Millions of tons of waste plastic are generated worldwide every year. These waste plastics are nonbiodegradable and are inappropriately disposed thereby constituting sanitary and environmental nuisance to society. The discarded plastics are dumped into drainages and water bodies where they pollute the environment, contaminate aquatic habitats, and harm aquatic animals. Researchers have devised techniques for converting waste plastic to biofuels to replace the dangerous fossil-based fuels and meet the Sustainable Development Goal (SDG) of affordable and clean energy for all targets. This study reviews the strategies for achieving affordable and clean energy through the conversion of waste plastic to biofuels and other value-added products. The classes of plastics and their applications, waste plastic conversion routes and their products, and conversion of waste plastic to bio-oil, biohydrogen, and other renewable fuels are examined. The application of waste plastic in the building and construction industries, production of carbon nanotubes, synthesis of graphene nanosheets as novel biocatalyst, and wastewater treatment are also discussed with a view to exposing other avenues for the utilization of waste plastic. The outcome of this intervention will enrich scholarship by providing updated information on the strategies for converting waste plastic to biofuels and other value-added products. Biofuel researchers, waste managers, environmental enthusiasts, and other stakeholders will be equipped with adequate knowledge on opportunities available in the waste plastic conversion and how to turn the menace of waste plastic into beneficial products. Implementable legislations and policies to encourage investments into waste conversion for cleaner environment, employment generation, and biodiversity. More targeted interdisciplinary studies are required to evolve innovative pathways for sustainable conversion and utilization of waste plastic. The use of appropriate state-of-the-art technologies such as machine learning, artificial intelligence, etc. as well as statistical modeling, and optimization tools are needed to improve the conversion efficiency, optimize process parameters, and guarantee the sustainable production of quality products from waste plastic towards meeting SDG 7.

Introduction

Rapid population explosion, uncontrolled urbanization, and accelerated industrialization have continued to put immense pressure on the available resources. Among the worst hit by this increasing demand are the finite resources that has direct impact of human beings, especially energy. This is barely surprising bearing in mind the direct correlation between energy access, industrialization, and quality of life. In today's world, lack of access to adequate energy supplies and transformation systems is one of the major impediments to abundant human and socio-economic development. Access to energy is fundamental to poverty alleviation, socio-economic growth, industrialization, and enhanced living conditions [1,2]. Since 2010, the percentage of the global population with access to energy for lighting and cooking has increased. However, regional disparities in energy accessibility to clean energy has continued to persist and militate against universal coverage. For example, more than half of the population of Sub-Saharan Africa has no access to electricity, which is equivalent to about 75% of the worldwide deficit [3]. Though the percentage of the global population with access to clean cooking fuels and technologies rose from 57% in 2010 to about 69% in 2020, nearly 20 million people, majorly from Sub-Saharan Africa, Eastern Asia, South-eastern Asia, Central Asia, and Southern Asia, has no access to clean and modern technologies for cooking [4]. Governments must show political commitments and prioritize investments to achieve universal access to clean, cheap, and sustainable energy as envisioned by the Sustainable Development Goal (SGD) 7 [5]. Fig. 1 shows the SDG goal 7 and the targets. One of the cheapest means of achieving SDG 7 of cheap, readily accessible, and sustainable energy is the transformation of wastes to renewable fuels.

Plastic wastes are discarded, abandoned, and out of use synthetic plastic products in a way that is harmful to the environment. Since they are nonbiodegradable, they remain in the environment for a very long time, constituting a nuisance and inflicting enormous damage to the environment. The global plastic production rose from 270 million metric tons (MMT) to 367 MMT in 2020 and has been projected to become 445 MMT and 590 MMT in 2025 and 2050, respectively (Fig. 2) [6,7]. The United States, China, and India topped the ten largest producers of plastic waste in 2016 with 34 MMT, 26 MMT, and

21 MMT respectively (Table 1) [8]. Since plastics don't decay, most of them end up discarded and dumped in landfills and oceans as waste. Also, about 9% of plastic wastes are recycled and 19% incinerated while the remaining are left to the environment, oceans, and water bodies. Plastic waste is a global problem and pumped about 850 MMT of greenhouse gases (GHGs) into the environment in 2019. By 2050, the emission of GHGs from plastic waste is expected to become 2.8 billion tons, unless something urgent is done to stem the worrisome trend [9].

The increased demand for plastic is as a result of increased popularity of plastics as a key material for diverse applications in the packaging, textiles, construction, and healthcare sectors. With 115 MMT, 64.1 MMT, and 47.5 MMT, the packaging, building and construction, and transportation sectors dominated the plastic consumption scenario in 2017, as shown in Fig. 3 [10].

The enormous plastic waste generated globally can be converted to meeting the global energy need if well managed. Various methods have been used to transform plastic waste into useful energy. Thermochemical conversion is one of the pathways for the conversion of plastic waste into useful energy. In a different study, Liu et al. [11] converted waste plastics into carbon nanotubes over a Nickel/ceramic-based catalyst at 700 °C while Chandran et al. [12] explored thermal energy to convert plastic waste into biofuels. Sharma et al. [13], Fernandes [14], and Mohanty et al. [15] equally exploited various techniques to convert waste plastic into biofuels and other value added products as a way of managing the menace of plastic wastes. While the outcomes of these investigations have been well reported in the literature, there is a need to have a single document that will contain the techniques, processes, products, and outcomes of the various conversion processes for waste plastic to specifically address strategies for achieving SDG 7 of affordable, readily accessible, and sustainable energy for environmental sustainability and national development. The recent efforts of Papari et al. [16], Li et al. [17], Yang et al. [18], and Al Rayaan [19] though reviewed the various instances of converting plastic waste into biofuel, chemicals, and useful products did not thoroughly address the link between the conversion of waste plastic and clean energy, in our view. obvious gap by their inability to link the outcome of studies to meeting the SDG 7, in our view.