HUB TECH IA

Deliverable report 43

AI and IAGEN Application Use Case

Energy Optimization: Digital Twins, simulation of Operations to improve efficiency in Vaca Muerta

Executive Summary – Application of IAGEN for Energy Optimization in Dead Cow

This executive summary presents a strategic application of generative artificial intelligence (IAGEN) in the energy sector, specifically in the optimization of energy consumption and operational efficiency in the Vaca Muerta formation. This is a key opportunity to modernize operations through technologies advanced technologies such as digital twins and AI agentic flows, in one of the most promising for hydrocarbon development in Argentina.

Use case classification

The report classifies this application of AI and IAGEN based on four dimensions:

1. By main resource: oil, gas, water and energy (comprehensive approach).
2. By activity: energy efficiency and sustainability.
3. By technology: generative AI models, machine learning algorithms, data integration platforms, computer vision and intelligent agents.
4. By strategic impact: sustainability and reduction of environmental impact.

1. Opportunities for using AI and IAGEN in the sector

Among the main opportunities are predictive maintenance, advanced scenario simulation, optimization of operating parameters, real-time risk detection, improved asset performance management and simulation-based energy planning. These technologies allow for a more precise, dynamic and sustainable decision-making at all stages of the energy operation.

2. Expected benefits

The implementation of these solutions allows:

- Improve asset performance and lifespan.
- Anticipate failures and reduce downtime.
- Optimize the energy efficiency of operations.
- Increase safety through emergency simulations.
- Promote sustainability and environmental compliance.

3. Application of AI

AI is applied at multiple levels: from the analysis of operational data through advanced algorithms (CNN, RNN, Transformers) to real-time predictive process simulation. Its integration with digital twins allows for fine-tuning automatically operating variables to maximize efficiency, reduce costs and minimize risks. The proposed architecture combines IoT sensors, processing distributed and visualization platforms to operate with dynamic data from the environment.

4. Proposed AI Agent

The report proposes a generative artificial intelligence agent (IAGEN) designed to operate on a digital twin architecture. This agent acts in four interconnected phases: (1) collection of operational data through IoT sensors, (2) generation of a digital twin that replicates in real time the conditions of the

reservoir, (3) simulation and predictive analysis with AI algorithms to optimize operating parameters, and (4) continuous monitoring with the ability to automatically adjust to changes in the operating environment.

The agent integrates with existing systems and uses the digital twin as an environment testing to anticipate failures, evaluate hypothetical scenarios and optimize efficiency energy without directly intervening in physical assets. Its main benefit lies in its ability to prevent interruptions, reduce energy consumption and assist in decision-making through information generated in real time and adjusted to each operational context.

5. Conclusion

The incorporation of IAGEN and digital twins represents a transformation disruptive for the Vaca Muerte energy industry. These technologies allow evolve towards a smarter, more efficient and sustainable operating model, positioning Argentina as a regional benchmark in energy innovation. Its Strategic adoption can maximize the value of resources, minimize the impact environmental and accelerate the transition to a more resilient energy system.