Energy Informatics Using the Distributed Ledger Technology and Advanced Data Analytics

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EXECUTIVE SUMMARY

The main drivers of the third industrial revolution era were the internet technologies and rise of renewable and distributed energy technologies. Transition to green and decentralized energy resources and digital transformation of the existing industrial infrastructure had been the biggest achievements of the third industrial revolution. The main drivers of the fourth era will be artificial intelligence (AI), quantum computing, advanced biotechnology, internet of things, additive manufacturing, and most importantly, distributed ledger technology (DLT). Energy forecasting such as wind and solar power forecasting models are the most common energy AI-based informatics applications in the energy sector. In addition, use of DLT is expected to be an industrial standard in various industrial sectors including energy business in the coming decade. This chapter emphasizes description of energy forecasting using AI and energy DLT and future developments and solutions to overcome challenges that are associated with standardization of the energy DLT applications.

BACKGROUND INFORMATION

The industrial revolution is now in the fourth phase. The first industrial revolution is started with the invention of the steam engines and matured with the extended infrastructure supported by derivative or follow-up technologies such as building the factories and railways. Electrification, invention of combustion engines and evolving the mass production were the major indicators of the second industrial revolution. The main drivers of the third industrial revolution era were the internet technologies, advance molecular biology, smart internet of every things, rise of renewable and distributed energy technologies. Transition to green and decentralized energy resources and digital transformation of the existing industrial infrastructure had been the biggest achievements of the third industrial revolution. Rifkin (2011;2013) described the third industrial revolution as "a new convergence of communication and energy" to design and operate a powerful new infrastructure. While the industry is evolving towards the third relation wave, the fourth industrial revolution stage is started. Schwab (2016) showed "Third used electronics and information technology to automate the mass production" and "now a fourth industrial revolution is building on the Third, the digital revolution that has been occurring since the middle of the last century. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital and biological spheres.". According to this definition, the industry is evolving to the cyber-physical-system (CPS) level, where the information and communication technologies (ICT) are converging to physical components such as mechanical and energy systems or in future biological systems. The main drivers of the Fourth era will be artificial intelligence, robotics, quantum computing, advanced biotechnology, internet of things (IoTs), additive manufacturing, fully autonomous vehicles and most importantly distributed ledger technology (DLT). There had been a very strong correlation between the fundamental changes in the field and use of energy, the monetary flow (economics aspects) and the social aspects, if the historical influences of the previous industrial evolutions are considered. Therefore, it is inevitable that the new Third and Fourth industrial revolution infrastructure will enable fundamental paradigm shifts in near future. Sharing economy and democratization of information and power (or any good or service in general) infrastructure will be central hot spots of the new scientific discussions. In this study, we attempted to discuss the use of two main (AI and DLT) Third and Fourth industrial era technologies in the field of energy.

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