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## **New Tendencies and Technologies on Tomography Applied to the Petroleum Industry: A Comparative Analysis**

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This work aims to present, and critically analyze, the “State of the Art” – or the “State of the Science” – in Industrial Tomography, focusing on the Petroleum Industry, as well as comparing it with the measurements and tomographic results carried out by the authors, within a project funded by the IAEA, called: “Strengthening of Industrial Process Tomography Technology to Characterize Brazilian Reservoir Rocks and to Improve Quality Control of Refining Towers and Pipes for Enhancement of Petroleum Production - BRA1036”. This industry has been one of the most advanced users of this technology for many years. Industrial Process Tomography (IPT) has many useful applications here, being able, in its recent advances, to provide increasingly more information in real time about rocks and fluids. However, the dissemination of it still faces some challenges, such as its high costs, and the need for highly qualified personnel. Gamma Ray Tomography, for instance, is still little known in this area. The main difference compared to X-Ray Tomography is that the former can generally penetrate much deeper into the reservoir rock samples, allowing analysis of much bigger samples, or with many different types of core holders: fluid flow through them, under high pressures and temperatures, can be analyzed. And new X-Ray technologies are also considered for these applications. To conduct this study, the authors first analyzed the main types of tomography applied to this sector. The focus here is on Radioactive Tomography, but other similar techniques are also presented. Microwave Tomography, for example, can also be used, with IPT. This technique has evolved considerably, although still with few non-medical applications. Another similar technology, common in this area, is Gamma Ray Logging, either Natural or Induced. Other ways of obtaining the same type of information – porosity and permeability through petrophysics, for example – are also compared. Finally, a discussion about the current terminologies for these technologies is presented, including suggestions for better classification and uniformity. All these comparative analyses take into account the United Nations Sustainable Development Goals (SDGs), to evaluate the best options for the coming decades, in the world: this industry is currently largely responsible for global warming, but it is one of the biggest Investors in CO<sub>2</sub> capture. The most related SDGs here are the numbers 9 (Industry, Innovation and Infrastructure), and 12 (Responsible Consumption and Production). The main results presented are comparative, definitions, and classification tables, as well as suggestions for applications that can help improve the use of Industrial Tomography. In conclusion, the strong evolution of X-Ray Tomography may represent a challenge for the competitiveness of Gamma Ray. In general, real time tomography deserves a great emphasis in this scenario. But it is possible to state that Gamma Ray Tomography, and IPT, are among the most promising evolving technologies, considering their rapid growth and potential to increase the efficiency of petroleum recovery and its derivatives production.