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An Austere Digital Engineering Approach for Energy Decarbonisation

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ABSTRACT

Digital engineering (DE) is an active area of research in systems engineering. This paper explores the application of digital engineering to complex, large-scale energy decarbonisation projects. Energy decarbonisation projects are highly diverse in nature, spanning multiple industries, such as: energy generation, transportation, and mining. A DE approach that combines systems engineering design and analysis, supported by physics-based modelling, can be used to effectively understand, design, and deliver these often complex projects. However, such an approach can quickly become highly resource intensive. The paper addresses this issue though a flexible yet cost effective approach that utilises a modular combination of model-based systems engineering, physics-based modelling, and operations analysis techniques to analyse a range of energy decarbonisation projects. Furthermore, many energy decarbonisation projects are enterprise activities with a range of critical externally controlled elements or effectively function as a strategic alliance with significant independence in the development of the component systems. The paper describes how lessons from defence mission engineering can be used to address these system-of-systems aspects and shape the modular DE approach. Finally, the paper outlines some examples from the mining industry of applying this modular digital engineering approach.

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