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M2Or2G-04: [Invited] Can process intensification of liquefaction technology for LNG and LH2 accelerate adoption for transportation use?

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One of the reasons gaseous fuels, methane, and hydrogen, are renewable, sustainable replacements for traditional liquid hydrocarbon-based transportation fuels is their small carbon footprint. Global awareness of the immediate need to address impacts of emissions from transportation energy use has emphasized urgency of changes from business as usual. However, the transition from existing fuels to new fuels is complex because their usage is huge, and so many variables influence the rate of adoption. One only need to read credible energy outlooks of major energy companies and international or national energy agencies along with studies of the water, energy, food nexus to appreciate these complexities. Marchetti's insightful numerical modeling of the rate of transition among different energy sources over the past two centuries with credible recorded usage data shows the time scale for appreciable change is several decades. A further important observation of this work is that transitions among energy sources were and are driven by substitution of superior technology rather than by depletion of prevalent sources. These observations incentivize developments of multiple more efficient, less expensive, robust, scalable methods of production, liquefaction, storage, transport, delivery, and dispensing of hydrogen and natural gas are essential to accelerate adoption by transportation customers. This paper focuses on a few examples of how process intensification in advanced liquefiers for LNG and LH2 at the same location could reduce capital costs, energy costs, and foot prints of different sized liquefiers. These solutions help address gaps in existing technology for several essential needs such as refueling station or bunkering-sized liquefiers, boil-off management systems on several scales, or modular containerized, several tonne/day liquefiers that can be scaled by numbers to make distributed-sized industrial plants that match localized fuel demands from mobile users

Author: Dr BARCLAY, John (Pacific Northwest National Laboratory (USA))

Co-author: ARCHIPLEY, Corey (Pacific Northwest National Laboratory (USA))

Presenter: Dr BARCLAY, John (Pacific Northwest National Laboratory (USA))

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