Book

Energy Sector and Climate Action: Initiatives Inspired by the Paris Agreement

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INSTITUTO BRASILEIRO
DE PETRÓLEO, GÁS E
BIOCOMBUSTÍVEIS

From Energy to Knowledge:

The Path to Decarbonization

Brazil is uniquely qualified to lead the transition towards a low-carbon economy. With its diverse energy mix and long-standing technical expertise, the country is well-placed to integrate different energy sources and take a leading role in the global energy transition.

The oil and natural gas sector, responsible for about 80% of the world's energy supply, faces the challenge – and the responsibility – of continuing to contribute to social and economic development in an increasingly sustainable way. This journey necessarily involves innovation and the adoption of new technologies aimed at reducing and mitigating carbon emissions, increasing the sector's efficiency and competitiveness.

The decarbonization of the economy involves both the search for new forms of low-carbon energy generation and the improvement of existing processes. In segments known as hard to abate, in which emissions reduction is more complex, technology and innovation play a decisive role.

Companies are mobilized, and the transformation is already underway. This IBP special book brings together concrete examples of this evolution — projects, methodologies, and technological solutions developed by our Associates to boost decarbonization and energy efficiency in the country.

Producing and sharing technical knowledge is part of the DNA of the Brazilian Petroleum, Gas and Biofuels Institute (IBP). As a representative of the oil, natural gas, and biofuels industry in Brazil, we are committed to promoting the advancement of the sector, contributing to a safe, responsible, and fair energy evolution.

Enjoy your reading!

Roberto Ardenghy
PRESIDENT/CEO
Brazilian Petroleum, Gas and Biofuels Institute

Decarbonization and Energy Security

The energy transition process must be gradual, equitable, and fair, ensuring supply safety, energy accessibility for society, and the efficient use of existing energy resources.

Thus, the oil, gas, and biofuel industry is part of this trajectory of decarbonization of the economy, expanding the supply of more sustainable energy, increasing investments in low-carbon sources, and enabling the use of technologies in different segments.

Within this context, one of the objectives of the oil and gas chain is to reduce CO2 emissions and increase the sustainability of its activities. It should be noted that there is a constant process of innovation in search of new technologies capable of expanding the decarbonization of the industry.

Among the technologies for decarbonizing activities are the electrification of oil and gas production platforms, the development of Carbon Capture, Utilization, and Storage (CCUS) plants, the improvement of digital technologies to increase production efficiency throughout the chain and reduce costs and CO_2 emissions, and the development of enhanced biofuels.

In Brazil, it is worth noting that the oil, gas, and biofuel industry funds several innovation projects in decarbonization technologies, energy transition, and low-carbon energy sources through the ANP's Research, Development, and Innovation (RD&I) Clause. In 2024, approximately 45% of the financial resources from this program were invested in projects related to efficiency, energy transition, and sustainability, indicating the contribution of the O&G industry to the evolution of the energy sector.

Given this scenario, the oil, gas, and biofuel industry has contributed to the diversification of the energy sector, supporting supply and promoting innovation in the search for new technologies applied to decarbonization, ensuring amplified development of the energy sector.

Summary

PETROBRAS

PETROBRAS
PROFLORESTA+ | PURCHASE OF REFORESTATION CREDITS

STARTING YEAR: Public Notice in 2025 | Purchase of credits begins in 2033

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: Mitigation; Nature-Based Solutions; Carbon Market

Project Summary:

ProFloresta+ is a joint initiative by Petrobras and BNDES aimed at structuring ecological restoration projects to generate high-quality and integrity carbon credits. The program supports Petrobras' emission reduction commitments, contributes to increasing vegetation cover with native species, and strengthens the technical and management structure of the production chain in the forest restoration sector and the carbon credit market in Brazil. The goal is to restore up to 50,000 hectares of degraded areas in the Amazon, generating about 15 million carbon credits (each credit equals 1 ton of CO2e). Projects with native species will be selected to generate carbon credits, with guaranteed purchase by Petrobras through long-term (offtake) contracts. BNDES participates by offering subsidized financing through special lines, such as the Climate Fund.

Methodologies | Technologies Applied

The development of ProFloresta+ utilized methodologies that integrated multidisciplinary collaboration, innovation, and practical validation. Design Thinking, applied by technical, legal, environmental, and financial experts, allowed for the understanding of the carbon credit market demands and creation of user-centered solutions. In parallel, the use of Requests for Proposal (RFP) allowed for the collection of pro- posals and feedback from the market, adjusting clauses, conditions, and technical aspects of the con- tract. This combination ensured technical rigor, clarity, and adherence to best practices, consolidating ProFloresta+ as an innovative and robust initiative.

Results | Indicators Achieved

ProFloresta+ aims to restore up to 50,000 hectares in the Amazon, generating approximately 15 million carbon credits. With three planned offtake contracts, the project seeks to consolidate a scalable restoration chain, strengthening nurseries, seed collectors, and local training. In addition to guaranteeing high-quality credits to Petrobras, it proposes a model contract that serves as a benchmark for the market and reinforces the company's commitment to long-term decarbonization.

Partnerships

ProFloresta+, a partnership between Petrobras and BNDES, aims to structure ecological restoration projects to generate high-integrity carbon credits. Petrobras will act as the offtaker, guaranteeing the pur- chase at a fixed price, while BNDES will finance the projects at reduced rates. This is Petrobras' first long-term reforestation credit contract. The initiative has technical support from the Climate and Society Institute (iCS), in partnership with Imaflora, Agroícone, and Mattos Filho, responsible for structuring the public notice and contractual model.

Replication Possibility

Yes, in other companies/sectors.

SLB

FIRST BECCS PROJECT IN BRAZIL CCS SOLUTIONS

STARTING YEAR: 2021

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: GHG Emissions Reduction; Biofuels; Carbon Market; MRV; CCS

Project Summary:

SLB, a leading technology company in the energy sector, has partnered with FS, an innovative and leading Brazilian corn ethanol producer, in its BECCS project at Lucas do Rio Verde, Mato Grosso, aiming to produce carbon-negative ethanol. SLB has supported the initiative from the start, from interpreting seismic data and drilling a stratigraphic well to map geological formations suitable for safe CO_2 storage. The project, Brazil's first BECCS and part of FS's sustainability vision, will capture CO_2 from fermentation, compress and dehydrate it, and then inject it underground, potentially removing over 400k TPA of CO_2 annually. FS plans to invest further to expand the plant once regulatory approval is granted, creating jobs and enabling the monetization of carbon credits.

Methodologies | Technologies Applied

A complete portfolio of subsurface studies, from seismic processing and interpretation, to well design, including drilling, logging, completions, and support with the certifications required in the carbon market.

Results | Indicators Achieved

Once implemented, the project would have around 400k CO_2 emissions TPA negative.

Partnerships

SLB, FS, ANP, MME, and many others.

Replication Possibility

Yes, in other companies/sectors.

PETROBRAS

PETROBRAS
SÃO TOMÉ CCS PILOT PROJECT

STARTING YEAR: 2028
CURRENT STATUS: In progress
AREA OF CONTRIBUTION: CCS

Project Summary:

Petrobras' São Tomé CCS Pilot Project is the first initiative for carbon capture and storage in a saline reservoir in Brazil. Located in Macaé (RJ), it aims to capture up to 100,000 tons of CO_2 per year between 2028 and 2031 and store it deep underground in the Barra do Furado region. With support from ANP and INEA, the project seeks to validate technologies and standards for future CCS hubs, promoting regulatory and technological advances. It is a strategic RD&I platform that positions Brazil at the forefront of industrial decarbonization and energy transition.

Methodologies | Technologies Applied

CO_2 Capture, Geological Storage, Research, Development, and Innovation (RD&I).

Results | Indicators Achieved

The goal of the São Tomé CCS project is to capture up to 100,000 tons of CO_2 per year over a three-year period starting in 2028 and inject it into a deep saline reservoir in the Barra do Furado region of Quissamã (RJ). As the first project of its kind in a saline reservoir in the country, CCS São Tomé will enable agencies such as ANP and INEA to test, adjust, and validate procedures and standards applicable to the CCS value chain, marking a regulatory advance in geological carbon storage for future commercial projects. The São Tomé CCS Pilot Project is a strategic Research, Development, and Innovation (RD&I) initiative that will validate, in a real-world environment, technologies and methodologies fundamental to implementing carbon capture and storage (CCS) hubs in Brazil. The technologies applied enable the monitoring of the CO_2 plume's evolution with unprecedented accuracy nationwide. The information obtained from the project may lead to new applications for CO_2, such as the production of synthetic fuel.

SLB

CCS – NORTHERN ENDURANCE PARTNERSHIP | UNITED KINGDOM

STARTING YEAR: 2028

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: GHG Emissions Reduction; Carbon Market; MRV; CCS

Project Summary:

SLB has been awarded a technologies and services contract for carbon storage site development in the North Sea by the Northern Endurance Partnership (NEP), an incorporated joint venture between bp, Equinor and TotalEnergies. NEP is developing onshore and offshore infrastructure needed to transport CO_2 from carbon capture projects across Teesside and the Humber — collectively known as the East Coast Cluster — to secure storage under the North Sea. In the project, SLB will deploy its Sequestri™ carbon storage solutions portfolio — which includes technologies specifically engineered and qualified for the development of carbon storage sites. The project scope includes drilling, measurement, cementing, fluids, completions, wireline and pumping services.

Methodologies | Technologies Applied

Sequestri™ solutions, drilling, measurement, cementing, fluids, completions, wireline, and pumping services.

Results | Indicators Achieved

Infrastructure to transport and permanently store up to 4 million tCO_2/year.

Partnerships

SLB, Northern Endurance Partnership, bp, Equinor, TotalEnergies.

Replication Possibility

Yes, in other companies/sectors.

NORTHERN LIGHTS

STARTING YEAR: 2021
CURRENT STATUS: In progress
AREA OF CONTRIBUTION: CCS

Project Summary:

Northern Lights is the world's first open-source CO_2 transport and storage infrastructure, developed under Norway's Longship initiative. Phase 1, now complete, enables the storage of 1.5 million tons of CO_2 annually, with operations set to start in the summer of 2025. Backed by Equinor, Shell, TotalEnergies, and the Norwegian Government, it offers scalable decarbonization for European industries. In March 2025, Phase 2 was launched to expand capacity to 5 million tons/year, supported by EU funding. The new infrastructure includes ships, tanks, and a jetty in Øygarden, with operations expected to start in late 2028.

Methodologies | Technologies Applied

Carbon Capture & Transport, Pipeline Infrastructure, and Subsurface Storage.

Results | Indicators Achieved

Phase 1 Completion and Expansion: We have completed the first phase of Northern Lights' CO_2 transport and storage infrastructure, with an initial capacity of 1.5 million tons per year. With operations set to start in the summer of 2025, we are now expanding to a minimum of 5 million tons annually to meet growing demand from European industries.

Partnerships

With the support of the Norwegian Government and our owners Equinor, Shell, and TotalEnergies, Northern Lights provides realistic decarbonization opportunities for Norwegian and European industries.

SLB

CARBON CAPTURE AND STORAGE (CCS) LONGSHIP PROJECT | NORWAY

STARTING YEAR: 2021

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: Carbon Market; CCS; GHG Emissions Reduction; MRV

Project Summary:

SLB supports Norway's Longship project, Europe's first complete carbon management value chain. Activities include carbon capture, CCS digital workflows, subsea equipment, and EPC services. SLB Capturi deployed JustCatch™ and BigCatch™ capture plants for Heidelberg Materials (cement) and Hafslund Celsio (energy from waste). At the Northern Lights joint venture site, SLB expanded its CCS digital workflows and simulation capabilities through the Delfi™ platform, optimizing storage operations. Additionally, SLB OneSubsea was awarded EPC contracts for phase two CO_2 injection systems, which includes the supply of two new subsea CO_2 injection systems and tie-in equipment—following the successful completion of Phase 1 systems in 2023.

Methodologies | Technologies Applied

JustCatch™ modular carbon capture units, cross-border CO_2 transportation and storage, CO_2 liquefaction and temporary storage facilities, and modular plant design.

Results | Indicators Achieved

Brevik Cement Plant: 400,000 tCO_2/year captured, the world's first industrial-scale cement carbon capture. Hafslund Celsio: 350,000 tCO_2/year expected capture. Ørsted Kalundborg Hub (Denmark): 430,000 tCO_2/year planned. Twence Facility (Netherlands): 100,000 tCO_2/year captured.

Partnerships

Government of Norway, SLB, Northern Lights JV, Heidelberg Materials, Hafslund Celsio.

Replication Possibility

Yes, in other companies/sectors.

PETROBRAS

PETROBRAS' INTEGRATED CLIMATE ADAPTATION PLAN: CONNECTING CORPORATE STRATEGIES TO TERRITORIAL RESILIENCE

STARTING YEAR: 2024

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: Nature-Based Solutions; Adaptation; Asset Management

Project Summary:

Petrobras' Integrated Climate Adaptation Plan structures actions to address the challenges of climate change, combining the protection of corporate assets and operations with external initiatives aimed at strengthening the resilience of vulnerable urban communities. Developed by the Adaptation, Response and Recovery Working Group, the plan organizes workstreams that guide both corporate risk management and the company's socio-environmental engagement. With a nationwide scope, the plan connects the oil and gas industry to public policies and community-based actions, promoting climate solutions at the territorial scale through urban planning, green infrastructure, and collaborative governance.

Methodologies | Technologies Applied

Climate modeling using RCP and SSP projections (CMIP5 and CMIP6), applying dynamic downscaling for offshore regions. Water risk assessment tools such as WRI Aqueduct, IREH, and the Decision Support System (developed with USP). Platforms like AdaptaBrasil and Probable Futures for risk analysis related to extreme droughts, landslides, and floods. Methodological framework based on guidelines from FGV and IPCC for planning, implementing, and monitoring adaptation actions. Integrated assessment of physical climate risk using operational and reliability indicators.

Results | Indicators Achieved

Mapping 7 priority physical risks: water scarcity, extreme drought, meteorological-oceanographic changes, landslides, floods, wildfires, and heatwaves. Update of the physical risk matrix, including severity and probability assessments for critical assets. Definition of adaptation strategies by implementation horizon. Short term: use of drones for wildfire monitoring, increased storage capacity, and occupational health training. Medium term: update of hydrological studies, development of climate indicators, guidelines for heatwaves. Long term: climate control of facilities, expansion of green areas, revision of operational and social standards.

Partnerships

USP, UFRJ, INPE, FGV.

Replication Possibility

Yes, in other companies/sectors.

Braskem

Braskem

VESTA: IMPROVING ENERGY EFFICIENCY IN A PETROCHEMICAL COMPLEX THROUGH A PIONEERING APPROACH

STARTING YEAR: 2022

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: Energy Efficiency; GHG Emissions Reduction

Project Summary:

Redesign of the thermoelectric system at the ABC Petrochemical Complex, replacing low-efficiency steam turbines with high-speed and high-efficiency motors, supported by a new cogeneration concept. This advanced configuration not only delivers reliable electric and steam output (38 MW and 160 tons/hour, respectively) but also reduces emissions of CO_2, NO_x, and water usage through optimized low-emission combustion technologies. The investment presents a low payback and positive NPV, ensuring an expressive energy cost reduction of 4.3 MMU/year.

Methodologies | Technologies Applied

The Vesta' project features two major innovations. The first is electrification, which replaces the steam turbines previously used to drive process compressors with high-speed electric motors. Three motors were installed, ranging from 3.2 MW to 11.8 MW, operating at speeds of up to 14,250 rpm - significantly higher than traditional motors, which typically run at up to 3,600 rpm. The second innovation involves cogeneration. The gas turbines were specifically designed to operate using a residual process gas containing up to 80% hydrogen, which enhances energy efficiency and sustainability.

Results | Indicators Achieved

The project aims to reduce 100kt/year of CO_2e in the site's GHG emissions by decreasing natural gas and grid electricity consumption and replacing old generation technologies with more efficient ones. Reduction of energy consumption (7.3 %); water consumption (11.4%); and hydrocarbon flare events due to the enhancement of site operation reliability.

Partnerships

The cogeneration is based on a partnership between Siemens and Braskem, resulting in an integrated plant design. The motorizations were implemented by Braskem in partnership with GE/Baker Hughes.

Replication Possibility

Yes, in other companies/sectors.

SLB

REDA AGILE™ | EMISSION REDUCTION AND INCREASED EFFICIENCY IN ONSHORE ARTIFICIAL LIFT

STARTING YEAR: 2025

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: GHG Emissions Reduction; Energy Efficiency; Sustainability

Project Summary:

REDA Agile™ was developed to optimize production in mature onshore fields, reducing emissions, installation time, and energy consumption. With an ultra-compact design and modular architecture, it integrates a pump, motor, and protector into a high-speed assembly, up to three times faster than conventional systems. The solution reduces the use of rigs and raw materials, facilitates component reuse, and generates energy savings of up to 17%, with a reduction of up to 1,360 kg of CO_2e per workover. Aligned with UN SDGs 7, 9, 12, and 13, REDA Agile™ combines efficiency, sustainability, and reliability in onshore wells with high deviation or requiring rapid mobilization.

Methodologies | Technologies Applied

High-speed, high-efficiency 2-pole induction motors (IM) that can operate up to 167 Hz (10,000 RPM), pumps and gas separator with premium 5530 alloy stage material and tungsten carbide bearings, protector with sand filters, high-load thrust bearing with active cooling, and special mechanical seals for greater reliability.

Results | Indicators Achieved

Direct emissions reduction up to ~1,360 kg CO2e per workover. Energy efficiency up to 17% savings in daily consumption per barrel produced. Lower impact on the supply chain by using ~25% of the material used in traditional ESPs. Circular economy-wise, there are reusable and reconditionable modules that extend the useful life of assets. In terms of inventory optimization, the: standardization reduces inventory by up to 40% and simplifies logistics.

Replication Possibility

Yes, in other companies/sectors.

PETROBRAS

REFTOP PROGRAM

STARTING YEAR: 2021

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: GHG Emissions Reduction; Electrification; Mitigation; Energy Efficiency; Sustainability; Asset Management

Project Summary:

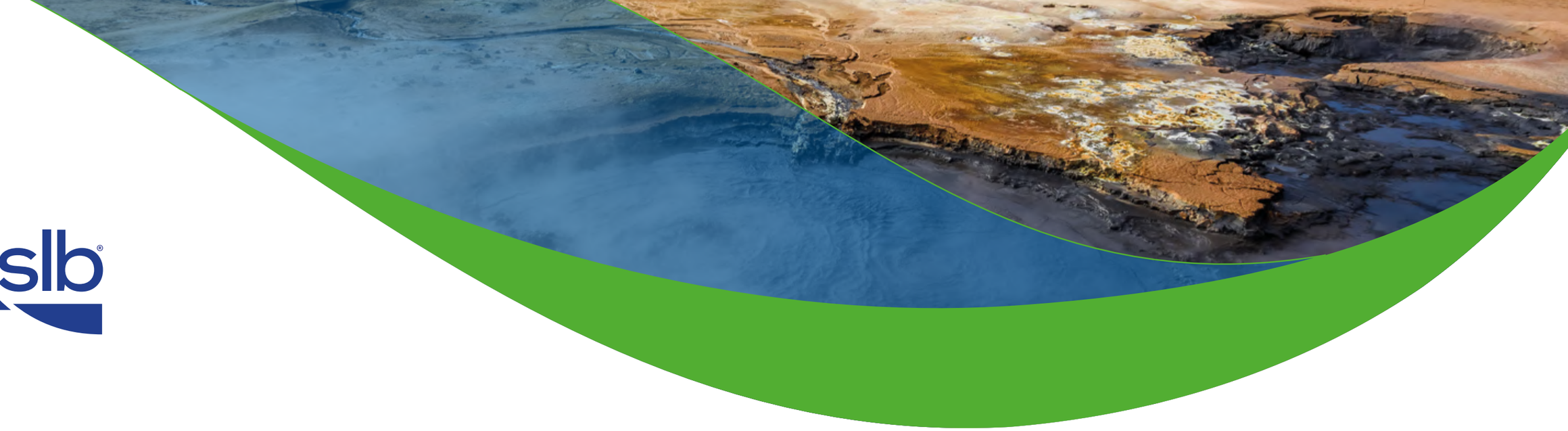
Launched in 2021, the RefTOP Program aims to position our refining facilities among the world's best in terms of sustainability, operational efficiency, and energy efficiency by 2030. The program involved a thorough analysis of our refining assets to identify ways to generate value through improved energy performance. Since then, we have set successive records in energy performance, reducing the Sustainable Energy Index (IES) by 11.4 points between 2020 and 2024. Currently, we have 113 mitigation actions in progress linked to the program.

Methodologies | Technologies Applied

Projects for energy integration and process optimization. Increased combustion efficiency of furnaces and boilers. Reduced steam and condensate losses through increased availability of steam traps and loss prevention. Optimization of the thermoelectric system, resulting in better use of inputs such as natural gas, electricity, and steam in operations. Reduction of systemic gas delivery to flare systems through increased availability of compressors, identification, and repair of valve losses.

Results | Indicators Achieved

Since its launch, the actions implemented by the Reftop Program have resulted in a reduction of approximately 833 million cubic meters of natural gas consumption, representing a decrease of about 1.7 million tons of CO_2 equivalent greenhouse gas emissions.



SLB

NATIONAL STRATEGY TO EVALUATE GEOTHERMAL RESOURCE POTENTIAL: OMAN

STARTING YEAR: 2022

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: GHG Emissions Reduction; Energy Efficiency; Sustainability; Renewable Energy Sources

Project Summary:

SLB collaborated with Oman's Ministry of Energy and Minerals and the Oman Investment Authority to develop a national geothermal strategy. SLB's GeothermEx services analyzed data from over 7,000 wells to identify geothermal "sweet spots." Proprietary AI technology expedited the analysis of data from the Oman Oil & Gas Data Repository (OGDR). The next phase is conducting economic feasibility studies for geothermal projects.

Methodologies | Technologies Applied

SLB's GeothermEx geothermal consulting services, data evaluation, mapping of geothermal "sweet spots", assessment of surface, subsurface, and well data, use of a proprietary AI solution for data assessment, sorting, and evaluation, analysis of Oman Oil & Gas Data Repository (OGDR) data.

Results | Indicators Achieved

At this stage, the project has completed a comprehensive assessment of Oman's geothermal potential by analyzing data from over 7,000 wells using proprietary AI technology. While specific quantitative results such as emissions reduction or energy savings are not yet available, the successful identification of geothermal "sweet spots" lays the groundwork for future development and economic feasibility studies, which will provide measurable environmental and energy impact indicators.

Partnerships

Ministry of Energy and Minerals, Oman Investment Authority, SLB.

Replication Possibility

Yes, in other countries.

PETROBRAS

DIGITAL LIFE CYCLE ASSESSMENT SYSTEM APPLIED TO REFINING

STARTING YEAR: 2023

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: Digital Technologies (AI, Blockchain, Digital Twins, etc.)

Project Summary:

Petrobras developed the Digital LCA system to calculate the carbon intensity of its product portfolio with agility and traceability. The model integrates with systems such as Digital Twin, energy dashboard, and SIGEA® in addition to using real-time operational data. Petrobras initially implemented it at Revap and Replan in 2023, then expanded it to four additional refineries in 2024, which are currently undergoing validation. This technological solution enhances the company's ability to develop and certify products with a lower carbon footprint, supporting its decarbonization strategy.

Methodologies | Technologies Applied

The Digital LCA system for refining applies the Life Cycle Assessment methodology adapted for real-time use. It integrates operational data from systems such as Digital Twin, which simulates refinery processes for production optimization; the energy dashboard, which monitors energy performance; and SIGEA®, which manages atmospheric emissions. This approach enables precise, traceable, and agile calculation of the carbon intensity of refined products, supporting operational decisions and the development of lower-impact solutions.

Results | Indicators Achieved

The system was implemented at Revap and Replan in 2023 and expanded to four additional refineries in 2024, with the current phase being validation and refinement. Initial results are under evaluation and already support internal studies focused on developing products with lower carbon intensity and certification potential. Petrobras expects to complete part of the work within two years, including validation and critical review stages, consolidating the Digital LCA system as a strategic tool for monitoring product carbon intensity.

Replication Possibility

Yes, in other companies/sectors.

SLB

PROOF OF CONCEPT: MICRO-ADDITION OF HYDROGEN IN THE DECARBONIZATION OF HEAVY ROAD TRANSPORT USING ECOTORQUE COMBUSTION OPTIMIZATION

STARTING YEAR: 2024

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: GHG Emissions Reduction; Logistics; Renewable Energy Sources; Sustainability

Project Summary:

Proof of concept (PoC) conducted with the EcoTorque device, which enables the micro-addition of hydrogen to diesel engines, aiming at the decarbonization of heavy road transportation. The tests were conducted under controlled conditions using two trucks (manual and automatic) that operated on real routes in the state of Sergipe, Brazil. The research demonstrates that the controlled introduction of small amounts of hydrogen can significantly improve combustion efficiency in diesel engines, without requiring significant modifications to existing infrastructure. This approach represents a viable solution for reducing emissions in the heavy transportation sector through energy transition.

Methodologies | Technologies Applied

Developed with cutting-edge technology, Ecotorque optimizes diesel engine fuel consumption using hydrogen and reduces engine wear, ensuring more time on the road and less time in the shop. The technology is activated only when the engine is started and does not re- quire any operation by the driver. The combustion-based EcoTorque begins the process of electronically controlled electrolysis, separating hydrogen and oxygen molecules from water. This gas is then mixed with the engine's intake air. Hydrogen acts as an additive when introduced in small doses into the en- gine. This mixture helps improve fuel combustion, making it faster and more complete. As a consequence, it increases combustion efficiency, enhances engine performance, and reduces environmental impact. As a result of this process, less fuel is needed for greater range, enabling cost savings on diesel and longer distances between refueling stops.

Results | Indicators Achieved

5.5% reduction in diesel consumption, thus reducing GHG emissions.

Partnerships

Protium Dynamics.

Replication Possibility

Yes, in other companies/sectors

ICONIC Lubrificantes

BIOMETHANE: AN ENERGY TRANSITION AND DECARBONIZATION INITIATIVE

STARTING YEAR: 2024

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: GHG emissions reduction

Project Summary:

Reduction of greenhouse gas (GHG) emissions from ICONIC Lubrificantes' largest source of emissions (the natural gas boilers at the Duque de Caxias plant) through the replacement of fossil fuels with biomethane. Scope: The project is focused on Scope 1 (the stationary combustion category) and will implement the biomethane network in 2024. The initiative includes calculating, monitoring, and verifying the reductions achieved in accordance with the GHG Protocol. Context: Considering the climate crisis and global decarbonization goals (e.g., the Paris Agreement and Brazil's Nationally Determined Contribution, or NDC), ICONIC has accelerated its target to reduce relative emissions by 43% within six years, having reached 57% by 2024. The project aims to be a sector benchmark in terms of energy transition and circular economy.

Methodologies | Technologies Applied

Fuel replacement.

Results | Indicators Achieved

56% reduction in relative emissions (tCO_2e) compared to the base year (2020), totaling all initiatives implemented by ICONIC.

Partnerships

Ultragaz.

Replication Possibility

Yes, in other companies/sectors.

PETROBRAS

PETROBRAS

CO-CREATING AND CO-MANAGING VALUE AND MARKETS VIA BLOCKCHAIN, TOKENIZATION, AND WEB3: THE SAF (SUSTAINABLE AVIATION FUEL) CASE IN PETROBRAS R&D&I

STARTING YEAR: January 2025, expected to last until December 2028

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: Biofuels; Logistics; Carbon Market; Climate Finance; Energy Efficiency; Sustainability; Digital Technologies (AI, Block Chain, Digital Twins etc)

Project Summary:

The R&D&I project "Blockchain Framework and ESG Tokenization, originating in the Energy Business Value Network" is a Petrobras Value Delivery, funded by the National Petroleum Agency (ANP), with PUC-RJ (IAG/LedgerLabs) as the ICT. It researches use cases for the business/partners in the company's chain and value network, particularly for multi-stakeholders, who benefit from the trust, traceability, disintermediation, and scalability enabled by an infrastructure that natively empowers other technologies (WEB3). The first case study is the SAF, encompassing those who generates value for the industries involved by consuming renewable fuel that promotes a just transition, with/for society: Book and Claim via Tokenized Renewable Attributes and Market and Margin Management (product and tokenized attributes).

Methodologies | Technologies Applied

Strategy, Business, Financial, Risk, Process, and Governance Modeling via Blockchain and Tokenization (Petrobras Value and Network Chain). Consensus Mechanisms, Public Blockchain Smart Contract Platforms, Systems Integration (Networks and/or BaaS), Tokenization, Wallets, dAPPs (Decentralized Applications), and SDKs (Software Development Kits). WEB3: Infrastructure in Networks or Services via Blockchain and its Artifacts (Tokenization, Smart Contracts, etc.) applying synergistic technologies (AI, IoT, etc.) and prioritizing User Experience (Personas; Users).

Results | Indicators Achieved

Launched in 2025, the research with SAF (Sustainable Aviation Fuel) explores the tokenization of renewable fuel attributes, even with fossil fuel blends, creating value for Petrobras and its partners through reliable, transparent, and regulatory-compliant digital processes. The study addresses topics such as Book & Claim, Scope 3 traceability, certifications, and smart trading and logistics platforms. The project also investigates economic and financial opportunities, evaluating consensus mechanisms in public blockchains with potential impact on financeability and capital structure.

Partnerships

Three main partners are currently involved: the experienced LedgerLabs (IAG/PUC-RJ), an ICT chosen through the same process that funds the research via ANP; the Cardano Foundation, maintainer of the 3rd Generation blockchain (robust, scalable, hack-proof, used by NASA, and one of the most ESG-friendly ones), through a covenant with PUC (which anticipates other blockchains to benefit resilience, risks, and opportunities); and, more recently, SERPRO, an Brazilian government institution, whose participation is being discussed (NDA) with a view to future use cases in this Petrobras R&D&I.

Replication Possibility

Yes, with adaptations.

BP Energy

REGENERATIVE AGRICULTURE AT BP BIOENERGY

STARTING YEAR: 2021

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: Sustainability; Biofuels

Project Summary:

The project intends to transform sugarcane production through regenerative agriculture, integrating technological innovation and sustainability. Its goals include increasing productivity (TCH), raising sugar content (ATR), reducing the use of mineral fertilizers, optimizing water consumption, and lowering carbon emissions. The project's scope includes expanding the use of biological inputs, localized irrigation, Agriculture 4.0, process standardization, and sustainable soil management. Set against a global backdrop of transitioning to a low-carbon economy, the project aims to establish the company as a global benchmark in sustainable production, promoting positive environmental impact, economic viability, and lasting social benefits.

Methodologies | Technologies Applied

The project utilizes biological inputs, including nitrogen fixers and phosphorus solubilizers, to reduce the need for mineral fertilizers. It adopts localized irrigation and digital monitoring of soil moisture, optimizing water consumption. Agriculture 4.0 integrates remote sensing, drones, management software, and automation for accurate decisions and greater efficiency. It includes the strategic use of vinasse and the standardization of processes for sustainable soil management and carbon emission reduction.

Results | Indicators Achieved

The project has made significant progress in sustainability and productivity. Biological control grew from 36% in 2020 to 53% in 2024, with a target of 60% in 2025, reducing the use of chemicals (64% to 40%). The consumption of mineral fertilizers fell sharply: N from 100% (2020) to 53% (2023) and 35% (2025); P from 100% to 56% and 33%; K from 100% to 42% and 17%. Productivity rose from 69 t/ha (2021) to 88 t/ha (2023), with projections of 85 t/ha (2025). Fertilizer costs were reduced from 44% (2021) to 12% (2024). These results strengthen regenerative agriculture, with positive environmental, social, and economic impacts, aligning with the global low-carbon agenda.

Replication Possibility

Yes, in other companies/sectors.

PETROBRAS

PETROBRAS

AMAZON CARBON NEUTRAL PROGRAM
PCN AMAZÔNIA

STARTING YEAR: 2024

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: GHG Emissions Reduction; Mitigation; Nature-Based Solutions; Logistics; Energy Efficiency; Renewable Energy Sources

Project Summary:

PCN Amazônia is a program developed in 2024 by Petrobras to design and monitor decarbonization initiatives throughout the Amazon region. It is structured across multiple fronts, such as studies for energy optimization of the power generation park and the installation of a Flare Gas Recovery Unit (FGRU) (Urucu Energy Optimization Project – under study). The program also includes complementary efficiency initiatives in Urucu, such as the installation of photovoltaic plants, the use of solar panels to supply electricity to wells, and efficiency actions in the industrial hub. Due to its cross-sectional nature, it encompasses activities focused on logistics, such as the use of more efficient vessels and the installation of photovoltaic plants at terminals and aerodromes, as well as initiatives based on Nature-Based Solutions (NBS), including reforestation actions, carbon monitoring, and partnerships with Scientific, Technological, and Innovation Institutions (ICTs).

Methodologies | Technologies Applied

The Urucu Complex, isolated from energy utilities, relies entirely on Petrobras' internal generation. The Urucu Energy Optimization Project includes modernizing the generating complex, electrifying large machines, and studying flare gas recovery (FGRU). Other initiatives in the state of Amazonas include photovoltaic plants in Urucu, Belém, and Porto Encontro das Águas; replacing TEGs with solar panels; online monitor- ing of batteries and furnaces; and efficiency plans for the Manaus headquarters building. Lighting was also installed at the Oiapoque airfield, and the portfolio of socio-environmental projects in the Amazon region was expanded.

Results | Indicators Achieved

Estimated Mitigation Potential (under study): Initiative Estimated Mitigation Potential (thousand tons CO_2e/year). Urucu Energy Optimization Project: 100.00. FGRU in Urucu: 40.00. Installation of photovoltaic plant at PEA and Belém Terminal: 0.10. Installation of photovoltaic plants in Urucu (Vitória Régia Hotel Complex. Administrative Buildings, and Mineral Deposit (under study). Installation of TEGs at wells: 0.42. Online monitoring of pre-heating batteries: 8.00. Energy, water consumption, and waste management reduction plan (under study). Installation of lighting towers at Oiapoque Aerodrome(not estimated). Carbon stock panel in forest and soil in the Urucu area (not applicable).

Replication Possibility

Yes, in other companies/sectors.

Equinor Brasil Energia Ltd

SAFE – SUSTAINABLE AGROFORESTRY FOR ENERGY: OPTIMIZING BIOENERGY PRODUCTION, ECOSYSTEM RESTORATION & CARBON SEQUESTRATION

STARTING YEAR: 2025

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: Nature-Based Solutions; Biofuels; Carbon Market

Project Summary:

SAFE is a research project developed in collaboration between Equinor Brazil and Senai CIMATEC. Its primary objective is to develop an innovative technological approach to establish a sustainable agroforestry system in the Atlantic Forest biome, focusing on bioenergy. The project utilizes sustainable techniques to optimize oilseed production for biofuel processing, while integrating ecosystem restoration in degraded pasture areas and carbon sequestration, leveraging machine learning and remote sensing. The implementation of the activities is planned over a period of 42 months. The project aligns with the SDGs related to climate action, sustainable agriculture, and clean energy.

Methodologies | Technologies Applied

Sustainable Agroforestry Systems, optimization and prioritization of species with a focus on bioenergy, restoration and supplementation of degraded soil, carbon modeling in biomass and soil, remote sensing, multi-sensor integration, artificial intelligence, blockchain, life cycle analysis.

Results | Indicators Achieved

The project is concluding the informational phase (state-of-the-art, requirements, and needs of the project) and is transitioning to the concept definition stage. It is expected to yield an optimized protocol for implementing and managing sustainable agroforestry for oilseed production, generating biofuels with a low carbon footprint. Additionally, it is anticipated that an integrated model will be developed to represent carbon sequestration and potential productivity, utilizing experimental soil, biomass, and climate data, along with sensors and artificial intelligence. These results can be expanded to similar systems in the Atlantic Forest biome.

Partnerships

EMBRAPA, State University of Feira de Santana (UEFS) - Labespectro.

Replication Possibility

Yes, with adaptations.

OceanPact

OCEANPACT
MANGUELAB

STARTING YEAR: 2024

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: GHG Emissions Reduction; Nature-Based Solutions; *Carbon Market; Sustainability; MRV; Innovation

Project Summary:

Mangroves cover 137,600 km² worldwide, sequestering carbon up to eight times more than tropical forests. Brazil holds 9% of this area, 36% in Maranhão, and 80% on the northern coast. Between 1985 and 2020, it lost 15% of its mangroves to urbanization and aquaculture. Institutions seek to restore these ecosystems for biodiversity, subsistence, coastal protection, and carbon credits. Brazil could host 35%–50% of global Nature-Based Solutions projects, but blue carbon remains underexploited due to methodological uncertainties and low scalability. The MangueLab project proposes a replicable and low-cost protocol, with selected genetic material, semi-automated technologies, growth accelerators, and a module for carbon projection, in partnership with universities and research centers.

Methodologies | Technologies Applied

The project integrates technologies and methodologies to optimize mangrove restoration and carbon measurement. It uses adapted germplasm to select more resilient species, autonomous vehicles, drones, and robots for planting and monitoring, and biological accelerators with local microorganisms to enrich the soil and accelerate carbon sequestration. Drones with LiDAR, RADAR, RGB, and NIR analyze biomass, while eDNA analyzers monitor biodiversity. Environmental sensors measure CO_2, CH4, humidity, and temperature, with data processed in the cloud (Azure) and visualized using a Python/JavaScript platform. Meliponiculture with native bees complements the restoration and generates local income.

Results | Indicators Achieved

The main results expected include a new mangrove restoration protocol — replicable, low-cost, and scalable — and a prototype autonomous vehicle for semi-automated planting. It also includes the validation of a biological accelerator and methodologies for selecting adapted germplasm. A module will integrate field and remote sensing data to estimate accumulated carbon, compiled on a digital platform aligned with FAIR standards. The project aims to reduce costs, strengthen certifications, and engage local communities through meliponiculture.

Partnerships

The project will be developed in the Guapimirim Environmental Protection Area (RJ) with the support of strategic partners. ICMBio coordinates the initiatives, local NGOs provide restoration expertise, and traditional communities contribute their ecological knowledge and beekeeping skills. Universities and research centers provide the scientific basis, technological validation, and dissemination of results.

Replication Possibility

Yes, in other companies/sectors.

Repsol Sinopec Brasil

DAC TO SEA

STARTING YEAR: 2025

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: GHG Emissions Reduction; Carbon Market; Sustainability; CCS; Low-carbon fuels.

Project Summary:

The DAC to SEA initiative aims to produce Brazil's first sustainable marine fuel from CO_2 captured from the air (DAC). The initiative combines two innovative technologies within the country: DAC and e-MGO production via the e-fuels route. These technologies will decarbonize the shipping sector and align with the goals of the International Maritime Organization (IMO). The project includes an experimental plant at PUC-RS, where Repsol Sinopec will integrate DAC technology with e-fuel production. A larger demonstration-scale plant will be installed at the Port of Açu with a production capacity of approximately 300 liters per day of drop-in synthetic fuel for the port's tugboats.

Methodologies | Technologies Applied

To produce marine synthetic fuels (e-MGO), direct air CO_2 capture (DAC) technologies will be used, coupled with the production of synthetic fuels from low-carbon hydrogen, captured CO_2, and electricity.

Results | Indicators Achieved

e-MGO can achieve 90% emission reduction compared to fossil MGO.

Partnerships

Porto do Açu and Pontifícia Universidade Católica do Rio Grande do Sul.

Replication Possibility

Yes, in other companies/sectors.

PETROBRAS

LOW-CARBON PRODUCTS DIESEL R5, SAF, VLS B24 AND CAP PRO W 30/45

STARTING YEAR: Trading started in 2023

CURRENT STATUS: Available on the market

AREA OF CONTRIBUTION: GHG Emissions Reduction; Mitigation; Biofuels; Sustainability; Digital Technologies (AI, Blockchain, Digital Twins, etc.)

Project Summary:

Diversifying into low-carbon businesses is a key part of Petrobras' strategy in response to the Energy Transition. The company has developed innovative solutions, such as Diesel R5, which has 5% renewable content and is already available on the market, compatible with existing engines and infrastructure. SAF, scheduled for launch in 2025, is a sustainable aviation fuel produced through the coprocessing of kerosene with renewable feedstock. For maritime transportation, Petrobras developed VLS B24, a bio-bunker with 24% biodiesel, capable of reducing emissions by around 20%. CAP Pro W 30/45, a sustainable asphalt cement, can be applied at temperatures up to 40 °C lower than conventional ones, reducing energy consumption, emissions, and vapors associated with paving.

Methodologies | Technologies Applied

Diesel R5 and SAF are produced through co-processing in hydrotreatment units, integrating renewable raw materials into the existing chain. This approach leverages the existing infrastructure, reducing costs and idle assets. Life Cycle Assessment (LCA), applied with digital systems in refineries, ensures trace- ability and real-time calculation of the carbon intensity of products. VLS B24 combines mineral bunker fuel and biodiesel, certified by ISCC EU RED and authorized by the ANP, and is also sold in the Asian market. The low-temperature CAP Pro W 30/45 allows for application with lower energy consumption and greater use of residues (RAP), increasing sustainability and efficiency in paving.

Results | Indicators Achieved

Developing low-carbon products drives the energy transition and prepares the market for large-scale solutions. Launched in 2023, Diesel R5 already surpassed 100,000 m³ sold in 2024 and is consolidated in five refineries. SAF, successfully tested at REDUC, will be launched in 2025, anticipating legal requirements for 2027. VLS B24, a pioneer in Brazil, reduces GHG emissions by up to 20% and has established an international presence with sales in Singapore. CAP Pro W 30/45, applied in Copacabana (RJ), reduced the application temperature by up to 40°C, resulting in lower energy consumption, fewer emissions, and better working conditions.

Wilson, Sons

Wilson Sons

UNPRECEDENTED USE OF GREEN DIESEL IN THE BRAZILIAN MARITIME SECTOR

STARTING YEAR: 2025

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: GHG Emissions Reduction; Biofuels; Logistics; Renewable Energy Sources

Project Summary:

With over 187 years of history, Wilson Sons is leading a pioneering initiative in the Brazilian maritime sector by adopting green diesel (HVO) in its operations as part of its decarbonization strategy. Monitoring emissions since 2013—with the Tugboat business responsible for approximately 70% of scope 1 and 2 emissions—the company is investing in HVO, a 100% renewable fuel compatible with existing engines, capable of reducing lifecycle emissions by up to 90%. The pilot project, approved by the ANP in February 2025, is being developed at the Port of Açu in partnership with Vast Infraestrutura and Efen. The first HVO refueling, carried out on March 27, 2025, used used cooking oil and recorded a certified 83% reduction in carbon intensity.

Methodologies | Technologies Applied

Use of drop-in biofuel in diesel cycle engines.

Results | Indicators Achieved

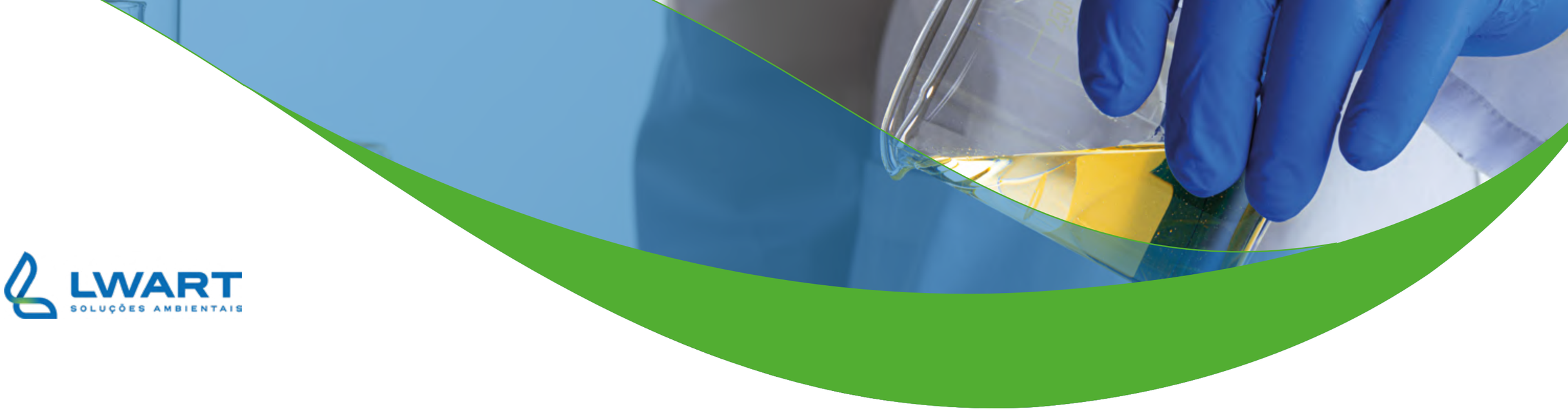
Use of fuel with 83% lower carbon intensity over its life cycle, total reduction in emissions of around 2,000 tons of CO_2eq.

Partnerships

Porto do Açu; Vast; Efen.

Replication Possibility

Yes, in other companies/sectors



LWART

H+ PROJECT

STARTING YEAR: 2022

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: Sustainability; Circular Economy

Project Summary:

The H+ Project will increase the re-refining capacity of used lubricating oil (ULO) by 60%, strengthening circular economy efforts by transforming hazardous waste into a high-value input for industry. The re-refining process is eco-efficient and contributes to environmental protection, the conservation of natural resources, and the decarbonization of the sector. In addition to environmental benefits, the base oil produced by Lwart reduces Brazil's dependence on imports, strengthening the national industry. The new plant incorporates technological innovation, energy efficiency, and the valorization of co-products, while also expanding the reverse logistics of ULO, in alignment with Brazil's Collection Goal established by Interministerial Ordinance MMA/MME No. 4/2023. With H+, Lwart consolidates its position as a benchmark in sustainable solutions, promoting economic development with environmental responsibility.

Methodologies | Technologies Applied

Re-refining by hydrotreatment.

Results | Indicators Achieved

Project under implementation, with an estimated reduction of 501,707.36 tCO_2eq of GHG emissions per year, considering the baseline scenario compared to the production of base oil from virgin raw material.

Partnerships

Engenharia Básica Rerrefino – CEP (Chemical Engineering Partners) Engenharia Detalhada – A1 Engenharia Caldeira – HPB Turbo Gerador – WEG Vasos, Reatores e Flare – Asvotec Sistema Elétrico e de Controle – Schneider Electric Pátio de Biomassa – Valmet Trocadores de Calor – CBC Sistema de Vácuo – APEMA Sistema de tratamento de Gases – Tequaly Compressores de Alta Pressão – Neumann & Esser Sistema de recuperação de hidrogênio – Air Liquide Montagem Eletro Mecânica – Grupo Estel Construção Civil – Mesquita Estruturas Metálicas - ICEC.

Replication Possibility

Yes, with adaptations.

SLB
DIGITAL SUSTAINABILITY PLATFORM

STARTING YEAR: 2023
CURRENT STATUS: Available on the market
AREA OF CONTRIBUTION: GHG Emissions Reduction; Mitigation; MRV; Sustainability; CCS; Digital Technologies (AI, Blockchain, Digital Twins, etc.)

Project Summary:
The Digital Sustainability Platform is designed to help our clients decarbonize and scale new energy systems. It is built around three pillars: Measure, Plan, and Act. Measure automates complex data at scale and streamlines the aggregation and visualization of Scope 1, 2, and 3 emissions. It enables accurate measurement, reporting, and verification of an organization's emissions to establish an accurate baseline and track the progress of decarbonization programs. Measure also supports OGMP 2.0 Level 5 and Product Carbon Footprint workflows. Plan allows the creation of decarbonization scenarios to strategically plan emissions reductions over multiple years.

Methodologies | Technologies Applied
Cloud, AI/ML, data flow, optimization, automation, dashboards, data analytics.

Results | Indicators Achieved
70% data automation for MRV, proprietary decarbonization planning optimizer, 80+ CCUS projects worldwide, 25+ years of experience in CCUS projects, 100+ technical publications, award-winning end-to-end CCUS Digital Solutions (2022 Frost & Sullivan Technology Innovation Leadership Award and Reuters Global Energy Transition: Top 100 Innovators).

Partnerships
Palantir.

Replication Possibility
Yes, in other companies/sectors

OceanPact

OCEANPACT

IMPLEMENTATION OF CONTAINERIZED SAILING TO REDUCE EMISSIONS ON OFFSHORE SUPPORT VESSELS

STARTING YEAR: 2024

CURRENT STATUS: In progress

AREA OF CONTRIBUTION: GHG Emissions Reduction; Mitigation; Energy Efficiency; Renewable Energy Sources

Project Summary:

The project involves installing a containerized sail on OceanPact's maritime support vessel. This pioneering solution will assess the potential of wind propulsion in this segment. This compact, easy-to-integrate technology is housed in a container and can be shipped without significant structural modifications. Initial expectations include reducing emissions by approximately 7% during navigation and investigating potential benefits during standby periods. The goal is to validate energy efficiency gains and emissions mitigation, thereby contributing to the energy transition of the maritime sector.

Methodologies | Technologies Applied

Containerized sail for auxiliary propulsion.

Results | Indicators Achieved

Estimated 7% reduction in GHG emissions during navigation; Impact assessment on standby operations.

Partnerships

Econowind.

Replication Possibility

Yes, in other companies/sectors.

PETROBRAS

PETROBRAS

TURBOGENERATOR SPINNING RESERVE OPTIMIZATION

STARTING YEAR: 2024

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: GHG Emissions Reduction; Mitigation; Energy Efficiency

Project Summary:

Turbogenerators are responsible for supplying electrical and thermal energy to our offshore platforms by consuming fuel gas. One factor that directly affects the efficiency of this type of equipment is the electrical demand since the energy generation efficiency is higher with loads close to the turbogenerator's nominal capacity. The optimization solution aims to minimize spinning reserve by utilizing the fewest possible turbogenerators to meet the platform's current electrical demand, ensuring each turbogenerator operates at its maximum load. This way, the equipment operates with greater efficiency and lowers fuel consumption, generating fewer GHG emissions.

Methodologies | Technologies Applied

To determine the minimum number of turbogenerators (without spinning reserve), it's necessary to check the maximum power each piece of equipment can generate. This maximum power can vary with climate conditions (such as room temperature) and with the natural efficiency drop that occurs on a turbogenerator (derating). The other variable that needs to be evaluated is the facility's electrical power demand. With these two variables, the minimum number of turbogenerators can be calculated by the following formula (rounding up the result): Min # TGs= (current electrical power demand (MW))/(GTG max power (MW)) For instance, if the maximum power each turbogenerator can achieve is 23 MW and the current electrical power demand is 50 MW, the minimum number of turbogenerators required to meet demand is 2,17. In summary, the minimum number of turbogenerators is 3.

Results | Indicators Achieved

Maintaining one spinning reserve turbogenerator can increase the emissions of a facility by up to 25,000 tCO_2e/y. Taking into account all Petrobras' offshore facilities and considering that not all of them maintained a spinning reserve turbogenerator, this initiative showed a high impact on E&P emissions reduction, with a potential of approximately 400,000 tCO2e in avoided emissions.

Replication Possibility

Yes, in other companies/sectors.

SLB

USE OF ELECTRIC SUBMERSIBLE PUMPS (ESP) FOR WATER EFFICIENCY AND EMISSIONS REDUCTION

STARTING YEAR: 2020

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: Redução de Emissões de GEE; Biocombustíveis; Fontes de Energia Renováveis; Sustentabilidade; Tecnologias Digitais (IA, *Block Chain*, *Digital Twins*, etc.)

Project Summary:

Electric Submersible Pumps (ESPs), traditionally used in oil production, are now applied to large-scale water pumping, offering reliability and energy efficiency. Implemented in Brazil since 2020 in sectors like mining, bioenergy, and water parks, ESPs reduce energy consumption, operational costs, and emissions. Examples include projects in Gramado (e.g.: water park) and partnerships with sugar/ethanol producers, supported by Lift IQ digital monitoring.

Methodologies | Technologies Applied

Electric Submersible Pumps (ESP) and a remote monitoring system (Lift IQ).

Results | Indicators Achieved

Emissions reduction: up to 50 tCO_2/year in pumping operations. Greater energy and water efficiency. Extended asset life, reducing corrective maintenance. Support for the circular economy through remote monitoring and extended equipment lifecycle. Expansion of oil and gas technologies into new industrial and bioenergy markets.

Replication Possibility

Yes, in other companies/sectors.

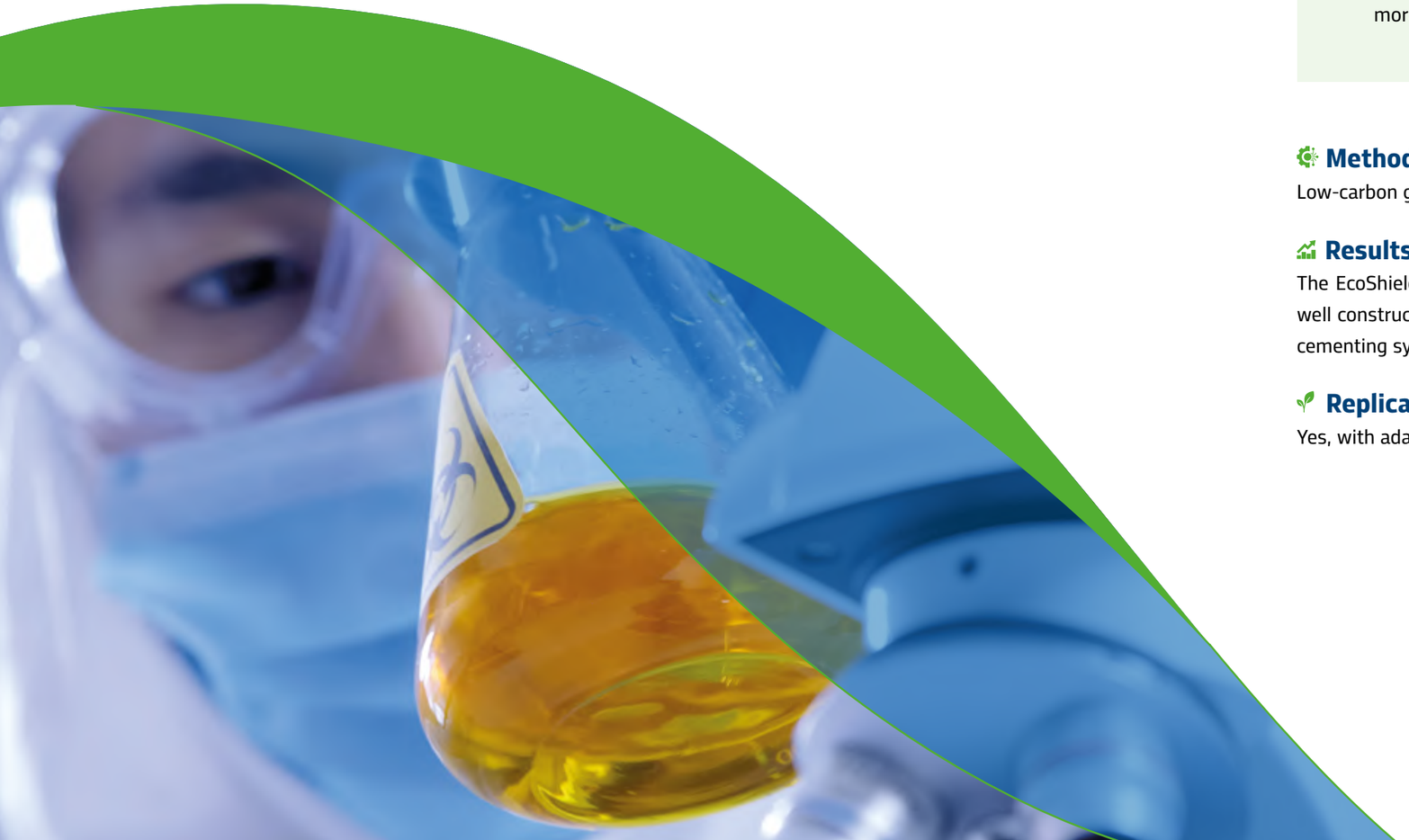
SLB

ECOSHIELD | LOW-CARBON GEOPOLYMER CEMENT-FREE SYSTEM

STARTING YEAR: 2020

CURRENT STATUS: Available on the market

AREA OF CONTRIBUTION: GHG Emissions Reduction; CCS; Sustainability.



Project Summary:

EcoShield™ is an innovative cement-free geopolymer system that aims to significantly reduce carbon emissions in well construction by replacing Portland cement with natural materials and industrial waste. This low-carbon technology eliminates up to 85% of embodied CO_2 emissions, equivalent to approximately 63 tons of CO_2 per well—the equivalent of removing nearly 14 cars from the road annually. Compatible with conventional workflows, EcoShield™ maintains the performance and zone isolation required by the industry without the need for adaptations in design or execution. Applied in more than 650 operations in eight countries, the system has already proven its effectiveness in onshore and offshore wells. Aligned with UN SDGs 12 and 13, EcoShield™ represents a concrete step towards decarbonization and the adoption of more sustainable practices in the energy industry.

Methodologies | Technologies Applied

Low-carbon geopolymer cement-free system.

Results | Indicators Achieved

The EcoShield™ low-carbon geopolymer cement-free system addresses the environmental impact of well construction, eliminating up to 85% of embodied CO_2 emissions compared with conventional well cementing systems.

Replication Possibility

Yes, with adaptations.

Equinor Brasil Energia Ltd

DEVELOPMENT OF ADDITIVE MANUFACTURING WITH WIRE AND ARC FOR APPLICATION IN CORROSION-RESISTANT ALLOYS

STARTING YEAR: 2022

CURRENT STATUS: In progress or completed

AREA OF CONTRIBUTION: Reduction of GHG Emissions; Digital Technologies (AI, Blockchain, Digital Twins, etc.)

Project Summary:

The project focuses on decarbonizing the oil and gas sector, with applicability in other industries. The transition from traditional to additive manufacturing (3D printing) offers advantages such as reduced waste, design flexibility, cost reduction, and reduced environmental impact. The WAAM technique, which uses wire and electric arc, is promising for high corrosion resistance (CRA) alloys. Four prototypes will be manufactured: super duplex stainless steel, nickel alloy 718, stainless steel 316L, and titanium alloy grade 2. The project aims to develop and validate WAAM manufacturing parameters, correlating deposition and material properties, in addition to comparing CO2 emissions with traditional methods, demonstrating greenhouse gas reduction.

Methodologies | Technologies Applied

Additive manufacturing technologies, such as wire arc additive manufacturing (WAAM), reduce raw material waste by producing net shape or near net shape geometries, thereby optimizing material conversion efficiency. In addition, replacing traditional manufacturing processes with additive manufacturing enables digital on-demand production inventory, reducing the need for physical inventory and potentially lowering costs and emissions associated with material transportation and storage.

Results | Indicators Achieved

The project is underway, and the parameterization and prototyping stage of WAAM with super duplex stainless steel was the first to be completed. In this phase, a spacer ring was prototyped and tested in offshore platform coalescers, which are responsible for separating production fluid components, a crucial step in the oil and gas exploration process. The test was carried out with Equinor's counterpart, marking the first time that an O&G field in Brazil has used a super duplex stainless steel prototype manufactured by WAAM. In addition, this manufacture represents a milestone in the development of additive manufacturing technology to produce super duplex metal parts by Equinor at a global level. In terms of results, the manufacture of the spacer ring with WAAM provided a 50% reduction in delivery time and a 68% reduction in carbon footprint.

Partnerships

Federal University of Rio de Janeiro (UFRJ) - COPPE - LNTSold

Replication Possibility

Yes, in other companies/sectors.

SLB
LOCALIZATION AT THE CORE

STARTING YEAR: 2021
CURRENT STATUS: In progress or completed
AREA OF CONTRIBUTION: Sustainability; Biofuels

Project Summary:

SLB has significantly reduced logistics emissions by establishing a local supply chain, resulting in a 90% reduction in delivery times. Conversely, the approach strengthens local economies and creates resilient, circular supply chains. The Oil and Gas sector, especially the drilling environment in Brazil (BRZ), requires unique materials that are typically imported. While eliminating these imports is not feasible, we have made great strides by reusing many raw materials, repurposing inoperative materials to manufacture new parts, and advancing technologies that have enabled higher levels of repair. Together with our exemplary diligence in materials management systems, this has led to a doubling of localization. This initiative diverts waste from landfills, reduces transportation costs, and mitigates resource scarcity to ensure more sustainable operations in an industry where reliability and resource availability are crucial.

Methodologies | Technologies Applied

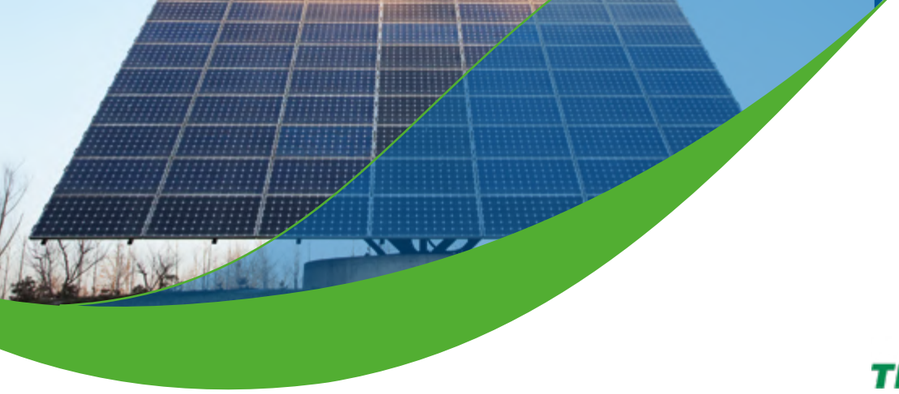
CNC and advanced machining technologies: they complement the surface and dimensional finish of repairs performed by the technologies above and are used to manufacture new parts from scrap. Laser cladding and pulsed laser cladding technologies: They allow for more complex and refined repairs with less induced heat and less damage to the structure. Additive manufacturing: also used to manufacture replacement parts, avoiding some imports and allowing less material to be used during manufacturing. Plasma Transfer Arc (PTA): used to rebuild and reinforce areas of high wear with hard facing application. HVOF (High Velocity Oxy-Fuel): applied as a protective and recovery coating. Arc Spray: used to restore dimensions. Nickel Plating: an electrolytic or chemical electroplating process that applies a layer of nickel to metal surfaces, providing high corrosion resistance.

Results | Indicators Achieved

Fifteen different suppliers with 24 qualifications were developed. More than 310 assets were reused and removed from disposal (equivalent to 42k tons of CO_2e). 296 parts (mechanical and electronic) repaired locally, avoiding international shipments. Internal electronic rework allowed for a reduction of 148 tons of CO_2e, corresponding to the recovery of 126 electronic boards.

Replication Possibility

Yes, in other companies/sectors.



TRANSPETRO
DEPLOYMENT OF ON-GRID PHOTOVOLTAIC PLANT

STARTING YEAR: 2024
CURRENT STATUS: In progress or completed
AREA OF CONTRIBUTION: Reduction of GHG Emissions; Renewable Energy Sources

Project Summary:

Greenhouse gas (GHG) emissions measured at the Belém Terminal reveal a significant prevalence of contributions from the electricity supply. Therefore, decarbonization efforts must necessarily involve reducing dependence on the utility company's electricity by implementing renewable energy solutions. To this end, the project involves installing a grid-connected solar power plant designed to meet the unit's contracted demand. The installation of the solar power plant is estimated to result in a 92% reduction in the unit's emissions, equivalent to 29.5 tons of CO_2eq/year.

Methodologies | Technologies Applied

EPC contract, installation of ground-mounted and rooftop photovoltaic modules, and interconnection to the utility grid.

Results | Indicators Achieved

The plant opened in July 2025. The results of the impacted indicators are currently being calculated.

Replication Possibility

Yes, in other companies/sectors.

Fluxys
CONNECTING KEY ENERGY HUBS: FIRST H_2 AND CO_2 TRANSPORT PIPELINES IN BELGIUM & EMISSION REDUCTION

STARTING YEAR: 2022 for H2 and CCS projects | 2018 for the Emission reduction Program
CURRENT STATUS: In progress
AREA OF CONTRIBUTION: CCS; GHG Emissions Reduction; Logistics; (Green) Hydrogen

Project Summary:

In 2025, the construction of the first hydrogen pipelines between Antwerp and Ghent began, along with CO_2 ones. The emissions reduction program, which started in 2018, aims to reduce emissions in gas transportation, adhering to the OGMP 2.0 and the Gold Standard.

Methodologies | Technologies Applied

Establishement of the entire value chain for Belgium, with Fluxys as one of the key stakeholders (technical, regulatory, legal, commercial). For emission reduction, detailed assessment, also with OGMP (site by site) and combination of technologies applied to aim at (direct & indirect) emission reductions

Results | Indicators Achieved

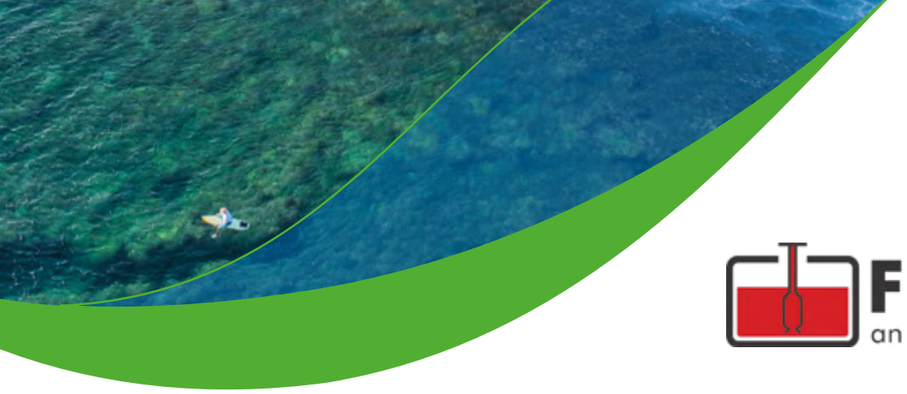
50% reduction in emissions by 2025 (compared to 2017).

Partnerships

In Brazil, a partnership with TBG

Replication Possibility

Yes, in other sectors/companies.



FRAMO
SUBMERGED TURBINE FOR ENERGY RECOVERY

STARTING YEAR: 2023
CURRENT STATUS: Available on the market
AREA OF CONTRIBUTION: GHG Emissions Reduction; Carbon Market; Energy Efficiency

Project Summary:

Our Framo submerged turbine is placed on the discharge of the seawater lift and uses the energy of the water drop to regenerate energy.

Methodologies | Technologies Applied

Same concept of the hydroelectric.

Results | Indicators Achieved

It can return 20-30% of the energy to the system.

Replication Possibility

Yes, in other companies/sectors.

ONESUBSEA
ALL ELECTRIC CHRISTMAS XT

STARTING YEAR: 2017
CURRENT STATUS: Available on the market
AREA OF CONTRIBUTION: GHG Emissions Reduction; Electrification; Energy Efficiency; Sustainability; Digital Technologies (AI, Blockchain, Digital Twins, etc.).

Project Summary:

Electrification of Underwater Equipment, focused on Subsea Christmas Trees, which allows for the removal of hydraulic control fluid. The removal of hydraulic fluid alone has a significant impact on sustainability, as it avoids the disposal of fluids into the environment, whether through regular operation or potential leaks. It also contributes to reducing the carbon footprint, as such fluids are no longer necessary to be transported to the offshore environment. Additionally, it facilitates digitalization, increasing the reliability and efficiency of processes and reducing the need for offshore interventions and personnel.

Methodologies | Technologies Applied

Electrification / Product Development.

Results | Indicators Achieved

20% emissions reduction
concerning equipment operation.

PETROBRAS
FLARE GAS RECOVERY SYSTEMS (FGRS) OPERATION

STARTING YEAR: 2022
CURRENT STATUS: In progress or completed
AREA OF CONTRIBUTION: GHG Emissions Reduction; Mitigation

Project Summary:
The FGRS aims to recover all gas streams that would otherwise be directed to the flare, bringing them back into the process.

Methodologies | Technologies Applied
The system operates in a closed loop and can recover, on average, a gas volume of approximately 50,000 m³/day in the units currently in operation. When this volume is exceeded, a valve automatically opens and the excess stream is directed to the flare, ensuring the unit's safety. This system prevents unnecessary gas flaring, contributing to emission reduction and supporting our goal of zero routine flaring.

Results | Indicators Achieved
We estimate that the mitigation potential provided by our integrated solutions for reducing gas losses on a common platform corresponds to approximately 5 to 10% of CO_2 equivalent emissions.

Replication Possibility
Yes, with adaptations.

Schneider Electric
E-HEATER EUROPE

STARTING YEAR: 2025
CURRENT STATUS: In progress
AREA OF CONTRIBUTION: GHG Emissions Reduction; Electrification; Sustainability

Project Summary:
We are currently collaborating with Axens on the deployment of a 9 MW electric heater (E-Heater) aimed at significantly reducing CO_2 emissions in a major oil and gas refinery. This innovative solution replaces traditional fossil-fuel-fired process heaters with a fully electrified alternative powered by low-carbon electricity. The E-Heater will contribute to decarbonizing one of the most energy-intensive units in the refinery, aligning with the operator's net-zero roadmap. This project marks a key milestone in the transition toward more sustainable refining operations and showcases the potential of electrification in hard-to-abate industrial sectors.

Methodologies | Technologies Applied
Electrification of fired heaters.

Results | Indicators Achieved
Approximately 14,600 tons of CO_2 per year.

Replication Possibility
Yes, in other companies/sectors.

Expedient

President / CEO of IBP:
Roberto Furian Ardenghy

Corporate Executive Director:
Claudia Rabello

E&P Executive Director:
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