Digital Security and Sustainability: Synergies and Trade-offs

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Recent developments in data science provide powerful tools for facilitating a low-carbon economy [1], although they can also consume large amounts of energy [2]. At the same time, the digitisation and increasingly online modes of energy infrastructure (e.g. through digital twinning) make it more vulnerable to cyber-attacks, while climate change impacts are exposing the infrastructure to new risks. To address the overarching challenges of sustainability and digital security, the synergies and trade-offs between them need to be articulated and unintended consequences exposed.

This paper analyses common features of sustainability and digital security together with important differences between them, and provides an overview of general research trends at the intersection of these areas. The decentralised nature of both is explored, as well as potential lessons that the two areas can learn from each other's failures and successes to date. The work traverses several themes of the Data Science of the Natural Environment Conference, including low-power applications, policy adaptation, and digital trust.

Findings indicate that, while there is vibrant research in the two areas separately, studies that cover them simultaneously are limited to cybersecurity of smart grids (e.g. [3, 4]) and smart cities (e.g. [5, 6]), with the latter often overlapping with research on electric vehicles (e.g. [7]) and autonomous vehicles (e.g. [6]). Publications mainly include conference papers, and articles in second-tier journals, indicating that this research field is nascent. By research type, most of the publications are conceptual or theoretical papers and literature reviews. There are few empirical studies, and those tend to focus on surveys of stakeholders' perceptions (e.g. [8]).

When it comes to risks, both areas suffer from difficulties of enforcement, collective inaction, free riders, dispersed benefits, and concentrated costs [9]. Where infrastructure critical for sustainability (such as electricity transmission lines, subsea interconnectors, and natural gas pipelines) spans international borders, parties often fail to cooperate on cascading effects [10]. Current legal frameworks covering both sustainability and digital security are usually fragmented and outdated [11].

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