

/Executive summary

/SOW 2023



It is with great enthusiasm that we present this comprehensive report on the evolution and continued need to develop energy systems to meet goals such as the SDGs and net zero. As stewards of innovation, FIDIC, the International Federation of Consulting Engineers, takes pride in shining a light on the compelling story of the development of today's infrastructure - but what about tomorrow's infrastructure?

This leads to the wider question of do such historical decisions and their influence on energy markets still hold true all these years later? Energy markets have developed to "provide energy" as demand for it grew, but now they are transitioning to a position of not only providing energy but doing it in a way that is greener, engages society and increasingly more locally.

Energy systems and grid development - the way forward?

In today's dynamic energy landscape, the significance of integrating renewable energy sources has taken centre stage. The imperatives of environmental sustainability and the urgent need to mitigate climate change have led to a remarkable shift towards harnessing energy from sources like solar, wind and hydroelectric power.

The unique nature of renewables, however, characterised by variability and intermittency, presents both challenges and opportunities. For example:

- Electricity systems have to balance as storage options were limited which can create issues with intermittent sources.
- Having the capacity to install or enable enough connections for more dispersed generation technologies and for high load end use such as the fast charging of electric vehicles.
- There is increasing use of interconnectors to provide flexibility against intermittency.
- Customers are becoming more aware of energy use and deploying demand management solutions which can potentially provide data for 'true' demand management.

The above demonstrates the pivotal role of power grids in facilitating the seamless integration of energy into our daily lives. Power grids, often likened to intricate circulatory systems, must evolve to become agile and adaptable to the ebb and flow of renewable generation.

This poses a number of questions:

- Are we adapting fast enough?
- Can the systems that have been developed over the past 150 years adapt to the goals we now wish to achieve?
- If we are developing new systems where they don't exist across the globe, is the old model of large capacity, limited site distribution still relevant?

As we steer towards a future powered by cleaner and greener sources, the role of power grids as enablers of sustainable energy transition becomes a linchpin and their evolution serves as a bridge between our energy aspirations and the reality of a renewable-powered world.

Amidst the dynamic landscape of renewable energy integration and the evolving role of power grids, various technologies from history are making a comeback in various forms, from windmills to solar collectors. So, what about grids and local solutions?

DC systems, once overshadowed by the prevalence of alternating current networks, have experienced a renaissance owing to their unique attributes.

The inherent advantage of DC systems lies in their ability to seamlessly integrate with various renewable energy sources, such as solar panels and battery storage systems, which inherently produce DC electricity. This intrinsic compatibility reduces the need for conversion processes, minimising energy losses and enhancing overall system efficiency. Furthermore, they can offer enhanced controllability, allowing for more precise management of power flow and distribution, thereby optimising the integration of intermittent renewables into the grid.

So, as we embark on the journey to a greener, sustainable, resilient, demand management, local and society-based energy model, it is important to go back to the wider question of do historical decisions, such as AC/DC, centralised generation and distance transmission still hold true all these years later?

In short, no. As we have seen through this report there are multiple ways in which a more diverse set of energy systems can not only provide efficiency, sustainability benefits and resilience, but also that in some instances for new networks they may even be the preferred solution.

Ultimately engineers will need to assess the complex set of requirements and deliverables needed to meet targets such as the SDGs and net zero, be it AC or DC. It is by balancing the complex set of requirements outlined in this report - and by implementing recommendations that enable innovation, policy development, sustainability and SDG linkages and community engagement - that progress can be made.

This report therefore provides the following overarching recommendations, which in each of the relevant sections also contains further sub-recommendations on the way forward.



Clients should procure solutions with specific links to the SDGs outlined: The SDGs play a vital role in the development of sustainability, economies and society. These goals are by no means simple to achieve and if solutions are to be procured to create the best outcomes to align to these goals, all projects should have a clear statement of intent as to the aims they are trying to achieve under the SDGs.



Modern power systems involve a complex delivery of multiple types of projects: As such it is important that engineers are engaged in project conception and feasibility at the earliest possible stage so that complex areas of assessment can be undertaken.



Society and communities matter: If we are to achieve the SDGs, the infrastructure sector is going to have to become more society and customer focused. We will no longer just be serving the initial public or private sector client.



Policy frameworks need to be in place and fit for purpose: Whether it is to improve, retrofit and/or upgrade existing infrastructure or to encourage the provision of new infrastructure (such as in developing countries), it is important that policy frameworks are tailored to the specific needs and goals a country is trying to achieve.

