol announced the contract extension with Occidental Petroleum. The company operates in the Permian Basin, the largest shale oil region in the U.S., where fracking is the standard extraction method for unconventional petroleum and gas reserves.

According to Reuters, the CEO of Colombia's state

petroleum company stated on Tuesday that, under this investment plan, Ecopetrol Permian could develop approximately 91 new production wells in the Midland and Delaware sub-basins by 2025, with an investment of over $880 million.

Based on 2024 data, Ecopetrol produces 95,200 barrels of crude oil per day in the Permian Basin, accounting for 12% of its total petroleum output. However, President Petro, a strong critic of the petroleum and gas industry and a firm supporter of the energy transition, has maintained his opposition to fracking, which is banned in Colombia.

According to OilPrice, in September last year, the Colombian government announced a $40 billion plan to move away from petroleum and gas, aiming to replace hydrocarbon revenues with alternative income sources. The funds will be allocated to nature-based climate solutions, low-carbon energy, electrification of transportation, improvements in agricultural practices, and biodiversity conservation projects.

I WANT THIS JOINT VENTURE TO BE SOLD, AND THE MONEY INVESTED IN CLEAN ENERGY.

Efforts to extend the lifespan of petroleum and gas wells

"Experimental Investigation of mechanism of insitu gel polymer containing paramagnetic nanoparticles for water shut-off in oil fields in presence of magnetic field and simulation of the system using computational fluid dynamics (CFD) technique" is the Ph.D. dissertation of Behnam Sabzi Dizajikan, conducted under the supervision of Arezou Jafari and supported by the Iran National Science Foundation (INSF).

Behnam Sabzi Dizajikan explained this project: "Currently, the economic lifespan of many petroleum and gas production wells has been reduced due to excessive water production and the associated costs. These costs include extraction, separation, and disposal. Additionally, the produced excess water increases the risk of formation damage, corrosion rates, and the tendency to form stable emulsions."

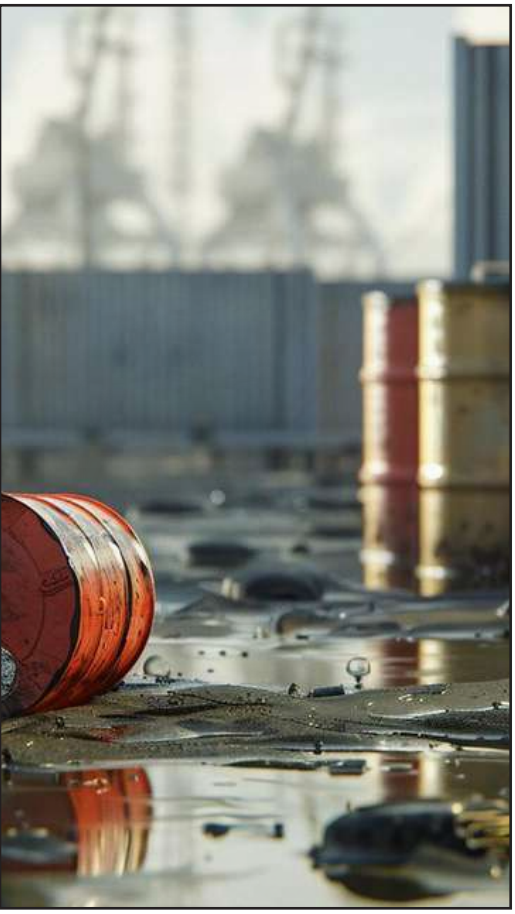
He continued: "Besides these issues, the improper water-to-gas ratio also increases the likelihood of hydrate formation. Therefore, adopting strategies to reduce excessive water production is essential."

The researcher further elaborated: "Implementing processes in reservoirs and wells to reduce unwanted water production while simultaneously enhancing hydrocarbon recovery can meet a wide range of environmental and economic objectives."

He described a potential solution to these challenges: "Blocking the pathways and fractures with high permeability that allow water to flow into petroleum production wells is an effective strategy—provided that petroleum flow paths remain unobstructed. To achieve this, smart polymer gels that swell in response to water but shrink in the presence of petroleum are a suitable option. However, they come with challenges such as poor performance in low-temperature reservoirs or lack of control, which can lead to blocking petroleum production pathways."

Quoting the Iran National Science Foundation (INSF), this researcher concluded: "To optimize and improve the performance of these gels, we explored the use of magnetic nanoparticles embedded within the polymer gel structure and applied a magnetic field to precisely control the gelation process.

The outcome of this research was the development of a magnetic gel with controllable gelation at the desired location and time, along with the ability to be degraded when necessary. Fortunately, the project's objectives were successfully achieved."



THE GLOBAL ENERGY OUTLOOK DOMINATED BY PETROLEUM AND GAS

Despite the push for renewable energy, demand for petroleum remains high, highlighting its continued importance in the global energy mix.

This month, Saudi Arabia's Energy Minister stated that petroleum is no longer an energy security challenge, but rather gas, electricity, and primarily critical minerals are. On the one hand, this statement might seem like the death knell for crude oil. On the other, it acknowledges that the world has become even more dependent on hydrocarbons than before.

The reality that the world relies on petroleum became evident recently when petroleum prices surged following news of extensive U.S. sanctions against Russia's energy sector, particularly its petroleum and gas exports. If petroleum demand had truly weakened due to the rise of electric vehicles in China and Europe, these sanctions would have had little effect on prices. But that was not the case.

Moreover, discussions about supply shortages in the petroleum market have emerged, whereas just a month ago, the conversation was about an oversupply.

John Kemp, a petroleum analyst, warned last week that U.S. petroleum inventories have been declining faster than usual since mid-2024, reaching their lowest levels since 2015.

Meanwhile, petroleum stockpiles in OECD countries are also decreasing. Global inventories, in general, have been falling faster than the International Energy Agency (IEA) had projected in its monthly reports. Yet, instead of acknowledging its forecasting errors, the IEA continues to predict an oversupply for this year.

The world still relies on crude oil. However, over the past decade or so, large parts of the world have also increasingly turned to natural gas. A prime example is Europe, where gas supply challenges have intensified amid efforts by EU governments to reduce dependence on Russian gas.

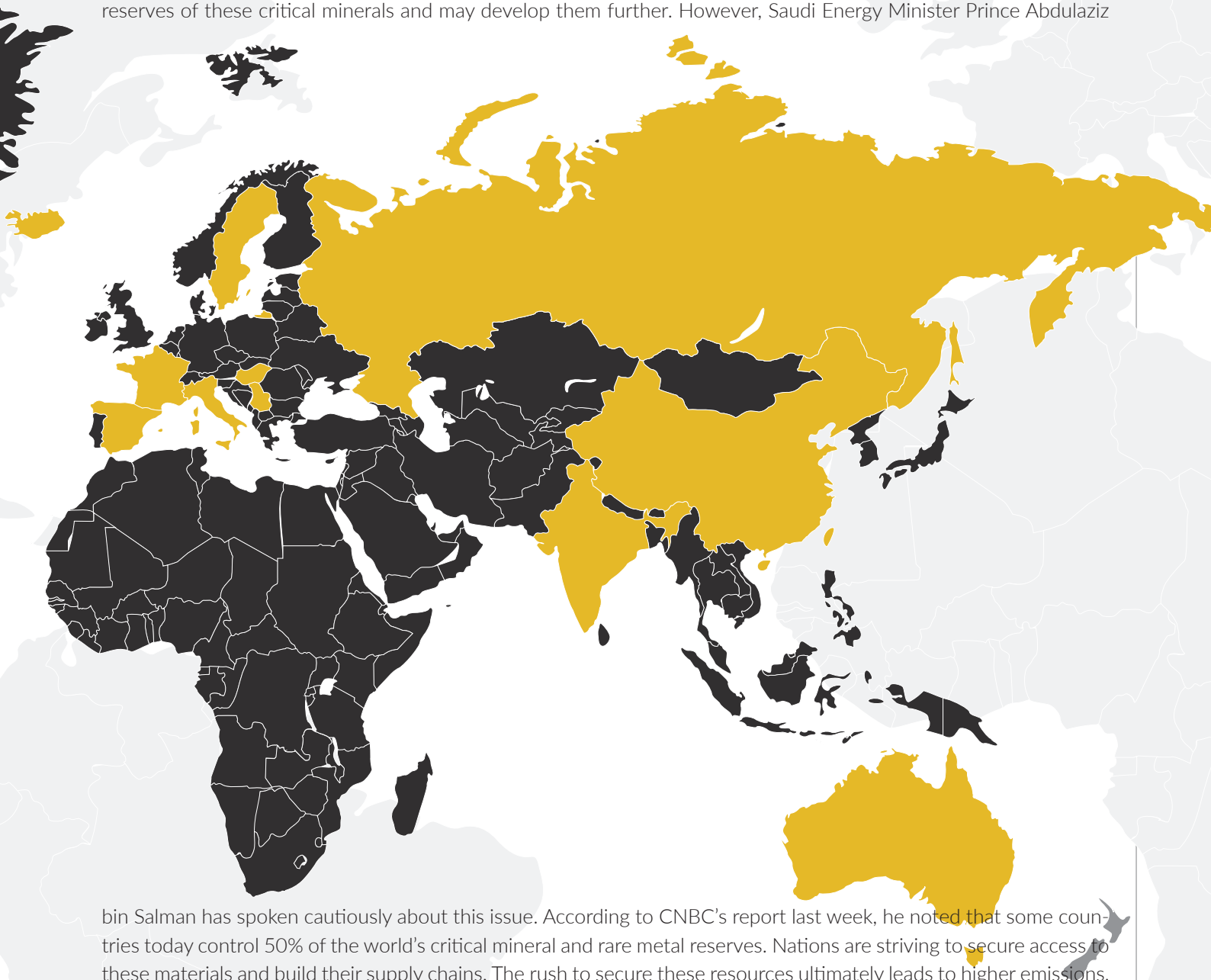
Last year, EU leaders insisted that member states cut gas imports from Russia. Nevertheless, European countries continued purchasing Russian liquefied natural gas (LNG). This trend has persisted this year despite the new EU foreign policy chief, Kaja Kallas,

advocating for sanctions on Russian gas.

Earlier this month, Politico, citing data from Kpler, reported that the EU bought over 800,000 tons of Russian LNG in the first two weeks of January.

At the same time, Europe's gas reserves have been shrinking, reaching alarmingly low levels due to strong demand. Such demand is typical in winter and further proves that while critical minerals are increasingly important today compared to 20 years ago, they still do not match the significance of petroleum and gas.

Critical minerals are so named because of their essential role in the energy transition. Wind and solar power installations, as well as electric vehicles, require specific amounts of these minerals. Incidentally, Saudi Arabia has some reserves of these critical minerals and may develop them further. However, Saudi Energy Minister Prince Abdulaziz



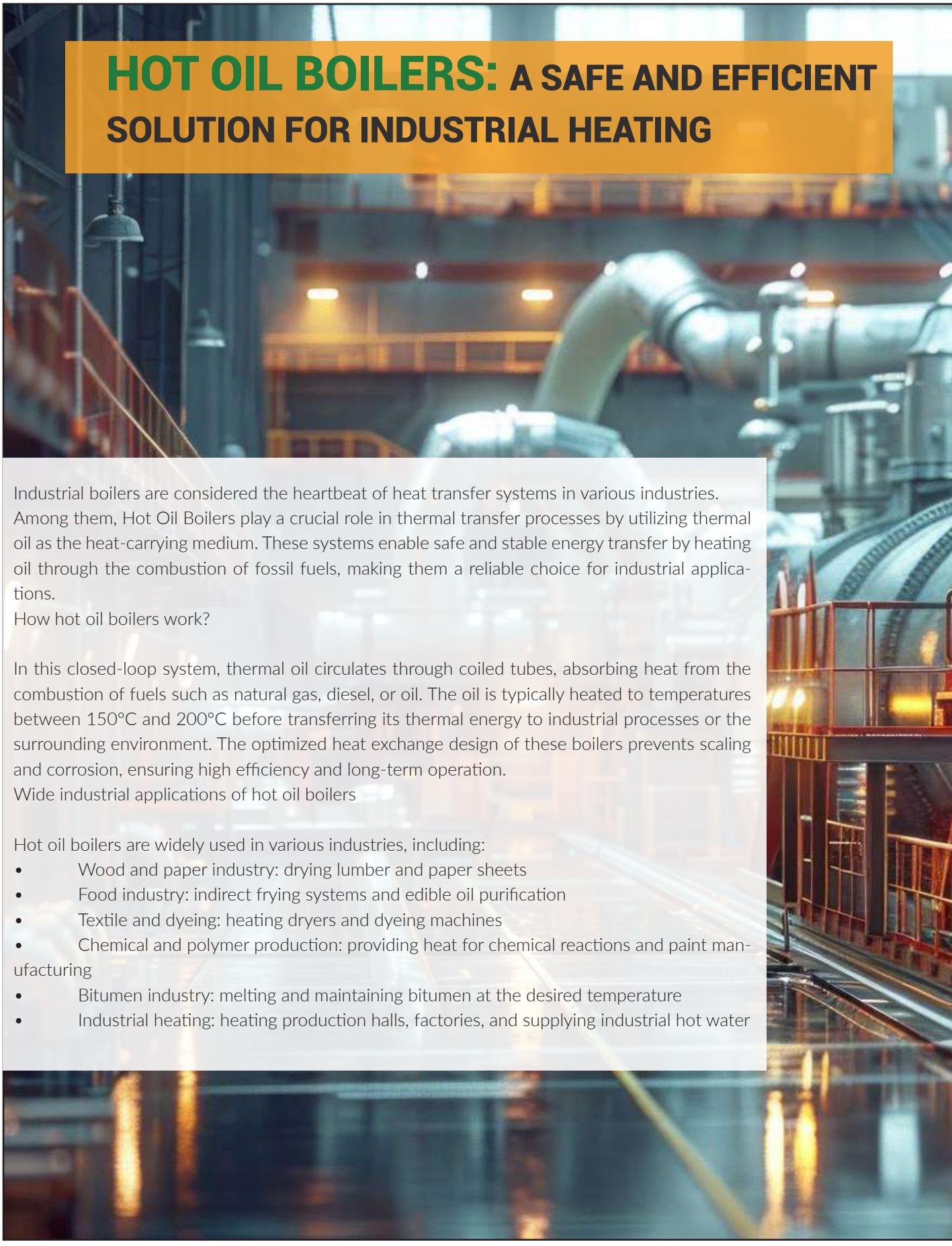
bin Salman has spoken cautiously about this issue. According to CNBC's report last week, he noted that some countries today control 50% of the world's critical mineral and rare metal reserves. Nations are striving to secure access to these materials and build their supply chains. The rush to secure these resources ultimately leads to higher emissions, increased metal costs, and rising energy prices.

This is because extracting all these critical minerals required for the energy transition still depends on hydrocarbon energy. Mining operations rely on petroleum and gas. The more extraction and refining needed, the more hydrocarbon energy is consumed, leading to greater emissions. It is a vicious cycle with no clear way out. No matter how many wind turbines these extracted minerals help build, when the wind stops blowing, the world turns back to petroleum and gas. Meanwhile, artificial intelligence and data centers are also consuming more energy.

According to OilPrice, some may still claim that petroleum is no longer vital for energy security and that gas has taken its place. However, with petroleum demand continuing to grow this year, it seems gas has joined petroleum as an indispensable commodity.

WPB

HOT OIL BOILERS: A SAFE AND EFFICIENT SOLUTION FOR INDUSTRIAL HEATING



Industrial boilers are considered the heartbeat of heat transfer systems in various industries. Among them, Hot Oil Boilers play a crucial role in thermal transfer processes by utilizing thermal oil as the heat-carrying medium. These systems enable safe and stable energy transfer by heating oil through the combustion of fossil fuels, making them a reliable choice for industrial applications.

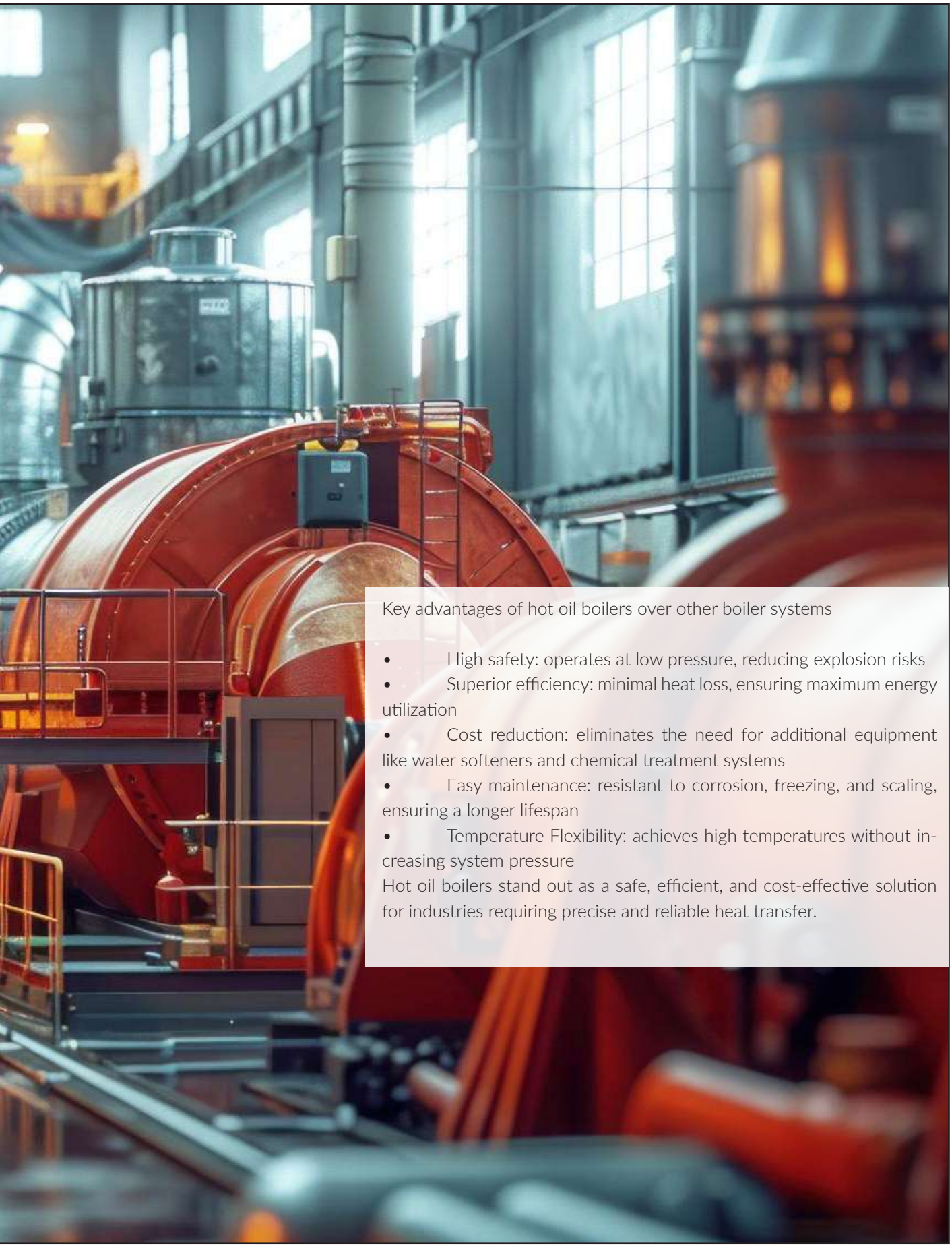
How hot oil boilers work?

In this closed-loop system, thermal oil circulates through coiled tubes, absorbing heat from the combustion of fuels such as natural gas, diesel, or oil. The oil is typically heated to temperatures between 150°C and 200°C before transferring its thermal energy to industrial processes or the surrounding environment. The optimized heat exchange design of these boilers prevents scaling and corrosion, ensuring high efficiency and long-term operation.

Wide industrial applications of hot oil boilers

Hot oil boilers are widely used in various industries, including:

- Wood and paper industry: drying lumber and paper sheets
- Food industry: indirect frying systems and edible oil purification
- Textile and dyeing: heating dryers and dyeing machines
- Chemical and polymer production: providing heat for chemical reactions and paint manufacturing
- Bitumen industry: melting and maintaining bitumen at the desired temperature
- Industrial heating: heating production halls, factories, and supplying industrial hot water



Key advantages of hot oil boilers over other boiler systems

- High safety: operates at low pressure, reducing explosion risks
- Superior efficiency: minimal heat loss, ensuring maximum energy utilization
- Cost reduction: eliminates the need for additional equipment like water softeners and chemical treatment systems
- Easy maintenance: resistant to corrosion, freezing, and scaling, ensuring a longer lifespan
- Temperature Flexibility: achieves high temperatures without increasing system pressure

Hot oil boilers stand out as a safe, efficient, and cost-effective solution for industries requiring precise and reliable heat transfer.

AI-ENHANCED SELF-REPAIRING ASPHALT : A LEAP TOWARDS ECO-FRIENDLY ROADS

Researchers have unveiled a cutting-edge asphalt material that can repair its own cracks, potentially addressing the UK's costly pothole issue, which currently demands £143.5 million annually. This innovative self-healing asphalt is crafted from biomass waste and designed with assistance from artificial intelligence (AI).

A collaborative effort between Swansea University, King's College London, and scientists from Chile is driving the development of this novel asphalt, which eliminates the need for manual repairs by autonomously restoring damage. The deterioration of asphalt occurs when bitumen—the viscous black binder—undergoes oxidation, causing it to become brittle. However, the precise mechanisms behind this process remain only partially understood.

The research team has devised a technique to counteract this cracking, allowing the asphalt to "stitch" itself back together, significantly boosting its longevity and sustainability. By leveraging machine learning, a subset of AI, the scientists analyzed the organic compounds found in complex substances like bitumen. This led to the creation of an advanced, data-driven model designed to accelerate molecular-level simulations, providing deeper insights into bitumen oxidation and the mechanisms behind crack formation. Additionally, the team partnered with Google Cloud to digitally replicate bitumen behavior using computational simulations.

To facilitate self-repair, the researchers embedded microscopic porous structures—known as spores—into the asphalt. These spores, produced by plants and finer than a human hair, are infused with recycled oils. When cracks begin to appear, the spores release their oil content, reversing the damage. Lab experiments demonstrated that this cutting-edge material could fully heal surface micro-

cracks within an hour.

Dr. José Norambuena-Contreras, a leading researcher in self-repairing asphalt and Senior Lecturer at Swansea University's Civil Engineering Department, emphasized the interdisciplinary nature of the study:

"Our project unites experts from civil engineering, chemistry, and computer science, integrating this knowledge with AI-driven tools from Google Cloud. This breakthrough research pushes the boundaries of sustainable infrastructure, paving the way for highly durable, net-zero emission roads."

The production of asphalt plays a significant role in road-related carbon emissions. As the transportation sector intensifies its focus on carbon footprint reduction to align with the UK Government's target of net-zero emissions by 2050, the development of innovative bitumen-based materials has become a crucial research area.

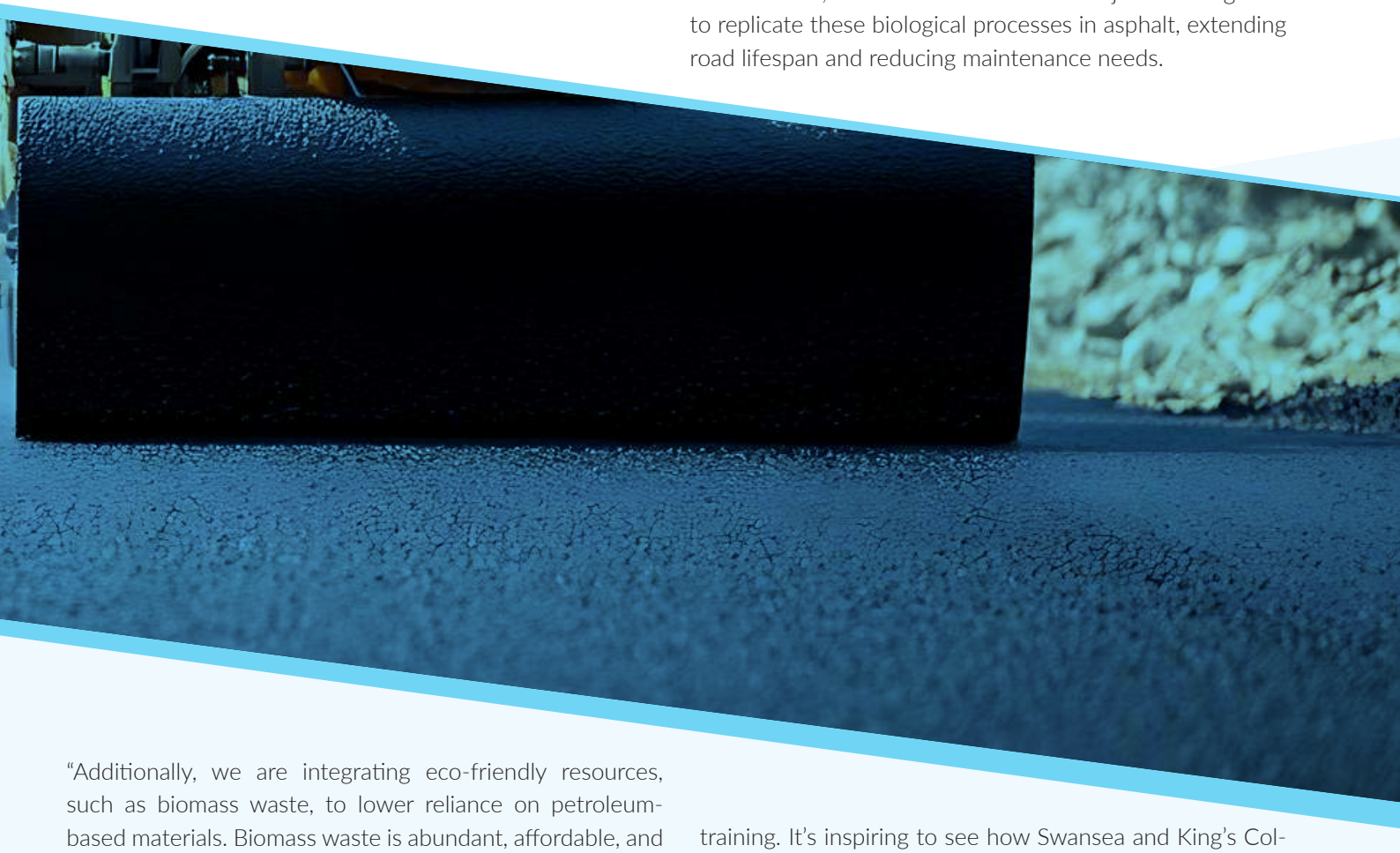
Dr. Norambuena-Contreras further stressed the need for strategic investments:

"For the UK to transition towards net-zero asphalt roads, both government and industry must support pioneering research. Reaching this milestone by 2050 will require close collaboration among academia, policymakers, and the private sector."

Though still in the experimental stage, this groundbreaking research holds immense promise for revolutionizing infrastructure and advancing global sustainability.

Dr. Francisco Martin-Martinez, a computational chemistry specialist at King's College London, highlighted the project's biomimicry approach:

"In nature, living organisms heal themselves—trees close their wounds, and animals recover from injuries. Our goal is to replicate these biological processes in asphalt, extending road lifespan and reducing maintenance needs.



"Additionally, we are integrating eco-friendly resources, such as biomass waste, to lower reliance on petroleum-based materials. Biomass waste is abundant, affordable, and locally sourced, making it a viable alternative to traditional asphalt components. Reducing dependence on petroleum-derived materials is particularly beneficial for regions with limited oil access."

Iain Burgess, UKI Public Sector Leader at Google Cloud, praised the research team's innovative use of AI-powered tools:

"Dr. Francisco Martin-Martinez joined the Google Cloud Research Innovators Program in 2022, where he gained access to Google's expert knowledge, technical resources, and training. It's inspiring to see how Swansea and King's College London are now utilizing AI models like Gemini and Vertex AI to enhance research efficiency and uncover new chemical properties."

In addition to asphalt infused with encapsulated bio-based solutions, Dr. Norambuena-Contreras is also investigating the potential of biopolymers derived from brown algae and vegetable oils. His team is further exploring the thermal transformation of discarded tires into rejuvenating agents that could enhance asphalt durability.

U.S. Expands Sanctions to Restrict Iran's Oil Trade with China

WPB: The United States has introduced new sanctions aimed at limiting the flow of Iranian oil to China. These penalties target a network of individuals and companies accused of facilitating the sale of millions of barrels of Iranian crude, as the Trump administration intensifies efforts to cut Iran's oil exports to zero.

This latest round of sanctions serves as an initial warning to both Tehran and Beijing, signaling U.S. disapproval without completely shutting down diplomatic efforts to negotiate restrictions on Iran's nuclear activities.

Experts suggest that while these measures—focused on individuals and ships linked to Iran's covert oil transportation network—could have some impact, they are unlikely to eliminate Iranian oil exports entirely. Stronger actions, such as sanctioning Chinese banks that handle oil-related transactions, would be required to achieve that goal. However, such steps could heighten tensions between the United States and China, the world's two largest economies.

Why Is Trump Targeting Iran?

Iran's economy is heavily dependent on oil revenues, which, according to the U.S. State Department, finance armed groups that oppose American and Israeli interests.

The sanctions announced on February 6 affect more than a dozen entities and individuals in China, India, and the UAE, including Iranian and Indian nationals, crew management companies, and a fleet of oil tankers.

"These penalties, along with further measures that are likely to follow, will undoubtedly have consequences," said Nader Itayim, an energy expert at the U.K.-based Argus Media. "The key question is how significant those consequen-

ces will be. That depends on how aggressively the Trump administration pursues Iran's oil trade."

Iran was allowed to sell oil under the 2015 nuclear deal, but when Trump pulled the U.S. out of the agreement in 2018, sanctions were reimposed, reducing Iran's crude exports to about 400,000 barrels per day. However, through sanctions evasion tactics and rising Chinese demand, Iran managed to increase its sales, particularly as enforcement of sanctions became more relaxed under former President Joe Biden.

By reinstating the "maximum pressure" campaign that defined his first term, Trump aims to cripple Iran's economy. He argues that Iran is dangerously close to acquiring nuclear weapons, while Tehran maintains that its nuclear program is peaceful.

"One of Trump's objectives now is to financially weaken Iran," said Tom Keatinge, director of the Center for Finance and Security at the Royal United Services Institute in London. "Since his last presidency, the international sanctions community has learned a lot about targeting a country's oil revenue—particularly by studying how Russia has used a covert tanker fleet to bypass Western restrictions."

How Does Iran's 'Shadow Fleet' Operate?

A network of tankers, often referred to as Iran's "shadow fleet," plays a critical role in allowing the country to evade sanctions and secretly deliver oil to China and other destinations.

These operations rely on ship-to-ship transfers, third-party intermediaries, hidden financial transactions, and rebranding of oil cargoes

to obscure their Iranian origin. These techniques enable Iran to continue exporting crude and generating revenue despite U.S. restrictions.

According to United Against Nuclear Iran, an organization that monitors Iran's activities, the country shipped 587 million barrels of oil in 2024, with 91% of those exports ending up in China.

China, historically the largest importer of Iranian oil, officially halted its purchases in 2022 to avoid U.S. penalties, according to data from research firm Kpler. However, Iranian oil continues to reach China through indirect means facilitated by the shadow fleet.

What Comes Next?

U.S. officials are trying to further restrict Iran's oil trade by urging China and other nations to stop dealing with Iranian crude and by penalizing ships suspected of transporting it.

The latest sanctions focused on vessels and shipping firms allegedly involved in moving Iranian oil. According to Keatinge, this reflects an evolving strategy by the U.S. and its allies, which has been refined through efforts to curb Russian oil shipments in recent years.

Future measures could extend beyond penalizing oil transport vessels. The U.S. might target companies that insure the ships, agencies that recruit crews, ports that receive the shipments, and even governments that register the tankers.

Itayim from Argus Media suggests that while such measures could deter more cautious Chinese buyers, they may not be enough to significantly disrupt the flow of Iranian oil. Stricter actions, such as pressuring Chinese ports, financial institutions, and intermediaries involved in the oil trade, would be required to reduce exports further.

However, escalating pressure on China could strain Washington's already tense relationship with Beijing, especially after the two nations imposed new tariffs on each other on February 4.

Keatinge believes that limiting Iranian oil exports may become part of broader negotiations between Trump and Chinese President Xi Jinping. The recent sanctions, he argues, provide the U.S. with leverage over Iran without directly intensifying friction with China.

CRRI UNVEILS INDIA'S FIRST LOCALLY DEVELOPED AGENT FOR RECYCLING AGED BITUMEN ROADS

WPB: The Central Road Research Institute (CRRI) has introduced Rejubit, India's first indigenously developed rejuvenating agent designed to restore and recycle aging bitumen roads.

This groundbreaking solution is set to reduce road resurfacing costs by 66% while also easing the country's dependency on imports.

Ambika Behl, a senior principal scientist at CRRI, explained that by using this new agent, aged road materials can be recycled at just one-third of the current cost, which presently requires expensive imported additives. She further noted that once production scales up, this chemical solution will drastically decrease the demand for fresh raw materials, many of which are currently sourced from abroad.

Addressing the launch event, Union Minister for Road Transport and Highways Nitin Gadkari emphasized that this innovation aligns with India's economic objectives, particularly its efforts to reduce import expenditures. "Our country's refinery capacity stands at 50 lakh tons, whereas our total requirement is 95 lakh tons, meaning 45 lakh tons of bitumen are imported," he stated.

Gadkari further highlighted the urgent need for cost-effective and environmentally friendly road construction methods to support India's rapidly expanding infrastructure. "We require high-quality roads while simultaneously lowering construction expenses and improving standards. Exploring alternative materials is key to achieving this goal," he added.

The production of this rejuvenating agent will be handled by Ooms India, a private firm that has obtained a CRRI license to manufacture it.

Later, during Question Hour in the Lok Sabha, Gadkari disclosed that over the past three financial years, 103 cases of action have been taken against contractors and concessionaires due to substandard work, inefficiency, failure to complete projects, or exceeding deadlines for national highway construction. Parliamentary records revealed that in six of these instances, contractors' bank guarantees were confiscated.

Among the states, Tripura, Maharashtra, and Nagaland recorded the highest number of flagged projects, with 13, 12, and 11 cases, respectively. Additionally, Rajasthan and Uttar Pradesh were significantly impacted, with 10 and 9 delayed projects making the list of 103 problematic cases identified by the ministry.

CHINA UNVEILS FIRST OIL PRODUCTION VESSEL WITH CARBON CAPTURE TECHNOLOGY

China's COSCO has introduced the first floating vessel designed for oil production and storage that incorporates a carbon capture system. This innovative ship has the capability to process up to 120,000 barrels of crude per day.

The vessel is equipped to capture carbon emissions not only from its journey to the production site but also from the extraction process itself.

"That tall structure you see is actually a tower used for collecting and purifying carbon emissions," explained Xu Xiaohua, a senior project manager at COSCO.

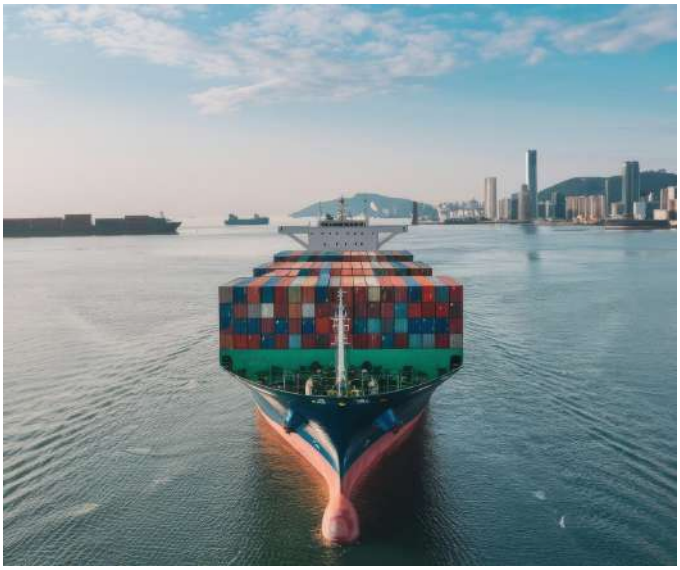
"The pipelines marked with green serve as the intake points for exhaust gases, which are pulled into the purification tower using fans. Inside, special absorbents extract hydrocarbons from these gases, significantly reducing the carbon content of the released air."

Carbon capture technology is widely regarded as a crucial component of the global shift toward cleaner energy. However, it remains a controversial subject among energy transition advocates, as it enables oil and gas companies to sustain and potentially expand production. Critics argue that a true energy transition necessitates a complete move away from fossil fuels.

A report from Wood Mackenzie last year projected that global investments in carbon capture technology would approach $200 billion by 2034. Nearly half of this funding is expected to be allocated to expanding capture capacity, while the remainder would support transportation and storage infrastructure.

By that time, global capture capacity is forecasted to reach 440 million tons per year, with storage capacity rising to 664 million tons. Government incentives are expected to play a crucial role in this expansion. Wood Mackenzie highlighted that five major economies focused on energy transition had collectively pledged around $80 billion to support the advancement of this technology.

Meanwhile, in 2024, Rystad Energy identified the Asia-Pacific region as an emerging hub for carbon capture, highlighting Australia, Malaysia, and Indonesia as key contributors. Over the next decade, investments in the region's carbon capture sector are projected to reach $15 billion.



Bitumen

COMPREHENSIVE EVALUATION OF THE AGEING BEHAVIOR OF BIO-BASED BINDERS AND CONVENTIONAL BITUMEN THROUGH CHEMICAL AND MECHANICAL ANALYSIS

Bitumen, a waterproof and viscoelastic material derived from petroleum, is widely used across various industries due to its unique mechanical and chemical properties. Its

primary applications include road construction, roofing, and waterproofing, with the paving industry consuming approximately 95% of total global production, amounting to nearly 100 million metric tons annually. In asphalt pavements, bitumen serves as a binder that holds mineral aggregates together, forming materials like asphalt concrete or bituminous concrete. This strong adhesive capability ensures structural integrity and long-term durability.

The Need for Bio-Based Alternatives

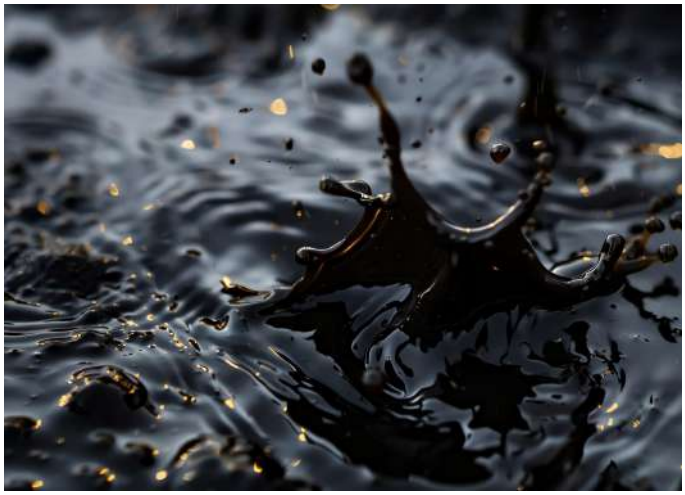
Since bitumen originates from fossil fuels, its availability is limited, leading to growing interest in renewable bio-based alternatives. However, bitumen's complex chemical composition is responsible for its unique properties, making full replacement a challenge. Currently, partial substitution of up to 50% has been identified as a practical solution. The incorporation of bio-based materials alters the composition and affects ageing behavior, which can significantly impact performance over time.

Environmental Regulations and Sustainability Challenges

With stringent environmental policies promoting emission reductions and the conservation of fossil resources, there is increasing pressure to adopt sustainable alternatives. These regulations target the entire lifecycle of materials, from resource extraction and transportation to manufacturing, usage, and disposal. This raises a crucial question: Does replacing fossil-based bitumen with bio-based alternatives compromise durability, or is it possible to achieve both sustainability and long-term performance?

Laboratory Ageing and Analytical Methods

To evaluate the ageing behavior of bio-based binders, laboratory artificial ageing procedures are conducted under controlled conditions. Three different bio-



binders were analyzed alongside an unmodified base bitumen and a reference bitumen. The bio-additive content ranged from 10% to 50%.

Two primary ageing simulation methods were applied:

- Short-term ageing (STA)
- Long-term ageing (LTA)

The binders were subjected to various ageing-inducing factors, including:

- High temperatures
- Light exposure
- Reactive oxygen species (ROS)

For chemical analysis, Fourier Transform Infrared (FTIR) spectroscopy was used to identify structural changes, while mechanical properties were assessed through Dynamic Shear Rheometer (DSR) testing to evaluate performance under different conditions.

Key Findings on Ageing Resistance

Results indicate that thermal ageing alone has a limited impact, and a single cycle of the Pressure Ageing Vessel (PAV) test does not induce the same level of ageing as more intensive long-term ageing methods, such as:

- Viennese Binder Ageing (VBA)
- Light ageing (LA)

The VBA method revealed that bio-binders 1 and 2 experienced significant ageing, while bio-binder 3 demonstrated higher resistance to ROS exposure.

Light Ageing and Rheological Performance

Light-induced ageing varied across different binders and was highly dependent on the specific light source (LA1–LA3). Compared to conventional 70/100 bitumen, all bio-binders exhibited lower susceptibility to ageing.

- Bio-binder 1 showed unique rheological properties, performing exceptionally well at both intermediate and high temperatures while demonstrating enhanced performance at low temperatures.
- Bio-binder 2 displayed mechanical characteristics close to those of the reference bitumen.
- Bio-binder 3 exhibited higher sensitivity to light ageing compared to ROS exposure.

These findings highlight the potential advantages and limitations of bio-based binders, suggesting that certain bio-additives may contribute to enhanced ageing resistance while others may require further optimization to ensure durability under real-world conditions.

New Research Initiative on Sustainable Asphalt Development

Project Objective

A collaborative research project between the Technical University of Braunschweig in Germany and Eurovia In France officially commenced on February 1, 2025.

Project Objective

The research initiative, known as ANNA (Application of Sustainable Asphalt), is dedicated to discovering alternative materials that can replace traditional bitumen. The ultimate goal is to advance the development of environmentally friendly asphalt and enhance sustainable road construction practices.

The project focuses on creating and evaluating innovative asphalt binders derived entirely from reclaimed asphalt and eco-friendly additives sourced from renewable materials.

These alternative binders are designed to serve as direct substitutes for conventional asphalt binders while maintaining essential properties such as durability, resistance to ageing, recyclability, and environmental sustainability, including lower emissions and reduced resource consumption.

To achieve this, researchers will conduct extensive laboratory analyses to identify and assess suitable renewable additives.

Over the course of three years, viable sustainable alternatives will be selected, incorporated into asphalt formulations, applied in large-scale road trials, and validated through performance assessments such as load testing. The consortium's core objective is the "development and evaluation of sustainable and climate-friendly bitumen substitutes for asphalt road construction."

This project is closely connected to NOBIT, a research initiative funded by the Volkswagen Foundation.

Project Overview

- Program: Road Innovation Initiative of BASt and BMVI
- Funding Call: "Alternative Binders or Additives for Sustainable Road Construction"
- Funding Institution: Federal Highway and Transport Research Institute (BASt)
- Project Title: Application of Sustainable Asphalt
- Acronym: ANNA
- Duration: February 1, 2025 – January 31, 2028 (36 months)
- Lead Organization: Braunschweig Pavement Engineering Centre (ISBS)
- Project Partner: VINCI Construction Shared Services GmbH (Eurovia)

Work Structure and Key Areas

The research is divided into nine work packages, covering all phases from material selection to large-scale testing and sustainability evaluation:

1. Project Coordination & Management – Overall supervision and organizational tasks.
2. Material Selection & Characterization – Identifying and assessing raw materials for sustainable asphalt binders.
3. Binder Performance Testing – Evaluating the properties of alternative asphalt binders.
4. Mix Design & Laboratory Production – Formulating and producing sustainable asphalt in controlled conditions.
5. Performance Testing of Asphalt – Assessing durability, strength, and environmental impact.
6. Full-Scale Production & Road Trials – Implementing selected asphalt mixtures in real-world test sections.
7. Load Testing & Validation – Analyzing road performance under various conditions.
8. Life Cycle & Sustainability Assessment – Measuring long-term environmental and economic impact.
9. Recommendations & Reporting – Compiling findings and providing industry guidelines.

Project Segmentation

The overall research is divided into two main sub-projects handled by the collaborating institutions:

- TU Braunschweig Sub-Project: Focused on laboratory-based studies for bitumen substitution, covering material analysis, binder testing, asphalt mix design, performance evaluation, and final reporting.

- VINCI Construction Sub-Project: Concentrated on real-world implementation, including large-scale production, field testing, and life cycle assessments.

By integrating scientific research with large-scale application, ANNA aims to drive innovation in sustainable asphalt technology, offering practical solutions for reducing reliance on virgin bitumen and promoting eco-friendly road infrastructure.

February 2025 Global Shipping Outlook: How It May Impact Your Relocation

The international shipping sector is constantly adapting, with recent developments influencing overseas moves. According to the latest report from the British Association of Removers (BAR), modifications in shipping alliances, regulatory shifts, and ongoing logistical hurdles could affect relocation timelines.

Current Shipping Landscape

North America (USA, Canada, Mexico)

The transatlantic shipping market remains strained as demand surpasses available cargo space. Hapag-Lloyd has introduced a Peak Season Surcharge, adding an extra $300 for a 20ft container and $400 for a 40ft container. Furthermore, adjustments in shipping services have led to alterations in direct routes to certain ports, which may result in longer delivery times. To ensure availability, customers are advised to secure bookings well in advance.

Asia, Oceania, and the Middle East

Trade routes connecting Asia, Oceania, and the Middle East continue to experience disruptions, with many vessels avoiding the Suez Canal and instead navigating around the Cape of Good Hope. These extended journeys have become routine, leading to longer shipping durations. Additionally, severe congestion at transshipment hubs in the Middle East is creating bottlenecks, increasing the likelihood of shipment

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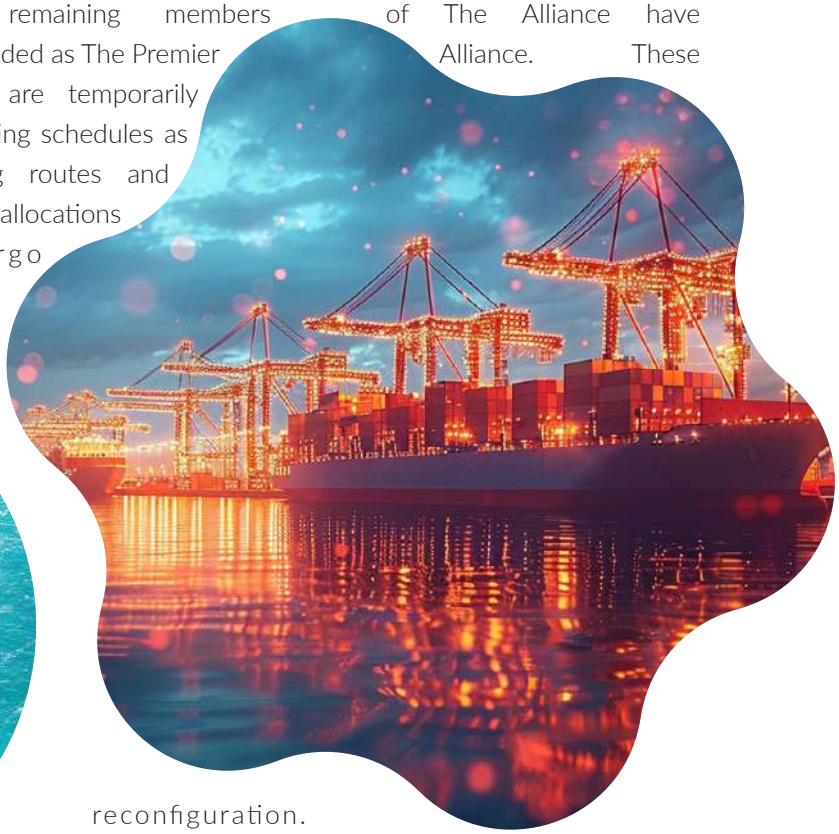
rollovers and hold-ups.

Changes in Shipping Alliances

Significant restructuring of shipping line collaborations is currently underway. Hapag-Lloyd has exited The Alliance to form a new partnership with Maersk under the Gemini Cooperation, while the remaining members of The Alliance have rebranded as The Premier Alliance. These shifts are temporarily disrupting schedules as shipping routes and vessel allocations undergo reconfiguration.



Essential Tips for a Smooth Move

- Book Early: Given rising demand and evolving shipping routes, securing a slot in advance can help prevent last-minute setbacks.
- Remain Adaptable: Port congestion and alliance restructuring may result in unpredictable transit times, making flexibility in scheduling crucial.
- Meet Regulatory Standards: The European Union's latest Import Control System (ISC2) mandates additional shipment details for vessels docking at EU ports. Promptly providing accurate information can help avoid processing delays.
- Electrical Goods & Environmental Checks: Although PAT testing is no longer required for household electrical appliances, the Environment Agency retains the authority to inspect shipments suspected of containing waste materials.
- Lithium-Ion Battery Limitations: Shipping lines continue to impose strict regulations on lithium-ion batteries. Misdeclaring these items could lead to fines, confiscation, or even disposal of the goods.

As the global shipping environment continues to shift, staying informed and planning strategically will be key to ensuring a smooth and timely relocation.

OIL MARKET OVERVIEW FEBRUARY 2025

Key Insights:

• Global oil demand is anticipated to grow by an average of 1.1 million barrels per day (mb/d) in 2025, increasing from 870,000 barrels per day (kb/d) in 2024. Although China remains the dominant contributor, its expansion is slowing considerably, with growth largely driven by the petrochemical sector. Meanwhile, India and other developing economies in Asia are accounting for a larger proportion of demand. In contrast, OECD consumption is expected to return to its structural decline after experiencing a modest uptick last year.

• Global oil production fell by 950 kb/d in January, settling at 102.7 mb/d, as colder seasonal temperatures disrupted North American output, exacerbating supply reductions in Nigeria and Libya. Nevertheless, overall production remains 1.9 mb/d higher than a year earlier, primarily due to increases in the Americas. Looking ahead, total global supply is projected to climb to 104.5 mb/d in 2025, with the bulk of the increase attributed to non-OPEC+ producers, assuming that OPEC+ voluntary production cuts stay in effect.

• Refinery throughput dropped by 1 mb/d to 82.9 mb/d in January, as extreme cold and planned maintenance work led to reduced US refining activity. This year, refinery runs are expected to average 83.3 mb/d, marking a year-on-year increase of 580 kb/d, primarily in non-OECD regions. However, in mid-January, margins for refining sour crude in Asia collapsed following the introduction of new US sanctions on Russia, which pushed Dubai crude prices higher. Meanwhile, refineries in the Atlantic Basin benefited from stronger middle distillate cracks.

• Oil inventories worldwide decreased by 17.1 mb month-on-month in December, reaching 7,647 mb, as crude stockpiles shrank by 63.5 mb, while product inventories increased by 46.4 mb. In the OECD, industry stocks continued their decline, falling 26.1 mb to 2,737.2 mb, which is 91.1 mb below the five-year average. Preliminary figures suggest that in January, global inventories fell by an additional 49.3 mb, with China experiencing a substantial draw in crude stocks.

• North Sea Dated crude prices surged by $8 per barrel in early January, briefly reaching a five-month peak of $83/bbl, as the market reacted to new US sanctions on Russia and the impact of severe winter weather in the Northern Hemisphere. However, these gains were largely reversed as economic concerns resurfaced, with expectations of increased US tariffs sparking fears of an impending trade war. By the end of the month, North Sea Dated crude had settled at $77/bbl, rising by $2.50/bbl, and was hovering around this level in early February.

Market Volatility and Adaptation

The global oil market experienced significant fluctuations in January, as the initial price surge at the start of the year gave way to multiple sources of pressure. Fears surrounding the newly imposed sanctions on Russia and Iran—and their potential to

disrupt supply—pushed oil prices higher in early January. However, market sentiment quickly shifted amid rising economic uncertainties, including trade disputes and their effects on oil demand growth. As a result, ICE Brent crude, which had rallied to over $82/bbl, declined to approximately $75/bbl as international trade tensions escalated.

The forecast for global oil demand growth in 2025 has been slightly revised upward to 1.1 mb/d, following a minor downward adjustment in 2024 growth estimates to 870 kb/d. Demand in the final quarter of 2024 was weaker than expected, despite colder weather affecting OECD regions and China. In the United States, November oil deliveries fell by 510 kb/d year-on-year, marking their sharpest contraction since June. Although China continues to lead demand growth, its share of the global increase has plummeted to 19%, a stark contrast to the 60% it commanded over the past decade.

This shift is driven entirely by petrochemical industry needs, while India and other Asian nations are taking up a growing share, contributing 500 kb/d collectively.

The impact of fresh US sanctions on Russia and Iran caused initial market turmoil, but they have yet to cause a substantial reduction in global oil supply. Iranian oil exports have only slightly declined, and Russian crude flows remain largely unchanged. Meanwhile, non-OPEC+ producers, particularly in the Americas, are expected to increase production by 1.4 mb/d this year, significantly exceeding the projected rise in global oil demand. However, OPEC+ compliance with existing production agreements is gradually reducing the expected 2025 supply surplus.

On February 3, the OPEC+ alliance reaffirmed its plan to begin reversing voluntary output reductions from April, highlighting that these adjustments have helped maintain market stability.

Looking back at 2024, the data suggests that global oil supply and demand were balanced at 102.9 mb/d for the year. However, a closer examination of crude oil, other liquids, and refined products reveals more complex dynamics. The crude oil market was undersupplied, as crude and condensate production fell by 120 kb/d year-on-year, while natural gas liquids and biofuels output increased by 570 kb/d and 200 kb/d, respectively. Refiners were compelled to operate at higher capacity to replenish declining product inventories. In December, global crude oil stocks dropped by 64 mb, while product inventories rose by 46 mb. Preliminary figures from January indicate further crude drawdowns, mainly in non-OECD regions.

In the United States, crude stockpiles remain tight, with Cushing inventories falling to their lowest level in a decade. This has helped maintain strong price structures, leading to a $2/bbl increase in the M1-M12 backwardation for both WTI and Brent crude. At one point in mid-January, WTI's M1-M12 spread neared $10/bbl, its highest level in over a year.

It remains uncertain how the market will adapt to potential new US tariffs and the broader consequences of escalating sanctions on Iran and Russia. However, history has demonstrated that the oil market is highly resilient and capable of adjusting to major disruptions—and this time is unlikely to be any different.

UK BITUMEN PRODUCTION SURGES IN 2025 AMID DECLINING DOMESTIC DEMAND

In the first 11 months of 2024, the UK saw a notable increase in bitumen production, despite a significant decline in domestic consumption due to reduced government investment in infrastructure projects.

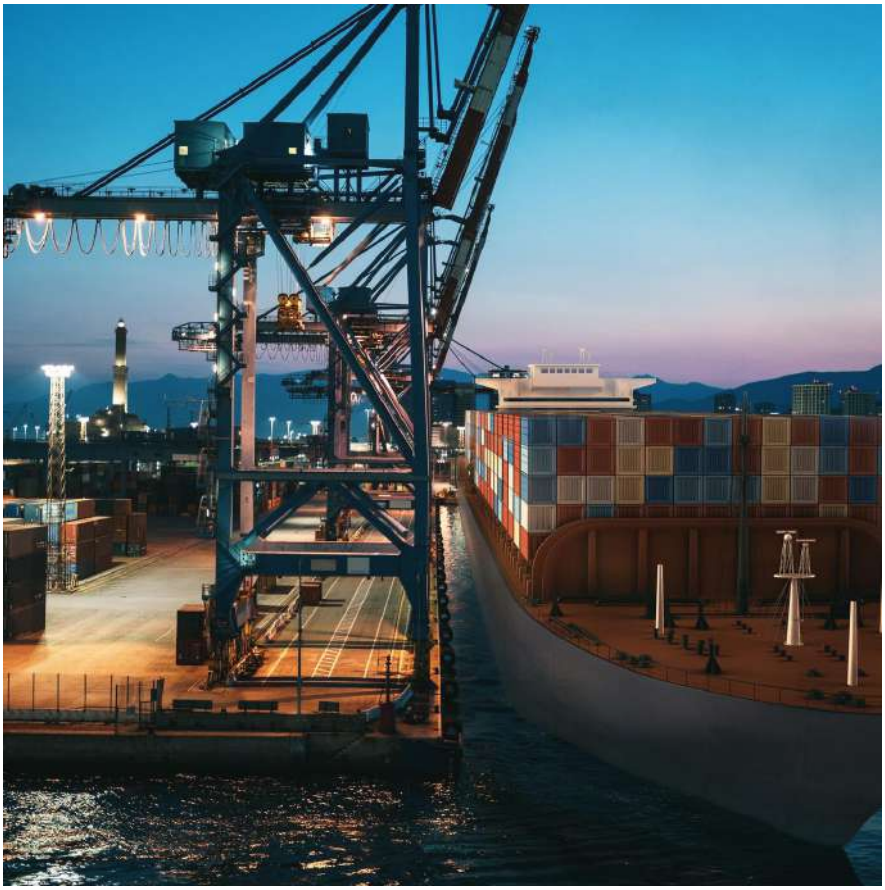
According to official data, bitumen output during this period grew by nearly 25%, driven solely by production at the Shell-Nynas joint venture refinery in northwest England—the only remaining bitumen-producing facility in the country. This sharp rise contrasts with the early 2023 cessation of bitumen manufacturing at the Lindsey refinery in northeast England. The refinery, with a capacity of 105,700 b/d, was acquired by Prax Group from TotalEnergies in 2020, but the company opted to discontinue bitumen production in favor of focusing on conventional petroleum products.

The most recent UK figures reveal a 23% year-on-year increase in bitumen production, reaching 434,000t from January to November 2024, compared to 352,000t in the same timeframe in 2023. However, output declined by 11% in the September–November period, falling to 82,000t from 91,000t recorded a year earlier.

Meanwhile, domestic consumption of bitumen dropped by 12% in the first 11 months of 2024, reaching 1.29mn t from 1.46mn t in the same period the previous year. This downward trend is attributed to insufficient government funding for construction projects, contributing to pessimism in the UK construction sector about the industry's future demand and activity levels.

Since 2021, UK annual bitumen consumption has been consistently declining. It stood at 1.84mn t in 2021, decreasing to 1.56mn t in 2022 and further to 1.54mn t in 2023. The decline in bitumen demand aligns with a broader contraction in UK refined product consumption, which saw a 12% drop in domestic deliveries between 2018 and 2023, alongside a 14% reduction in overall product output.

PLAN TO INCREASE OIL PRODUCTION BY 400,000 BARRELS BY NEXT SUMMER



The CEO of the National Iranian Oil Company (NIOC) said: "The plan to increase oil production by 400,000 barrels per day by next summer has started, and we urge the active players in the knowledge-based sector to participate in enhanced oil recovery projects."

According to WPB, Hamid Bord, speaking at the 3rd Petro-Tech conference, stated that in the past six months, significant progress has been made in increasing production, saying: "Both our production and exports are in good shape."

He also mentioned that several records for gas production had been set in the past, adding: "We once achieved a record of producing 1.115 billion cubic meters of gas."

The CEO of NIOC emphasized that the capacity to produce one billion cubic meters of gas is high, but the consumption figures are also large. He said: "In the seventh development plan, we aim to increase gas production to 1.35 billion cubic meters, but this figure is still not balanced with consumption, as the current consumption has reached the target level for the seventh plan."

Considering that many knowledge-based companies face challenges in implementing their valuable technologies, he explained that NIOC has planned to take responsibility for the implementation of technologies provided by these companies and apply them in oil fields and operational laboratories.

Bord mentioned that the amount of oil extraction from fields is another area of focus, noting: "According to statistics, the average extraction rate from oil fields in the south of the country is about 25%, but this can be increased with technological solutions."
He emphasized the need for broader collaboration between the oil industry and the technology sector, saying: "I call on all professionals in this field to actively participate in the development of smart oil industry initiatives." He also mentioned that by focusing on the development of new technologies, artificial intelligence, and digitalization, significant steps are being taken to increase efficiency, reduce costs, and improve oil reservoir management. This strategy not only improves the performance of the oil industry but also prevents technological surprises. Additionally, he pointed out that leveraging advanced technologies is a shortcut to overcoming the country's economic chal-

lenges, adding that over the past six months, more than 15 meetings with innovators, elites, and talented young people have been held, and the research and engineering section of NIOC has had notable outputs in this area.

He further added: "Two main strategies in the field of technology have been defined for NIOC. The first strategy focuses on improving organizational performance by relying on modern technologies, which leads to reduced time, lower costs, and improved quality. The second strategy aims to prevent technological surprises, as the rapid advancement of technology worldwide can pose significant challenges for the country if not properly managed."

Using Artificial Intelligence in Oil Reservoir Management

The CEO of NIOC highlighted that precise planning in various fields, especially artificial intelligence, is on the company's agenda. He said: "One of the most important projects is the use of artificial intelligence in oil reservoir management. Recently, a meeting was held with an Iranian expert, and collaborations have started in this field. Additionally, one of our neighboring countries has managed to use artificial intelligence to manage over 25% of its oil fields, resulting in at least an 80% increase in production. I hope we will soon witness the implementation of this project within the country."

Furthermore, NIOC's digitalization plan, utilizing smart technologies, will soon be implemented. He invited all experts and specialists in the technology sector to submit their ideas and suggestions, and announced that an official call for collaboration with knowledge-based companies would be made soon to benefit from their capabilities in this initiative.

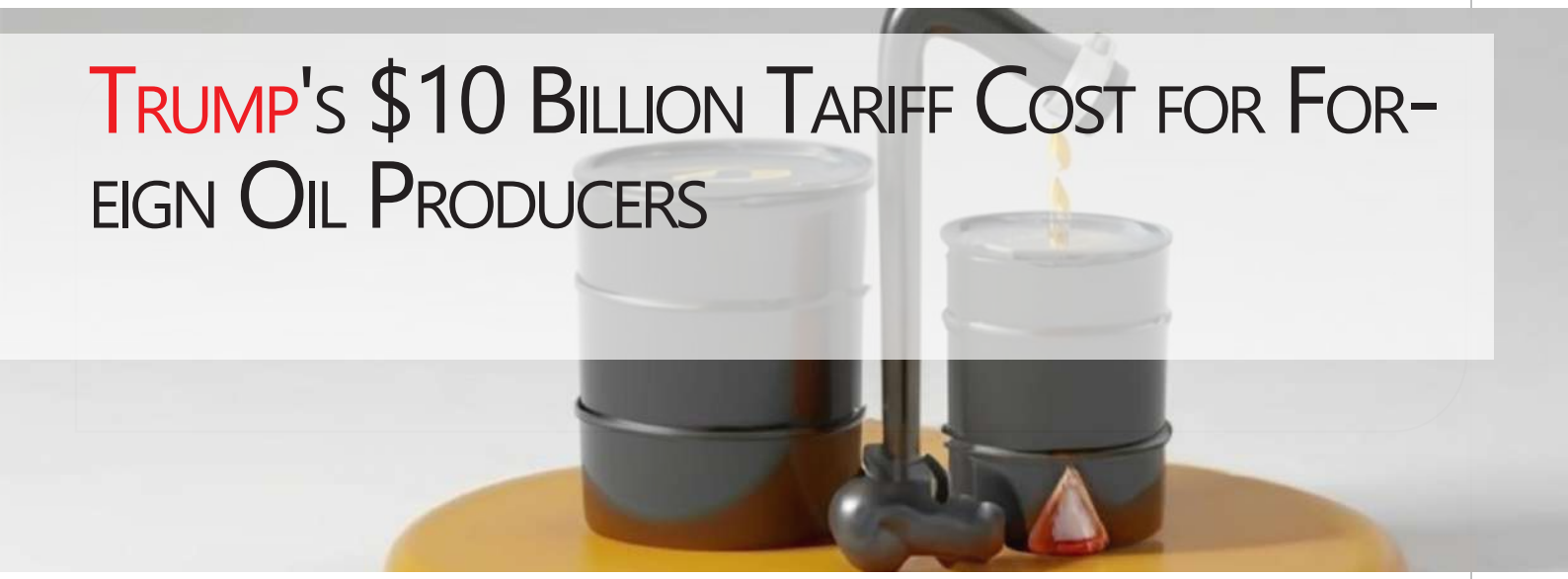
The Necessity of Using Modern Technologies

The CEO of NIOC said: "We welcome any idea that can help us." He mentioned that NIOC is collaborating with a university in Austria to use the latest global technologies. "In addition to intelligent machine management, we also need new technologies. By increasing productivity efficiency and boosting production, we can contribute to the country's economy and the organization we work for, which will ensure sustainability."

He added that despite the sanctions and other challenges, which are difficult to discuss, NIOC's colleagues have recorded excellent results in increasing oil and gas production, saying: "We also had a good record in crude oil exports during this time." He further noted that the winter gas production record was broken several times, reaching a peak of about 1.115 billion cubic meters, which is a very high number.

Regarding energy consumption, he emphasized: "While producing one billion cubic meters of gas per day is no small feat, consumption is extremely high and ruthless. Therefore, we must reach a production of 1.35 billion cubic meters of gas per day. With the current pace of consumption, the gas imbalance cannot be corrected."

Trump's $10 Billion Tariff Cost for Foreign Oil Producers



Goldman Sachs estimated that the 10% tariff planned by the U.S. on oil imports would cost foreign producers $10 billion annually.

U.S. President Donald Trump plans to impose a 25% tariff on Mexican oil imports and a 10% tariff on Canadian oil starting in March.

Despite these tariffs, U.S. investment bank Goldman Sachs expects the U.S. to remain the primary destination for heavy oil, as American refineries' advanced capabilities and low costs still make them the most competitive buyers.

Goldman Sachs estimated that the price of light crude would need to increase by 50 cents per barrel to make Middle Eastern crude grades more attractive for Asian refineries, as U.S. Gulf Coast refineries have prioritized domestic light oil over medium imported grades.

The investment bank projected that the cost of these tariffs for American consumers would amount to $22 billion annually, while the government would earn $20 billion.

Canada, the largest oil exporter to the U.S., is likely to continue exporting its 3.8 million barrels per day via pipeline, with price discounts mitigating the tariff impact.

Similarly, imports of 1.2 million barrels per day of heavy crude from Canada and Latin American countries, including Mexico and Venezuela, will likely see discounts to offset the tariff and ensure the continued flow of oil to the U.S.

According to a Reuters report, although tariffs may shift trade flows, Goldman Sachs believes Canadian producers, with limited alternative buyers, will have to bear the brunt of the tariff through price discounts in order to remain competitive in the U.S. market.

GLOBAL BITUMEN MARKET SET TO REACH $143.84 BILLION BY 2030 WITH A 3.56% CAGR

Expanding Infrastructure Fuels Bitumen Market Growth

WPB: The worldwide bitumen industry, which was valued at $112.60 billion in 2023, is anticipated to grow to $143.84 billion by 2030, reflecting a compound annual growth rate (CAGR) of 3.56%. This expansion is largely attributed to increasing investments in infrastructure and the growing demand for road construction on a global scale.

Key Factors Driving Market Growth

A significant rise in infrastructure initiatives, particularly in developing nations, has substantially increased the need for bitumen. Governments are allocating considerable resources to road construction and maintenance to support economic expansion and enhance transportation systems. Since bitumen acts as a crucial binding agent in asphalt, it plays an essential role in ensuring long-lasting road surfaces.

Beyond the transportation sector, the construction industry—especially the roofing segment—has emerged as a major consumer of bitumen. Its use in waterproofing membranes is widespread due to its resistance to environmental conditions, making it a vital material for safeguarding buildings. Additionally, bitumen's diverse applications in adhesives and sealants contribute to its expanding market presence.

Innovative advancements have led to the development of modified bitumen products with improved durability. These technological enhancements cater to specific industrial and paving needs, offering superior resistance to temperature fluctuations and mechanical strain. Such progress not only strengthens market growth but also helps meet evolving construction requirements.

Market Segmentation Overview

The bitumen industry can be categorized based on product type, application, and geographical region.

- Product Types: The market comprises paving-grade bitumen, oxidized bitumen, polymer-modified bitumen (PMB), and bitumen emulsions. Among these, paving-grade bitumen remains dominant due to its extensive application in road building. However, polymer-

modified bitumen is gaining popularity for its enhanced properties, particularly in high-stress environments.

• Applications: Bitumen is primarily used in road construction, waterproofing, adhesives, and insulation. Infrastructure expansion continues to drive demand in the road construction sector, while the waterproofing segment is also growing steadily, particularly in urban areas where building protection is crucial.

• Regional Trends: The Asia-Pacific region leads the market, driven by urbanization and large-scale infrastructure projects in nations such as China and India. North America and Europe follow closely behind, benefiting from substantial investments in road maintenance and development.

Country-Specific Market Insights

• United States: The U.S. market is expanding due to federal programs focused on upgrading infrastructure. Increased efforts in highway and bridge construction have led to rising demand for high-quality bitumen. Additionally, the integration of recycled materials into asphalt production aligns with sustainability goals.

• Germany: As a key player in Europe, Germany relies heavily on bitumen to maintain its extensive highway network. Additionally, its emphasis on energy-efficient buildings has fueled demand for bitumen-based roofing solutions, known for their durability and insulation capabilities.

• China: Rapid industrialization and urban expansion in China have significantly increased bitumen consumption. The Belt and Road Initiative further boosts demand as new infrastructure projects take shape. Additionally, metropolitan construction activities continue to drive bitumen usage in waterproofing applications.

• India: The Indian market is witnessing substantial growth due to government-led projects such as Bharatmala, aimed at developing extensive road networks. The push for improved rural and urban connectivity ensures a steady demand for bitumen, while modernized construction techniques enhance road durability.

• United Arab Emirates: The UAE has positioned itself as a major bitumen consumer in the Middle East due to large-scale infrastructure projects, including roads, airports, and commercial hubs. Given the country's harsh climate, polymer-modified bitumen is extensively used to ensure pavement longevity.

Competitive Landscape and Industry Developments

The bitumen sector is highly competitive, with major companies shaping market dynamics. Leading players include ExxonMobil Corporation, Royal Dutch Shell Plc, BP Plc, TotalEnergies SE, and China National Petroleum Corporation (CNPC).

• ExxonMobil Corporation remains a leader in bitumen innovation, focusing on high-performance products tailored for diverse environmental conditions and application needs.

• Royal Dutch Shell Plc supplies a comprehensive range of bitumen products for road construction and industrial use, ensuring a consistent global supply chain.

• BP Plc prioritizes sustainability by incorporating recycled materials and reducing environmental impact, addressing the demand for eco-friendly construction materials.

• TotalEnergies SE specializes in polymer-modified bitumen, offering enhanced durability and resilience for infrastructure projects requiring long-lasting surfaces.

• China National Petroleum Corporation (CNPC) plays a critical role in meeting China's surging bitumen demand, supporting the country's rapid infrastructure expansion.

Recent market trends include strategic mergers and acquisitions, enabling companies to diversify their product offerings and extend their geographical reach. Additionally, investments in sustainable technologies, such as bio-based bitumen, are increasing to align with global environmental standards and reduce reliance on fossil fuels.

Conclusion

The global bitumen market is on a steady growth trajectory, fueled by large-scale infrastructure investments, expanding road construction activities, and increasing demand for waterproofing solutions in the construction industry. As urbanization accelerates and governments worldwide prioritize road connectivity improvements, bitumen consumption is expected to rise significantly across key economies, including the U.S., Germany, China, India, and Brazil.

Exploring Asphalt Binder: A Key Opportunity in Bitumen Beyond Combustion

Alberta Innovates has identified asphalt binder—the adhesive component in asphalt mixtures—as the most commercially viable bitumen beyond combustion (BBC) product in both the short and long term.

Why Asphalt Binder Stands Out

According to Paolo Bomben, Director of Bitumen Beyond Combustion at Alberta Innovates, despite its lower market price compared to carbon fiber or energy carbon materials, asphalt binder holds significant promise for three primary reasons.

First, there are no substantial technological hurdles preventing the expansion of asphalt binder production. The process of extracting it from bitumen and other heavy oils is well established, with commercial production already underway at Alberta's Imperial Strathcona and Cenovus Lloydminster refineries. While each manufacturer follows proprietary steps, the core process remains a distillation sequence that isolates the desired product with properties tailored to customer needs.

Second, the global demand for asphalt—and consequently, asphalt binder—far exceeds that of other BBC products. While the market for carbon fiber stands at around 125,000 tonnes per year and energy carbons fall below 3,000 tonnes annually, the asphalt sector reaches approximately 140 million tonnes per year. As the global population grows and infrastructure expands, demand for high-quality asphalt binder is expected to rise accordingly.

Lastly, Alberta's bitumen-derived asphalt binder is considered a premium product. With the increasing weight of electric vehicles, the need for more durable road surfaces will become critical, further reinforcing the importance of high-quality asphalt binder in future infrastructure projects.

Challenges in Expanding Market Access

Despite its advantages, one of the key obstacles to expanding Alberta's asphalt binder industry is transportation. Efficient and cost-effective methods for shipping the material at low temperatures over long distances are necessary to open up markets beyond Western Canada.

To address this, Alberta Innovates has initiated multiple studies, including one that benchmarks the quality of Alberta's asphalt binder against global competitors and another that explores new market opportunities. These reports, released in early 2021, provide insight into the competitive advantages of Alberta's product.

Additionally, the organization has been supporting startups and research initiatives focused on transforming bitumen-derived asphalt binder into solid forms, allowing it to be transported more economically using unheated railcars and bulk carriers. Calgary-based Solideum Inc. is among the companies making significant progress toward commercializing such technology.

This segment of the series delves into findings from the asphalt binder benchmarking and market analysis studies, along with an update on Solideum's project, featuring insights from Ian Gates, the company's Chief Operating Officer and a professor of petroleum and chemical engineering at the University of Calgary.

Benchmarking Alberta's Asphalt Binder

Research has shown that Alberta's bitumen-derived asphalt binder is among the highest quality in the world, rivaled only by material sourced from Venezuela. The benchmarking study, conducted by Simon Hesp, a chemistry professor at Queen's University and an expert in asphalt binder research, compared Alberta's product—derived from various oilsands regions and recovery methods—to binders produced from crude oil worldwide.

The results demonstrated that Alberta's asphalt binder offers superior resistance to cracking, primarily due to its low wax content and optimal asphaltene composition. These properties enhance durability and performance, making it an ideal choice for road construction.

According to Hesp, excessive paraffin wax in asphalt binders leads to reduced adhesion and increased brittleness in cold temperatures, which can cause pavement cracking. Alberta's bitumen, with its naturally low wax levels and consistent composition, reduces pavement deterioration by up to 50%.

Further research indicates that roads constructed using Alberta's binder can last up to 40 years, significantly outpacing roads in regions like New England, where lower-quality binders result in a lifespan of just a decade. Additionally, its low wax content enhances recyclability, extending the usability of asphalt pavements by another 30 years.

However, premium quality comes at a cost. Alberta's asphalt binder is priced at approximately $800 to $900 per tonne—nearly double that of lower-quality alternatives. Given that one tonne of binder can produce 20 tonnes of asphalt mix, this cost factor plays a critical role in market competitiveness.

Opportunities in New Markets

To assess market potential, Alberta Innovates commissioned ADI Analytics, a Houston-based consultancy, to evaluate asphalt binder demand in Asia and the U.S. These regions were identified as strategic targets due to their proximity and growing infrastructure needs.

As of 2020, Asia accounted for over 39 million tonnes of global asphalt demand, while the U.S. consumed approximately 27 million tonnes. Both markets are projected to grow by over 3% annually between 2020 and 2025, aligning closely with global growth rates.

In Asia, the primary applications for Canadian asphalt binder include expressways, highways, and select airport projects, while in North America, the main opportunities lie in interstate highways, urban roads, and airport infrastructure.

The study revealed that Asian buyers prioritize supplier relationships and pricing above all else, with product quality ranking third. In contrast, U.S. customers place quality as the second most critical factor after cost. Given the rise of electric vehicles and the increasing adoption of recycled asphalt pavement (RAP)—which accounts for over 20% of asphalt demand in the U.S. and a growing share in key Asian countries—the importance of high-performance asphalt binder is expected to grow.

To differentiate themselves from competitors, Canadian producers must actively educate customers about the long-term benefits of using high-quality asphalt binder, emphasizing performance over price.

Innovations in Transporting Asphalt Binder

Solideum Inc. has developed a process that converts heavy oil, bitumen, and dilbit into two distinct fractions: a light product (with an API gravity of 33+) and a heavy product (with an API gravity below 5). The heavy fraction can then be solidified into various forms—including pellets, flakes, and spaghetti strands—to facilitate transportation over long distances. The spaghetti form has been identified as the most cost-effective option.

The company has expanded its Bonnyville pilot project, which initially processed 100 barrels per day, to a 500-barrel-per-day capacity with financial backing from Alberta Innovates. According to Gates, their technology has delivered promising results, demonstrating its potential to streamline asphalt binder transportation.

At present, Solideum faces minimal technical risks and continues to refine its process. However, Gates acknowledges that potential clients are hesitant to adopt the technology without a fully operational commercial-scale facility. The company is now working to scale up production to between 1,000 and 10,000 barrels per day.

Given the broader vision of utilizing Alberta's heavy oil and bitumen for fixed carbon applications such as asphalt, companies are increasingly exploring solutions like Solideum's to enhance product diversity and reduce emissions.

Although widespread commercialization of this technology may still be a few years away, industry experts believe that advancements in transportation and processing will be key to unlocking new markets for Alberta's asphalt binder.

Researchers Transform retired Wind Turbine Blades into Road Construction Material

LANZHOU – A team of Chinese scientists has introduced a groundbreaking method for repurposing old wind turbine blades, potentially changing the way these large structures are handled after their operational life ends.

Following five years of intensive study, a research group led by Tang Zhicheng from the Lanzhou Institute of Chemical Physics, part of the Chinese Academy of Sciences, has developed a technique that not only addresses the challenge of disposing of retired wind turbine blades but also turns them into useful materials, fostering sustainability in the renewable energy sector.

China's wind energy industry has expanded rapidly in recent years, playing a crucial role in the global transition to cleaner energy and efforts to combat climate change. However, as wind turbines typically last between two and two-and-a-half decades, a significant number are now reaching the end of their service life.

Projections indicate that by 2025, a substantial wave of wind turbines in China will be decommissioned, raising concerns about their disposal. While some components, such as towers, hubs, and gearboxes, can be salvaged for scrap metal, turbine blades present a unique challenge. These blades, constructed from composite materials like glass fiber, carbon fiber, and epoxy resin, are designed to be lightweight, durable, and highly resistant to environmental forces. However, these very characteristics make them difficult and expensive to recycle, with no widely adopted large-scale solution currently available.

The research team has addressed this issue by taking advantage of the retired blades' beneficial properties—lightweight construction, durability, and corrosion resistance. By employing a combination of mechanical grinding and chemical treatment, they successfully modified the blade materials for use in asphalt and concrete mixtures.

In collaboration with a local road construction firm, the team applied this innovative approach in September 2024, incorporating processed wind turbine blade materials into a section of the Qingfu Highway in Lanzhou, located in northwest China's Gansu province.

Wang Zhaoli, deputy general manager of the road construction company, reported that after more than five months of use, the modified asphalt pavement demonstrated excellent durability, showing no signs of cracking, rutting, or material detachment. These promising results indicate that the method could provide an effective and practical way to repurpose retired turbine blades.

The research team plans to conduct further demonstration projects in 2025, working closely with industry partners to refine and scale up the technology. Their goal is to establish a reliable and widely applicable solution for recycling decommissioned wind turbine blades.

Tang emphasized that as advancements in recycling techniques continue, the growing number of retired wind turbine blades could be transformed into valuable secondary raw materials, often referred to as "urban minerals."

This development, he noted, would not only support the long-term sustainability of the renewable energy sector but also play a role in China's broader environmental objectives—achieving peak carbon emissions by 2030 and reaching carbon neutrality by 2060.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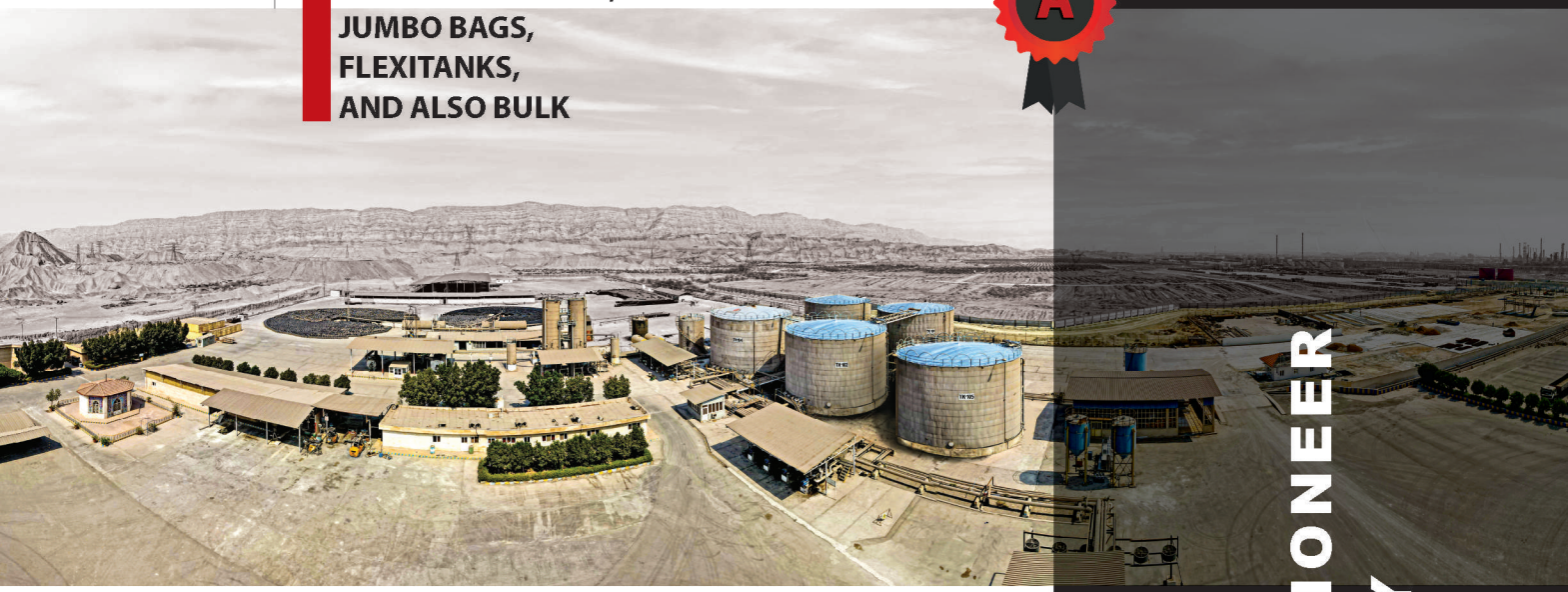

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