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" Decarbonization, AI and Digital Transformation for Sustainability in Process Industries "

Presenter's Biodata & Abstract

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Title of Presentation: Digital technologies supporting the pathway to develop green hydrogen and fertilizers

Presentation Abstract:

Many Southeast Asian countries have committed to reaching decarbonization goals by 2050, aiming to accelerate the energy transition while maintaining supply security. This effort can be significantly supported by newly established fertilizer plants powered by green hydrogen from renewable energy and electrolyzers. These facilities can produce green ammonia, which can then be used to manufacture nitrogen-based fertilizers.

Nitrate-based fertilizers are pivotal for global food security. However, their production and utilization significantly contribute to greenhouse gas (GHG) emissions. While post-production improvements in nitrogen-use efficiency can notably reduce GHG emissions, achieving sustainability objectives necessitates the decarbonization of the fertilizer production process. The evolving energy landscape, particularly the production of green hydrogen, provides an opportunity to establish a more sustainable and self-sufficient fertilizer industry. However, the integration of green hydrogen with downstream processes is currently in a demonstration stage, and the optimization of by-products and waste heat stream integration throughout the process is yet to be fine-tuned. For these processes to be economically viable and genuinely efficient, a comprehensive understanding of system interactions is vital to achieve the best design and ensure safe, reliable operations. Low-carbon fertilizers, generated from electricity without depending on natural gas or ammonia imports, offer prospects for supply security, stable pricing, and a reduced CO2 impact on the agricultural sector.

Digital process twins provide a virtual environment to test these interactions, informing better process design, integration, and tools for real-time process optimization, aligning with environmental and economic dynamics. This presentation showcases how digital process twins can explore integration concepts within the green fertilizer value chain. For instance, utilizing oxygen from electrolysis, recovering electrical energy from waste heat streams, or adjusting operating strategies to enhance downstream process efficiency during surplus renewable energy generation. An approach for efficient modelling and management of green hydrogen processes using modular integration and pre-built templates will be described. Thus, simplifying the creation

of a comprehensive plant model for engineers in exploring process results, calculating the Levelized Cost of Hydrogen (LCOH), as well as analyzing configuration and uncertainties to enhance the understanding and integration of green hydrogen technologies to existing assets. Operators can access an optimizer view through dashboards to monitor and optimize production plans, integrating real-time data and analytics. Such dashboards serve as a hub for energy efficiency monitoring, offering insights on renewable energy availability, H2 demand forecasts, and providing recommendations for effective energy use and meeting production goals for downstream fertilizer processes and empowering companies to navigate towards net-zero emissions with confidence and reduced risks.