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Editorial: Methane and Hydrogen for Energy Storage (IET)

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Drastic reductions of greenhouse gas emissions in the next few decades are essential to reduce the risks associated with global warming and climate change.

The Intergovernmental Panel on Climate Change [IPCC 2014] explains the severe situation:

"Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems."

"Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks."

A transition is needed throughout the whole of society, but this work focuses on a specific area: the possibilities to reduce emissions from the road transport sector by replacing fossil fuels with sustainable fuels based on renewable energy.

A new book has been published by The Institution of Engineering and Technology (IET) [1] entitled "Methane and Hydrogen for Energy Storage" edited by Rupp Carriveau and David S-K. Ting [2].

Commercial energy storage has moved from the margins to the mainstream as it fosters flexibility in our smarter, increasingly integrated energy systems. Natural gas has been identified by many as the fuel to take us to the no-carbon horizon; where a hydrogen economy waits on development. These two actors are already connected in precursor applications as transitional solutions for hydrogen handling and transportation are sought ahead of a fully established hydrogen infrastructure. This monograph explores some of leading advances in methane and hydrogen storage as well as the interesting link between these two important elements in our evolving energy system mosaic. Topics covered include: hydrogen absorption for storage; power-to-gas for energy system integration and storage; methanation for power-to-gas applications; production of hydrogen from methane decarbonisation into power to gas scenarios; power-to-gas in an ancillary service market; methane in MOFs: where, why and how; thermal management as a key in storing adsorbed natural gas; and gas hydrate potential and development for methane storage.

The monograph commences with Hydrogen Absorption for Storage by Makridis in Chapter 1 [3]. In this chapter, absorption is considered to facilitate the potential utilization of natural gas infrastructure as a hydrogen storage and delivery mechanism. This is followed by Power-to-Gas for Energy System Integration and Storage in Chapter 2 [4], where Walker et al. detail the use of surplus electricity from multiple sources to generate hydrogen gas that would also be injected into the natural gas infrastructure. These two chapters highlight some of the critical links that can be made between hydrogen and natural gas to help drive a more realistic march to a carbon-free economy.

Converting carbon dioxide back into methane can present a double benefit, as it captures undesirable emissions and converts them into useful fuel. On this, Kolb et al. tackle the challenge of the relatively low efficiency of conventional methanation with the latest technologies from a comprehensive analysis of the literature in Chapter 3 [5]. It is with minimal modification that hydrogen can be injected into natural gas infrastructure at low concentrations. This enablement builds great potential for storage of gas produced by surplus electricity. The volumes and time independency of such storage is attractive for energy utilities. This is echoed by Abanades in Chapter 4 [6], Production of Hydrogen from Methane Decarbonization into Power-to-Gas Scenarios.

To have a viable Power-to-Gas system in practice, stakeholders at both the supply and demand ends have to work together. The flow of power must be carefully regulated in the time and manner of its delivery. In Chapter 5 [7], Mukherjee et al. carry out a simple techno-economic feasibility study of a Power-to-Gas energy hub that offers said load regulation capabilities in what is termed the ancillary services market.

To overcome the high pressure required in traditional compressed natural gas (CNG) storage, Adsorption of Natural Gas (ANG) in Metal-Organic Frameworks(MOFs) has been revealed as a promising alternative. Storage pressures are up to seven times less than those required by CNG. Such pressure reductions can lower the costs of compression and increase flexibility for storage container designs.

Makal delineates how MOFs' high surface areas and chemically-tunable structures have made them prominent sorbent materials for enhancing the natural gas storage capacity of on-board vehicular fuel systems in Chapter 6 [8].

Recently, conformable storage ANG tanks have been proposed to better utilize the limited space on vehicles. To make ANG competitive, further improvement in the high-performance sorbents like MOFs is needed. As importantly, proper thermal management is necessary when it comes to reasonably short refueling times.

This is unveiled thermodynamically in Chapter 7 [9] by Ahmadi-Baloutaki et al. Where would one harvest for clean methane years from now? From the large amount of gas hydrates naturally stored under our feet, according to Goyal et al. in Chapter 8 [10]. The naturally occurring gas hydrates contain a large amount of methaneper molecule of hydrate. This is not lost on countries like the United States, India, and China that are committing significant levels of research investment to find feasible ways to economically crop and harvest methane from these hydrates.

References

1. Carriveau Rupp, Ting, David SK, editors. Methane and Hydrogen for Energy Storage (Energy Engineering, 2016). DOI: IET Digital Library. Available from: http://digital-library.theiet.org/content/books/po/pbpo101e.
2. Rupp Carriveau, David SK. Ting with Turbulence & Energy Laboratory, University of Windsor, Windsor, Ontario, Canada; 2016. Book doi: 10.1049/PBPO101E.
3. Sofoklis S Makridis. Hydrogen storage and compression; 2016. p. 1-28. arXiv:1702.06015. Chapter doi: 10.1049/PBPO101E_ch1.
4. Sean B Walker, Ushnik Mukherjee, Michael Fowler, Daniel van Lanen, AzadehMaroufmashat. Power-to-Gas for energy system integration and storage; 2016. p. 29-52. Chapter doi: 10.1049/PBPO101E_ch2.
5. Thomas Kolb, Siegfried Bajohr, Jonathan Lefebvre, Manuel Götz, DominikSchollenberger. Methanation for Power-to-Gas applications; 2016. p. 53-66. Chapter doi: 10.1049/PBPO101E_ch3.
6. Alberto Abanades. Production of hydrogen from methane decarbonization into Power-to-Gas scenarios; 2016. p. 67-80. Chapter doi: 10.1049/PBPO101E_ch4.
7. Ushnik Mukherjee, Sean B. Walker, Michael Fowler. Power-to-Gas in an ancillary service market; 2016. p. 81-103. Chapter doi: 10.1049/PBPO101E_ch5.
8. Trevor A Makal. Methane in MOFs: where, why, and how; 2016. p. 105-124. Chapter doi: 10.1049/PBPO101E_ch6.
9. MojtabaAhmadi-Baloutaki, Rupp Carriveau, David SK Ting. Thermal management as a key in storing adsorbed natural gas; 2016. p. 125–136. Chapter doi: 10.1049/PBPO101E_ch7.
10. AyushGoyal, Jacqueline Stagner, David SK Ting. Gas hydrate potential and development for methane storage; 2016. p. 137-163. Chapter doi: 10.1049/PBPO101E_ch8.