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Enhanced LP-CRS™

This position paper provides an overview of the Enhanced LP-CRS™ system developed by NGLTech and its potential to address the challenges of associated gas flaring in the oil and gas industry. The paper discusses the environmental impact of flaring and highlights the limitations of existing solutions. It presents the key features of the Enhanced LP-CRS™ system, emphasizing its commercial viability for low-pressure natural gas streams. The paper proposes a global marketing and commercialization strategy, focusing on partnerships, market penetration, demonstration projects, thought leadership, scalable manufacturing, and continuous research and development. The Enhanced LP-CRS™ system aligns with the vision of sustainable practices and environmental stewardship. By optimizing resource utilization and reducing emissions, it contributes to the industry's goals. Moreover, the high performance and low capital expenditure (capex) of the Enhanced LP-CRS™ system result in a short payback period, making emission reduction profitable for end-users rather than an additional cost.

The Enhanced LP-CRS™ system developed by NGLTech addresses the global challenge of reducing emissions and maximizing resource utilization in the oil and gas industry. It offers a commercially viable solution to extract valuable components from low-pressure natural gas, specifically targeting flare gas applications. The system's environmental and economic benefits, technological advancements, and potential for widespread adoption make it a promising solution for achieving sustainability goals.

INTRODUCTION

The global oil and gas (O&G) industry faces a significant challenge in reducing emissions and maximizing the utilization of valuable resources. Associated gas (AG) flaring is a prevalent practice that contributes to greenhouse gas (GHG) emissions, with alarming statistics from the World Bank's Global Gas Flaring Partnership (GGFR) highlighting its environmental impact. Malaysia, among other countries, also contributes to the high levels of AG flaring.

To address this urgent issue, NGLTech has developed the Enhanced LP-CRS™ system, an innovative technology specifically designed to extract valuable NGLs and oil condensates (C3+ components) from low-pressure natural gas streams, with a focus on flare gas applications. This system stands out as the only commercially viable solution optimized for NGL extraction from low-pressure natural gas.

This position paper provides a comprehensive overview of the Enhanced LP-CRS™ system and its potential to revolutionize emission reduction and resource monetization in the O&G industry. It highlights the environmental and economic benefits, showcases unique features and enhancements, and demonstrates alignment with industry objectives.

By examining the commercial potential of the Enhanced LP-CRS™ system, this paper unlocks opportunities for emission reduction and revenue generation. It emphasizes the urgency of the issue, showcases technological advancements, and presents a compelling case for widespread adoption.

Implementing the Enhanced LP-CRS™ system fosters sustainable practices, optimizes resource utilization, and contributes to global emission reduction efforts. This position paper serves as a foundation for industry stakeholders, policymakers, and investors to understand the potential impact and role of the Enhanced LP-CRS™ system in achieving sustainability goals of the O&G industry.



Position Statement

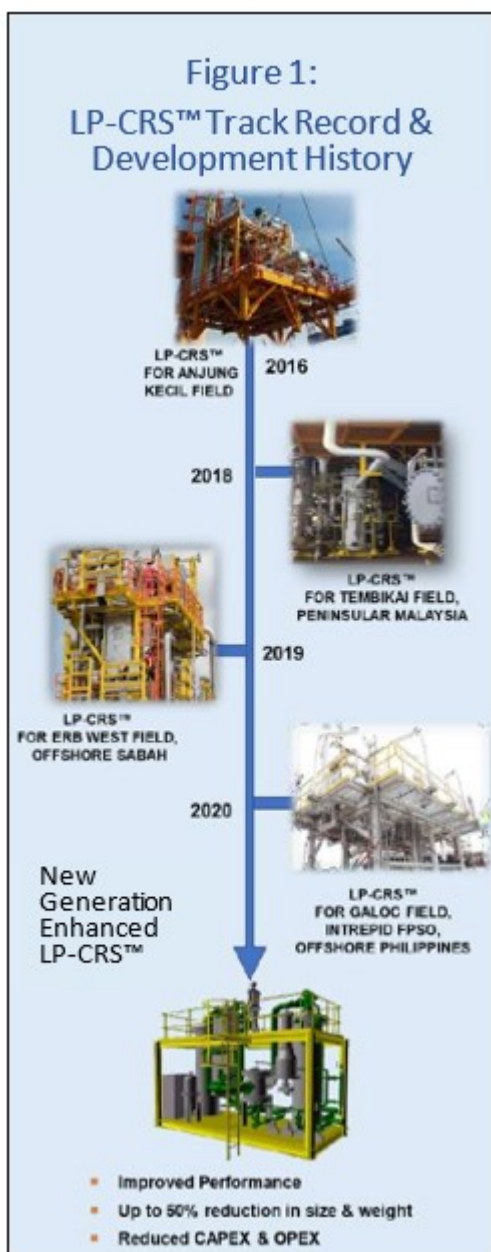
The Enhanced LP-CRS™ system represents a game-changing solution for the reduction of emissions and monetization of flare gas in the oil and gas industry. As virtually the only technology in the world that is both techno-commercially viable for the extraction of oil condensates from low-pressure natural gas streams and specifically tailored for flare gas applications, the Enhanced LP-CRS™ system offers unmatched performance, reliability, and operational advantages. By leveraging the Enhanced LP-CRS™ system, companies can significantly reduce emissions, optimize resource utilization, and unlock new revenue streams. This technology paves the way for sustainable practices and establishes a leadership position in the emission reduction and carbon capture space.

PROBLEM STATEMENT

Monetizing associated gas from oil producing facilities presents significant challenges due to the specific characteristics of the gas and the nature of oil production operations. The key issues surrounding associated gas flaring and the limitations of existing solutions are as follows:

- **Low Pressure and High Impurities:** Associated gas is typically low pressure and contains high levels of impurities, including significant water vapor content. Processing such gas for monetization requires substantial energy consumption and capital investment.
- **Marginal Oil Production Facilities:** Oil production facilities have become relatively marginal in size, often producing less than 30 MMscfd and typically short production life of 5 to 10 years. The combination of these issues further complicates the monetization of associated gas, exacerbating techno-economic challenges.
- **Limited Solutions for Low Gas Production Rates:** Existing gas monetization technologies face obstacles due to the short lifespan of oil-producing fields and the relatively low gas production rates. Justifying the high investments required for commercial viability becomes difficult.
- **Cost-Prohibitive Market Solutions:** While numerous gas monetization solutions exist, they often involve significant capital investments and long lead times for customized designs. This renders them commercially unviable for many facilities.
- **Untapped Potential of C3+ Components:** The low-pressure associated gas flared at oil producing facilities contains a high concentration of valuable C3+ components, such as NGLs, LPG, and oil condensates. However, the extraction and monetization of these components remain largely untapped.

Given these challenges and limitations, there is an urgent need for a commercially viable solution that efficiently and economically monetizes low-pressure associated gas while meeting the specific requirements of oil production facilities. The Enhanced LP-CRS™ system developed by NGLTech offers a unique and promising approach to overcome these obstacles. It enables the extraction and monetization of valuable C3+ components while simultaneously reducing flare gas emissions.



The Enhanced LP-CRS™ system, developed based on 8 years of operational experience, is an advanced solution for reducing flare gas emissions and extracting valuable resources. It offers enhanced performance, improved reliability, compact design, standardized units, and container-size footprint. It helps achieve sustainability goals and establish leadership in responsible energy production.

OVERVIEW

The Enhanced LP-CRS™ system represents a significant advancement in addressing the industry-wide challenge of flare gas emission reduction and monetization. Building on our extensive operational experience and lessons learned from deploying the LP-CRS™ system in multiple facilities, we have further refined and optimized the technology to create the Enhanced LP-CRS™ system. This enhanced version incorporates several key improvements, including:

1. **Enhanced Performance:** Achieves up to 40% reduction in GHG emissions from flaring and allows for the extraction of valuable NGLs, LPGs and/or oil condensates from the gas.
2. **Improved Reliability and Operability:** Ensures consistent and efficient operation under demanding conditions, providing a higher level of operational stability.
3. **Compact and Lightweight Design:** Reduced size and weight by up to 50%, facilitating transportation, installation, and integration into existing facilities.
4. **Container-Size Footprint:** Designed to fit within a standard 20-foot container, simplifying logistics and reducing deployment time.
5. **Standardized Nominal Capacity Units:** Offers four standardized units, enabling flexibility in operating conditions, high quality components, quick delivery and ability to be relocatable.

These enhancements position the Enhanced LP-CRS™ system as a game-changing solution for flare gas management, allowing companies to achieve sustainability goals, capitalize on valuable resources, and establish leadership in responsible energy production.

The LP-CRS™ system offers unparalleled performance by extracting NGLs from natural gas streams with low GHG emissions, without the need for compression or external refrigeration. Technological advancements, such as compact heat exchangers and a high-speed turbo-expander, ensure efficient NGL extraction and operational stability.

The combination of this enables deep chilling of the feed gas after pressure boost at the turbo-expander down to temperatures as low as

-40°C, allowing for the separation of heavy ends (C3+) from the NG stream that may be supplied at pressures as low as 3 barg. To inhibit the formation of hydrates, methanol is used as a Hydrates Inhibitor (HI) in the system. Importantly, the methanol is regenerated within the Enhanced LP-CRS™ package, significantly minimizing the need for methanol make-up and ensuring the sustainability of the process. The whole process is self-contained with no external utility requirements apart from nominal amounts of instrument power supply.

These technological advancements, including the proprietary cooling process, compact turbo-expander, and effective hydrate inhibition, are integral to the Enhanced LP-CRS™ system's exceptional performance and efficiency.

UNPARALLELED PERFORMANCE

The LP-CRS™ is designed to extract Natural Gas Liquids (NGLs) from natural gas streams ranging typically from 20 to 100 barrels/MMscf, with inlet gas pressures as low as 3 barg and a corresponding reduction of greenhouse gas (GHG) emissions by up to 40%. It achieves this without the need for inlet booster compression or external refrigeration nor gas dehydration thus making it a high-performance solution for NGL extraction that is also highly reliable and compact. Apart from the highly reliable turbo-expander, there are no other moving parts in the system, thus the high reliability and operability even under demanding conditions. Rigorous field trials and refinement have further enhanced the system's performance and operational stability.

TECHNOLOGICAL ADVANCEMENTS

The Enhanced LP-CRS™ system incorporates several technological advancements that enable efficient and effective NGL extraction. The system utilizes a combination of compact heat exchangers, separators, and a proprietary compact, high-speed turbo-expander, coupled with NGLTech's patented expansion cooling and evaporative cooling technology.

The Enhanced LP-CRS™ system by NGLTech offers standardized nominal capacity units, reducing size and weight by up to 50%. It fits into a standard container footprint, ensuring convenience, faster deployment, and easy relocation. Customization options are available for tailored solutions.



Table 1: Standardized Capacity

| Model No. | LP-CRS-05 | LP-CRS-10 | LP-CRS-15 | LP-CRS-20 |
|-------------------------|------------------|------------------|------------------|------------------|
| Nominal Design Capacity | 3 ~ 7 MMscfd | 7 ~ 12 MMscfd | 12 ~ 17 MMscfd | 17 to 22 MMscfd |
| Skid Size (W, L, H) | 2.3m, 5.3m, 5.0m | 2.3m, 6.0m, 5.5m | 2.3m, 7.0m, 5.8m | 2.3m, 8.0m, 6.0m |
| Skid Weight (dry) | 20,000 kg | 25,000 kg | 30,000 kg | 40,000 kg |

STANDARDIZED NOMINAL CAPACITY

In response to the industry's demand for efficient and adaptable solutions, NGLTech has achieved significant reductions in the size and weight of the Enhanced LP-CRS™ system, up to 50% compared to previous iterations.

The Enhanced LP-CRS™ system is specifically engineered to fit within a standard 20 or 40-foot container, depending on its capacity, offering a standardized container-size footprint. This standardized design ensures logistical convenience, reduces deployment time, and enables faster implementation of the technology across various facilities.

The combination of compact, standardized and container size design enables the system to be delivered within 5 months, easily transported and installed, eliminating the need for complex and time-consuming customization. Coupled with the fact that the system is designed for varying inlet flow conditions, this will also enable the units to be easily relocatable after the field production life expires.

Four standardized nominal capacity units for the Enhanced LP-CRS™ system are available and these units provide high quality components with consistent performance. Additionally, NGLTech provides customization options for clients with unique needs, offering tailored solutions to maximize the benefits of the Enhanced LP-CRS™ system in a variety of operational contexts.

APPLICATIONS

The Enhanced LP-CRS™ system offers versatile applications that address multiple challenges in the oil and gas industry. This cost-effective solution enables the monetization of flare gas by extracting valuable Natural Gas Liquids

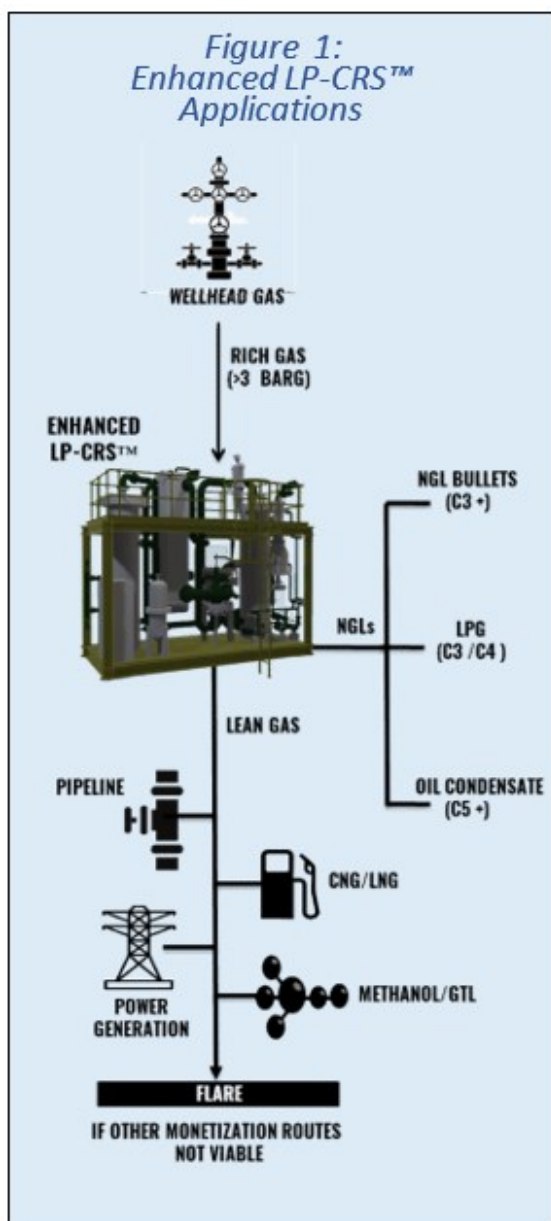
(NGLs) while simultaneously reducing greenhouse gas (GHG) emissions. The system can efficiently process raw gas to deliver lean dehydrated gas, which can be utilized as fuel gas, production of LNG, CNG or GTL or if no other alternatives are available, safely flared. Irrespective of whether the lean, dehydrated gas exiting the Enhanced LP-CRS™, is utilized or is flared, the resulting CO2 emissions is expected to reduce by up to 40%.

The removal of NGL and dehydration of gas using the Enhanced LP-CRS™ skid is essential for two reasons. First, dry lean gas (similar to typical methane natural gas) is necessary for power generation, CNG, LNG or methanol production. Specifically, natural gas-powered engines, used to drive generators run poorly on rich natural gas. Second, the value of the NGL is much higher than natural gas, and it simply makes good business sense to recover the liquids.

The extracted NGLs offer various possibilities for utilization. They can be co-mingled with the export crude oil stream, enhancing the volume and quality of the crude oil. Alternatively, the NGLs can be stored separately in LPG bullets, providing a valuable product for market distribution. Furthermore, the NGLs can be routed to a condensate stabilizing column, enabling condensate stabilization and extraction of LPG as separate products. This flexibility allows operators to choose the most suitable option based on their specific operational and market requirements.

In addition, the short delivery time of within 5 months for the standard units of the Enhanced LP-CRS™, enable quick reduction of emissions while increasing net revenue as an interim measure, while waiting for full-scale solution deployment which may entail a lead

time of more than 2 years. By offering a range of applications, the Enhanced LP-CRS™ system empowers oil and gas facilities to optimize their operations, reduce emissions, and generate additional revenue streams.



COMPETITION LANDSCAPE

While there are several technologies available in the market targeted for monetization of flare gas, virtually all are not practical for implementation at production sites at flare gas in the range of 3 MMscfd to 25 MMscfd. An impediment is the fact that oil production facilities in most locations generally have a short production life ranging from 3 to 10 years. The low production rates and low pressure coupled with short production life makes many of conventional technologies, like pipelines, power

generation, LNG, CNG, GTL, etc. for monetizing the gas generally economically not viable. Table 2 presents some of the prominent solutions providers in the market.

As indicated in the tabulation, all the solutions mentioned above require relatively high CAPEX and require additional facilities for pressure boost, gas pre-treatment, power supply, among others. Particularly for offshore facilities, these solutions become prohibitive.

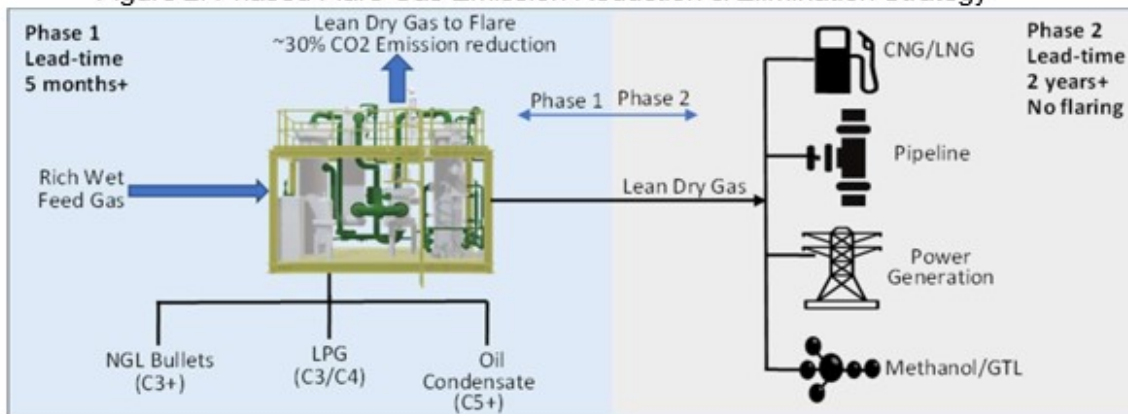
On the other hand, the Enhanced LP-CRS™ packages which come in four.

(4) nominal capacities are significantly smaller, lightweight and with lower capital cost. Even for facilities where the gas is to be monetized for power generation, CNG, LNG, CNG, pipelined, etc. the system is a cost-effective solution for pre-treatment. In addition, the short delivery time of within 5 months for the standard units of the Enhanced LP-CRS™, enable quick reduction of emissions and increasing net revenue as an interim measure, while waiting for full-scale solution deployment which may entail a lead time of more than 2 years.

Table 2: Competing Technologies

| Company | Merits/Demerits |
|---|--|
| Aspen E.S. NGL Pro – NGL Extraction | <i>Requires Compression, power supply, high space, weight & CAPEX</i> |
| CleanSmart Membranes– NGL Extraction | <i>Requires Compression, Pre-treatment, power supply, high space, weight & CAPEX</i> |
| Expansion Energy VX Cycle – LNG production | <i>Requires Compression, Pre-treatment, power supply, high space, weight & CAPEX</i> |
| GTUIT – NGL Recovery | <i>Requires mechanical refrigeration & compression, power supply. high space, weight & CAPEX</i> |
| MTRI Membranes – NGL Recovery | <i>Requires Compression, Pre-treatment, power supply, high space, weight & CAPEX</i> |
| Nacelle Membranes – NGL Recovery | <i>Requires Compression, Pre-treatment, power supply, high space, weight & CAPEX</i> |
| Pioneer Energy Gas Processing with Refrigeration | <i>Requires Compression, Pre-treatment, power supply, high space, weight & CAPEX</i> |

Figure 2: Phased Flare Gas Emission Reduction & Elimination Strategy



MARKET POTENTIAL—GLOBAL FLARING SCENARIO:

The global flaring of associated gas (AG) poses significant environmental and economic challenges. According to data from the World Bank's Global Gas Flaring Partnership (GGFR), AG flaring reached 139 billion cubic meters (bcm) in 2022, resulting in over 350 million tons of CO₂-equivalent emissions annually. This extensive flaring activity takes place across approximately 7,000 production sites worldwide, highlighting the urgent need for an effective solution.

Despite global efforts to reduce flaring, gas flaring has remained consistently high, ranging from 140 to 150 bcm between 2010 and 2022. This data demonstrates the magnitude of the problem and emphasizes the potential impact of addressing it. Major flaring nations and their corresponding volumes of gas flared can be observed in Figure 4.

The market potential for the Enhanced LP-CRS™ system is substantial, driven by the increasing emphasis on emissions reduction and sustainable practices in the oil and gas industry. By enabling the extraction of valuable natural gas liquids (NGLs) from low-pressure natural gas streams, this technology not only reduces flaring and greenhouse gas emissions but also presents a significant revenue-generating opportunity.

BUSINESS CASE

The business case for the Enhanced LP-CRS™ system is exceptionally compelling, offering NGLTech a wide range of commercial

technology aligns perfectly with industry trends and regulatory requirements, potentially making it a highly sought-after solution.

Figure 3: Historical Global Flaring and Oil Production

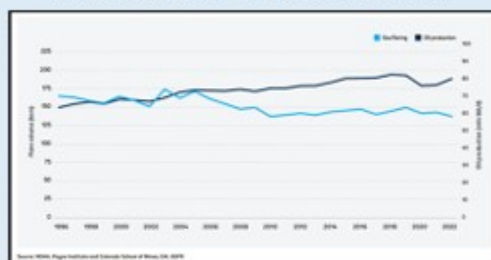
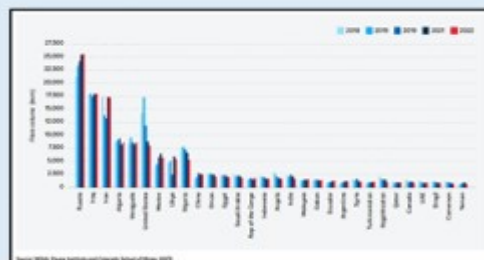


Figure 4: Major Flaring Nations



The global flaring of associated gas is a significant challenge. The Enhanced LP-CRS™ system offers compelling economic benefits, emission reduction, and vast market potential.

The scale of the market opportunity becomes evident when considering the number of production sites worldwide that flare significant amounts of associated gas. Based on data extracted from the World Bank's GGFR, there are approximately 7,000 production sites globally that flare AG, with around 850 production sites flaring more than 3 MMscfd, totaling 8.4 bscfd and with a mean AG flaring rate of 9.87 MMscfd.

Table 3: Business Case for Enhance LP-CRS™

| Global Associated Gas (AG) Flaring | |
|--|----------------|
| Total number of sites | 7000 |
| Total daily AG flared | 11.3 bscfd |
| Sites flaring more than 3 MMscfd AG | |
| Number of sites | 850 |
| Total daily AG flared | 8.4 bscfd |
| Mean flaring rate per site | 9.87 MMscfd |
| Average Cost of LP-CRS™ for each site | |
| Average cost of unit | USD 3.5M |
| Average installed cost | USD 10.5M |
| Benefit to end-user | |
| Average oil condensate extracted per day | 493.5 bopd |
| Expected Revenue per year | USD 12.6M |
| Expected CO2 emission reduction | 71,400 tons/yr |
| OPEX | USD0.5mil/yr |
| Carbon Tax Savings per year | - |
| Net Revenue per year | USD 12.1M |

If the initial target for the global commercialization of the Enhanced LP-CRS™ system focuses on facilities flaring more than 3 MMscfd of AG (approximately 850 facilities), the business case becomes compelling. With an average cost estimate of USD 3.5 million (ex-works) and an estimated installed cost of USD 10.5 million for each system, the financial feasibility is evident.

The system's capability to extract an average

of 493 barrels of oil condensate per day (bopd) from each production site unlocks incremental revenue of USD 12.1 million, assuming an oil price of USD 70 per barrel. Additionally, the system enables an average reduction of 71,400 tons per year in CO2 emissions, resulting in potential carbon tax savings.

The cumulative financial benefits realized with the installation of the Enhanced LP-CRS™ system are remarkable. The estimated payback period for the technology is approximately 11 months, highlighting its rapid return on investment. The total market potential for the Enhanced LP-CRS™ system is estimated at a staggering USD 2.98 billion, underscoring the vast commercial prospects waiting to be harnessed.

By capitalizing on this unparalleled market potential, NGLTech can position itself as a leader in emission reduction and carbon capture, simultaneously driving substantial financial gains. The Enhanced LP-CRS™ system's capability to deliver exceptional economic returns, reduce emissions, and create a sustainable

future establishes an unmatched business case that presents an irresistible proposition for global adoption.

CONCLUSION

The Enhanced LP-CRS™ system developed by NGLTech offers a promising solution to the challenges of associated gas flaring. By extracting valuable components from low-pressure natural gas streams, the system provides a commercially viable and environmentally friendly approach to monetizing flare gas. It addresses the limitations of existing solutions and presents an opportunity for emission reduction and revenue generation.

The system's high performance and low capex contribute to a short payback period, making emission reduction using the Enhanced LP-CRS™ system profitable for end-users. This economic advantage further incentivizes the adoption of technology and

promotes sustainable practices within the oil and gas industry.

In conclusion, the Enhanced LP-CRS™ system has the potential to contribute to emission reduction and resource monetization in the oil and gas industry. Its implementation aligns with sustainability goals, promoting responsible practices, optimizing resource utilization, and offering economic benefits for end-users.

The Enhanced LP-CRS™ system offers a promising solution to associated gas flaring challenges, enabling profitable emission reduction and revenue generation. Its high performance, low capex, and comprehensive marketing strategy position it as a leader in sustainable practices within the industry.



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