TECHMIND RESEARCH
ISSN: 2292-1648

International Journal of Management Excellence
Volume 17 No.2 August 2021

The bioenergy industry and the road to 2050 Net Zero goal in the UK context

Le Thanh Xuan[1*], Tran Minh Thu[2] & Le Thai Phong[3]
Chief Executive Officer (CEO), Goldkids Vietnam[1]
Lecturer, Foreign Trade University, Vietnam[2&3]
thanhxuan.mytalents@gmail.com[1]
thutm@ftu.edu.vn[2]
lethaiphong@ftu.edu.vn[3]
[*]Corresponding author

Abstract - *The target to have a corporate social responsibility and a healthy ecosystem has become even more essential for both scholars and managers. This report, led by the University of Bedfordshire of United Kingdom (UK), examines the current status of the UK climate change, 2050 net-zero target, bioenergy analysis, and issues. In the context of climate change, converting consumption and production from conventional energy to renewable energy, especially bio-energy, is both a challenge and an opportunity for enterprises with the responsibility to be fully decarbonized by 2050. The great thing is that the UK is urging world leaders to go further and faster to tackle climate change and achieve global efforts. Using PESTLE and Porter's 5 Forces as frameworks, the report suggests to provide insights into the opportunities, issues, and future forecasts about the internal and external environment of the bioenergy industry. The author recommends the four key issues belonging to the operation, society, economics, and policy which are (i) limited domestic bioenergy supply, (ii) land uses issues, (iii) limitation in investment, and (iv) lack of rigor in regulation. Thus, depending on collected information and analytical processes, the report predicts some forecasts in the short-term and long-term future so that government, businesses and other stakeholders can acquire valid and reliable literature as a live topic they need to take action.*

Keywords: *bioenergy; renewable energy; main issues; forecast evaluation*

1. INTRODUCTION

Over the past decade, United Kingdom policy has given renewable energy an increasingly significant role. Environmental aims include: reducing their emissions to below zero and better managing waste. Achieving the 2050 net-zero target will require fundamental changes across all sectors of the economy that this report highlight bio-energy sector. The energy industry encourages growth potential and presents challenges for executives or leaders. Business is profitable so that the profits are not allowed to harm the ecological environment. Through evaluating PESTLE analysis and Porter's 5 Forces as the academic frameworks, experiencing a portfolio of work, the report aims to identify the status of climate change, identify the net-zero carbon target, examine the potentials and issues bioenergy industry in the UK so as to descriptive forecasts about climate change's direct impact on this industry, support the UK achieve the ambitious emissions target in tackling climate change globally.

2. OVERVIEW

2.1 Net Zero Carbon Emissions Target By 2050

Climate change and global warming are not only challenging to the future. People are already observing changes in the UK climate about average temperatures have risen about 1 degree Celsius over the last century. It would seem that a trend towards warmer winters and hotter summers, rising sea level around 3mm per year, or even emerging evidence of changing rainfall (HM Government, 2017).

These urgent phenomena require the government to find solutions to prevent ongoing risks and then develop a new UK's target or an adaption program to address them to reduce long-term vulnerability to climate change - their Nationally Determined Contribution (NDC) under the Paris Climate Agreement. Prime Minister Theresa May presents her ambition by respecting UK to be the first pioneer country to legislate for net-zero carbon emissions 2050 supported by Committee on Climate Change (CCC). It represents a remarkable tightening 80% target set under the Climate Change Act 2008 with a new plan aim for at least 68% reduction in greenhouse gas emissions by continuing to decarbonize from fossil fuel, households, particularly transport, agriculture, and manufacturing (Virley et al., 2019). Additionally, the target promises to create 250,000 jobs for the British by 2030 following the Prime Minister's commitment under the Ten Point Plan.

Nonetheless, law for carbon reduction target only enshrine in the form of drafts and recommendations. The instance of waste management would transit food waste from landfills to recycling as a circular economy. Visible popularity is in the transport sector, encouraging people to control electric cars, walking, using green public transport. Regarding the energy industries, shift the use of coal-fired power plants to other alternative energy sources. One of the renewable sources highly appreciated for its widely-used applicability, multidisciplinary which is the biomass energy sector.

2.2 Bio-energy industry analysis

2.2.1 Scale and configuration - Porter's 5 Forces

Bioenergy sits at the roads of the UK's challenges - climate change and energy security. The energy demand are increased remarkably in the coming years due to population and economic growth. Bioenergy is called all types of energy derived from biofuels which are fuels derived from a material of biological origin or biomass by the Food and Agriculture Organization of the United Nations (FAO) in 2004. FAO classifies biofuels according to the biomass source used in production and the product state. Biomass sources come from forests, industries, or cities. Thus, biofuel includes fuels from woodfuels, agrofuels, and municipal products. Each group is divided into solid, liquid, and gaseous forms used for heat or power generation. Additional classification can be made in terms of traditional and modern bioenergy. Traditional bioenergy refers to bioenergy in the form of sugarcane, wood, wood waste, charcoal, crop residues, and manure, and it has been utilized as a source of energy during human history for cooking and heating. Modern bioenergy relates to biomass (or biosources) converted to higher value and more efficient energy carriers such as biogas, ethanol, and biodiesel. As bio-wastes are generated in large scales, in the range of billions of kilograms per year with largely available and rather inexpensive, scholar Ghosh et al (2016)[12] says that these materials are considered to be potential sources for the production and distribution.

Michael Porter's Five Forces competitiveness model aims to assess an organization's competitiveness and position in its operating environment. This model builds on the assumption that five industrial forces determine the level of industry competitiveness and attractiveness, particularly the bioenergy industry. The Five Forces model will help strategic managers understand the industry's current competitive position and the green revolution goals the organization hopes to achieve in the future.

(1) The threat of new entrants	In the past decades, electricity production from renewables has increased rapidly in the UK. In the summer of 2019, the UK became the first major economy globally to issue a Net-zero carbon target to reduce greenhouse gas emissions to net-zero by 2050, and intensifying the usage of renewable energy is essential. The second-largest renewable energy source in the UK after combined wind power is bioenergy, producing 37314-gigawatt hours of 2019 in accordance with Statista (February 19, 2021). When renewable energy makes up nearly a third of the nation, approximately half of it comes from wind energy. There is a competition between traditional energy (primary oil, natural gas, or coal) and renewable energy or competition between renewable energies (nuclear, wind, solar, natural flow hydrogen, or bioenergy). The dominant energy often depends on government policies to consider the advantages and limitations of each industry (Gómez-Marín and Bridgwater, 2021)[11]. Hence, the UK government attaches significant importance to the bioenergy sector based on the energy policy. Besides, bioenergy and waste received $123 billion in financing for new projects between 2010 and 2019 (UN Environment program; UNEP center). Nevertheless, the covid-19 pandemic has diminished deal-making renewables in recent months and impacted investment levels in 2020. Summary: • Government policies • Capital requirements • Limitation in channels and funds
(2) Power of Buyers	The UK government advisers acknowledge the country is indifferent to the extensive benefits of bioenergy (biomass or energy from organic materials). The bio-products are not only made from renewable sources, but they also require less energy in the manufacturing process (https://www.mt.gov.vn/). In the bioenergy industry stakeholders, the buyers are biomass traders (buyers and sellers of biomass) and biomass end-users. According to Mohammad et al (2018)[21], the bioenergy production landscape plays a considerable role in the growth of profits, markets, consumers, and purchasing power. It suggests that end-use should have risen on regional policies and emphasis on environmental protection, and possible costs. The cost of a biomass boiler can be difficult to pin down. In general, the cost of a biomass boiler can be high. Regarding to the renewable energy hub UK (2019), the average installation will cost you £ 12,000 for an automatically refueled boiler. A hand-fed boiler will cost less and can save you around £ 5,000. For biofuel, there are three types of fuel: pellets, wood chips, and logs. The estimated price for wood pellets per kilo is £ 245, logs £ 100, and wood chips £ 60. On average, the user can expect to use 11 tonnes of fuel per year. In short, the buyers or customers of the bioenergy industry pay a fairly high cost for bioenergy products. When cheaper biomass resources are used up and more expensive raw materials, such as forest residues and energy crops, are released to the market, prices are expected to increase. On the contrary, when the market is stable, it is likely to encourage investment in areas that can save costs, leading to pressure to reduce prices (Howes et al., 2018).

	Summary: • Buyer's ability to substitute • Price sensitivity
(3) Power of Suppliers	The Porter 5 forces model enables the perception of the 'balance of power' between biomass growers as suppliers and the customers as buyers. In terms of supply, the UK used 94,000 hectares of agricultural land, which is almost a third of the land (29%) used for bioenergy crops in 2018. In the same year, arable land used for the bioenergy crops in the UK accounts for 1.6% of the cultivated area. A figure in appendix 1 shows how this compares to the area grown annually since 2008. From 2014, wood fuel suppliers will be able to register fuel by subscribing to the Biomass Suppliers List (BSL). It is the first step for the UK biomass sector and the major milestone in ensuring the biomass supported under the Incentive of Renewable Heat (RHI) is sustainable. BSL will help develop the burgeoning renewable heat market, creating opportunities across the entire supply chain. Timber fuel producers and traders wishing to access the growing RHI market can apply for free to BSL (www.gov.uk/register-biomass-supplier). However, the bioenergy industry has an incomplete industry chain due to limited domestic bioenergy supply, it is almost impossible to have long-term contracts to provide stable inputs at reasonable prices. Summary: • Biomass Suppliers List • Incentive of Renewable Heat • Limited domestic bioenergy supply
(4) Threat of Substitutes	In Porter's model, the term "substitute product" refers to products in other manufacturing industries. The substitution risk arises when the demand for a product is affected by the price changes of a substitute good (Porter, 1980). The existence of substitute goods limits a firm's ability to increase prices in a given industry. Whether or not bioenergy has products replaced that depends on the sustainability of the supply chain. Levis and Papageorgiou (2004)[18] say that assessing the practical potentials of sustainability requires business, production, and ultimately biofuel conversion. Due to complex manufacturing processes and lack of funding, the threat of alternative products will be other energy sectors. These may be products made from higher quality alternative energy sources at a lower cost. Accompanying it is a negligible switching cost, causing buyers or traders to shake when making decisions to import bio-products. Summary: • Relative price performance of substitute • Switching cost
(5) Competitive Rivalry	To conclude, it is clear from the above explanations that bioenergy has brought the UK potential and chance to reach the zero net target by 2050. Energy sector strengths include high energy consumption, renewable heat incentive, and carbon tax on fuel, but there are many barriers such as policy instability, biomass CO2 concerns, limited domestic bioenergy supply. Therefore, according to Porter's Five Forces theory, it can be said that the opportunity with the bioenergy industry is quite possible, as well as, the threat from it is pretty much left, it is relatively challenging to avoid debate from scientists, scholars, managers, and policymakers.

2.2.2 Industrial opportunities and challenges - PESTLE

This report uses PESTLE analysis as a model to analyze the key factors influencing the bio-energy industry from the outside. It offers managers, scholars, or policymakers professionals insight into the external factors (Political, Economic, Social, Technological, Environmental, or Legal) impacting the renewable industry in the macro-environment. Then, they should use it for enterprises or organizations in a range of separate scenarios to guide strategic decision-making.

POLITICAL FACTORS	Politics in the United Kingdom is on a constitutional monarchy in which the monarch, currently Queen Elizabeth II, is the head of state while the prime minister of the UK, presently Boris Johnson, is the head of government. Today, the monarch only plays a ceremonial role, though it still maintains three primary rights: the right to counseling, the right to counsel, and the right to warn. Officially, the king leads the National Assembly, but in reality, the Prime Minister is the head of British politics. Prime Minister Boris Johnson has set out new vital goals for the UK to play UK leadership in addressing climate change. This determination does not stop at just declaring, but these goals are also supported by the Ten Point Plan for a green industrial revolution, providing potentially ambitious policies and investments that can bring about £ 40 billion private investment by 2030. That is the first goal that the UK sets after leaving the EU (Brexit). Before leaving EU, bioenergy industry in the UK had driven by directives developed by the

	European Commission called RED (Alsaleh et al., 2021)[4]. Brexit also means that the UK has to "start over again" in a series of fields, in which, to deploy the renewable energy sector, it might commit to creating more jobs for domestic employers. Besides, several factors influence the national biofuel market, including employment laws and tax policies. For market, the focus is on the differences in bioenergy development support policies for each country. The support system for each biofuel has a significant impact on the long-term sustainability of the biofuel. Summary: • National policies • Ambition targets • Brexit
ECONOMIC FACTORS	As mentioned, the political aspect impacts the economics of the bioenergy industry on providing subsidies and creating import tariffs so as to protect and support the market. Like any other industry, the bioenergy industry has been affected by changes in the economic climate, taxes, interest rates, and exchange rates (Aquilani, 2018)[3]. Nonetheless, for biofuel sustainability, this factor will be solved by supply and demand in biofuels (Zahraee et al., 2020)[25]. Furthermore, the current subsidies significantly affect the competitiveness of the costs of biofuel production. Biodiesel, Bio-alcohol, and biomethane have their economic sustainability, influenced by factors including the raw material, type of transfer technology, and the number of required treatment steps. Summary: • Cost and efficiency • Feedstock production • Conversion process
SOCIAL FACTORS	The influence of social aspects from the bioenergy industry is related to social stability and change. Commonly, the competition in food supply and the cost of bioenergy production is competitive. Furthermore, the use of water in this industry will affect social stability. Water has long been a scarce resource in more of the world, now adds to bioenergy, adding to the existing pressure. The findings of scholars Alsaleh et al (2020)[4] implied that water scarcity is becoming one of main obstacles for bioenergy expansion and growth. According to Horschig (2020)[13], a significant amount of the material discussed was agricultural products used in food products such as beets and corn. The development of biofuels has a conspicuous impact on global food security and farm markets. Moreover, planting crops for biofuel materials compares the issue of land with other food crops. Summary: • Price • Food competition • Water scarity
TECHNOLOGICAL FACTORS	The technological aspect encompasses technological developments and innovations in the bioenergy sector. Third-generation biofuel development, produced from algae that is a future development that could make biofuels look forward (Levidow, 2013)[17]. It is essential that the UK consider the overall development of the fuel and transport industries, due to vehicles become crucial. Starting with, manufacturing business leaders at this point should add the expected life cycle of the industry. From there, businesses can consider which type of bioenergy investments should be deployed. The technological impact on the bioenergy industry highlights the importance of the expected demand and raises the question: Is the expected time until the offer for biofuel that will decrease due to other technologies long enough to be a profitable investment? Summary: • High technological development of bioenergy industry • High technological innovation of other renewable transportation industries
ENVIRONMENTAL FACTORS	In terms of bioenergy, the environment is vital because reducing GHG emissions is one of the key components of sustainable development. It is one of the driving aspects of the transition to bioenergy. The correlation between social and environmental factors influences the industry. As in the social factors, PESTLE analysis mentioned water scarcity, food competition, and the issue of cropland used to produce products for the biomass energy sector. Saving the potential of greenhouse gases is necessary to biofuel development, but they have limited by land use like deforestation (Lin et al., 2021)[19]. The consequences of deforestation are also causing climate change, warming greenhouse effects, natural disasters, and a host of other negative consequences. Thus, the relationship between land use and environmental sustainability is recognized.

	Summary: • GHG emissions • Feedstock and bioenergy production • Direct and indirect land use issues • Biodiversity
LEGAL FACTORS	Over the past decade, the UK has cut carbon emissions by more than any similarly developed country and was the first major economy to legislate for net-zero emissions by 2050. Business and Energy Secretary and COP26 President Alok Sharma said: Tackling climate change is one of the most urgent shared endeavors of our lifetimes, demanding bold action from every nation to prevent catastrophic global warming. Legal factors on bioenergy have to come from political factors in the UK. The official climate change law passed in 2008 was the UK's commitment to reducing greenhouse gas emissions by at least 80 percent by 2050 compared to 1990 levels (The Climate Change Act, 2008). The law was amended and added in 2019. It would seem that there are no specific rules to regulate the work of utilization of biomass resources, and there are no specific penalties for not using behavior that should be comprehensively used. Regarding to Bellamy et al (2021)[5], the uncertainty and instability of UK Government policy are perceived as a major barrier for the bioenergy industry. The bioenergy industry is quite enormous that it may be a challenge for UK government to set out specific regulations and laws. Summary: • Political system • Goals to legislate for 2050 net zero emissions • Specific regulations and laws

Finally, the collected factors are correlated with different production technologies, depending on the biomass energy format like biofuels, raw materials, and conversion technology. The other factors in PESTLE analysis indicate the long-term sustainability of the biotechnology industry in the external macro-environment. They will be relevant to develop politically and economically developed countries such as the UK. Sociological governance encompasses elements of food competition, water scarcity, and biodiversity. All aspects are caused by land-use planning discussed. Greenhouse gas emissions and climate change are among the driving forces of the bioenergy industry development in the UK.

3. KEY ISSUES ABOUT THE BIO-ENERGY INDUSTRY

3.1 Operational Challenge: Limited Domestic Bioenergy Supply

In the bioenergy industry, biomass is a valuable renewable energy source to replace fossil fuels. The main barriers in biomass highlighted in the Power of Suppliers section of the Porter 5 forces model are feedstock high cost, lack of reliable supply, and uncertainties. According to scholars Mafakheri and Nasiri (2014)[20] about the research on supply chain operations, they have followed a BSC process including cultivating, harvesting, preprocessing, transporting, handling, and storage [appendix 2]. They say that is an incomplete chain of industries, so it is challenging to have long-term contracts to supply raw materials at a reasonable cost (Wilhelm and Searcy, 2011).

In addition to the UK, some countries such as Malaysia, the United States, and European countries have made efforts to improve trade to reduce human dependence on fossil fuels. Biomass can obtain from all types of plants and plant-derived materials such as sugars, oily plants, and animal manure used for energy and food production. The main types of biomass sources globally are shown in Figure 2. A crucial challenge to the UK in this sense is the efficient use of biomass having the lower costs of supply chain and providing required activities in order to convert biomass into a valuable energy source.

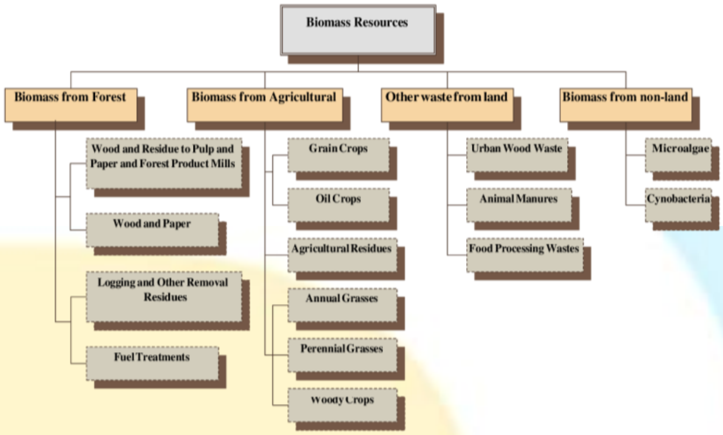


Figure 2. Biomass resources categories

- Short solutions:

According to Zahraee (2020)[25], the sustainability of the BSC is an important issue because it requires simultaneous consideration of economic, environmental, and social aspects. The studies used a multi-objective approach, in which the three sustainability criteria are assessed simultaneously. Therefore, designing a biomass ecosystem model incorporating socio-economic components will create an opportunity for researchers to be ready to dive into sustainable BSCs, to come up with ways to solve problems. Sustainability issues for the BSC model to make firm and less risky decision-making. It is a solution that helps to quantify and optimize the social activity ecosystem is a very valuable resource for managers.

3.2 Environmental Challenge: Land Uses Issues

The second key issue is about land use mentioned in environmental and social factors of PESTLE analysis. Using biomass energy has value to reduce climate change, which leads to a complex impact between the energy industry and the land-use sector through the emission pricing policy and the bioenergy market. Prior studies have demonstrated to shed light on the positive or negative effects of the land use issues for the production of biomass products. In 2018, Humpenoder et al stated that land-use intensification more challenging due to the higher cost to improve yield rates reflecting pessimistic assumptions on technological change. Furthermore, from land effects to other social challenges, trade for agricultural products is fragmented by trade barriers to consider increased food security concerns and national sovereignty (Popp et al., 2017)[22]. In the default case, bioenergy use is subject to land-use constraints rather than a focused upper limit (Kriegler et al., 2014)[16].

As can be seen, the energy-land relationship is very interesting for researchers and policymakers in the context of climate change mitigation in the UK as both sectors will become tightly integrated with dynamic interaction. The modern bioenergy large-scale land-use model is expected to take off sometime in the middle of this century if the global average temperature rises below 2 degrees Celsius compared to pre-industrial levels. Besides, land use issues in the UK lead to the inability to conserve the ecosystems and homes of native Britons. The population grows steadily, so they need more space to work and live. Therefore, the lack of space will be a challenge for bioenergy plants.

3.3 Socio – Economic Challenge: Limitation In Investment

Bioenergy can contribute to growth in several ways, primarily economic growth through employment. It also challenges to gain an advantage in the macroeconomy in supply security and improved trade balance (Abdeen, 2009[2]; Faaij and Domac, 2006). Particularly in this respect, bioenergy can contribute to human life. Prime Minister Boris Johnson's Ten Point Plan will create and support up to 250000 British jobs in 2030. Besides, there is a problem of limitation in investment channels and funds discussed in economic factors of PESTLE analysis. Referring to the UN Environment Program and UNEP center, biomass and waste received $ 123 billion in the financing of the projects. The lack of investment leaves the bioenergy industry under the conditions needed to limit the rise in world temperature below 2 degrees Celsius and significantly less than $ 2.7 trillion invested in energy amount of regeneration in 9 consecutive years since 2010 (BNEF). In 2019, biofuels only accounted for $ 500 million invested, a 43% decrease in 2018, and a significant drop from a peak of $ 22.9 billion in 2007. The bioenergy industry has a wide range of activities that need support in investment from stakeholders (Roder, 2016)[24]. Figure 3 summarizes the current bioenergy distribution of research topics in the UK (Cross et al., 2021)[7].

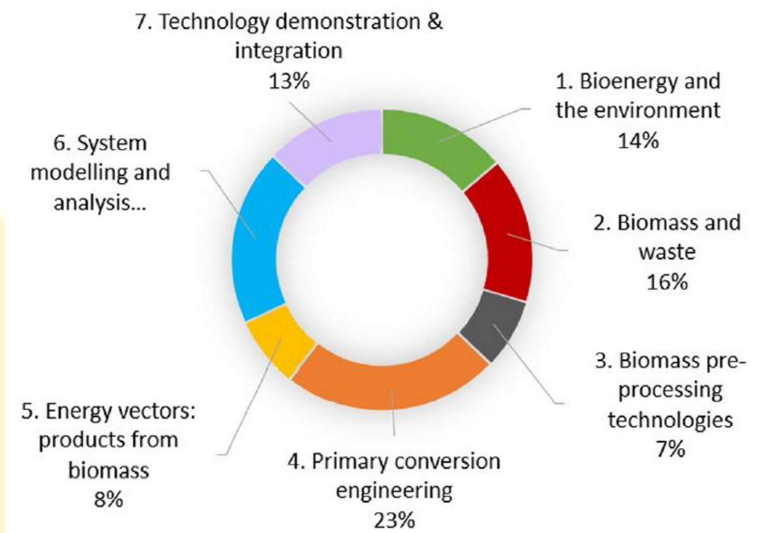


Figure 3. Research topic distribution (%) of bioenergy activities in the UK

* Short solutions:

The funding sources under national initiatives which is the internal sources of funding and instruments.

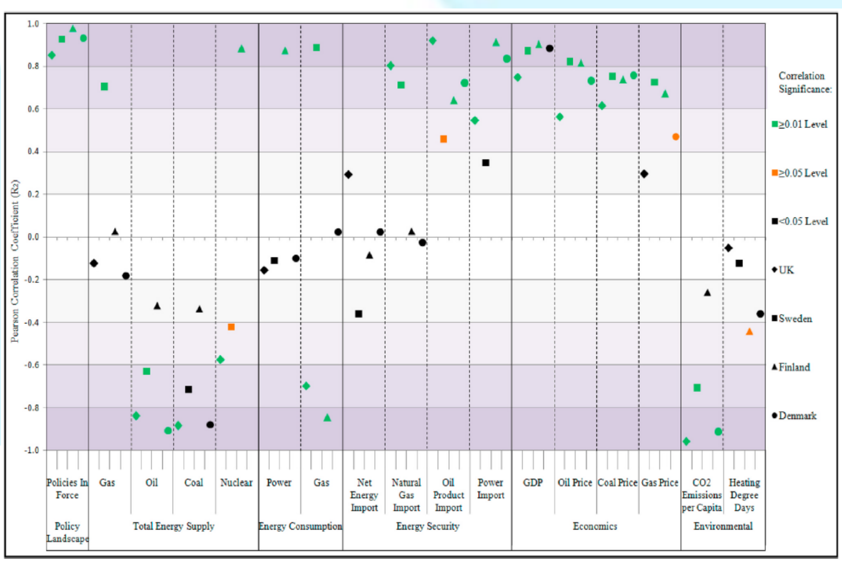
The external sources of funding flows for bionergy such as expatriate funds, international philanthropic organisations.

Mobilising funding for bioenergy using innovative sources involves non-traditional financial instruments and mechanisms of raising financing.

3.4 Policy And Regulatory Challenge: Lack Of Rigor And Stringent

The final key issue is lack of rigor policy and stringent regulation, which has been explained in political and legal factors in PESTLE analysis. This is a challenge for the UK government and their policymakers to legislate to act as deterrent laws and regulations if the businesses or organizations have any disapproval activities impacting the environment. Apart from the Climate Change Act 2008 and the amended law in 2019, there are no stricter regulations. There are no specific penalties for not using behavior that should generate. Absolutely, the regulation has to reduce negative consequences in production on a large scale, at the same time, to ensure bioenergy technologies are effectively activated. For example, the Pearson Correlation statistical analyses highlight the importance of the policy landscape in encouraging bioenergy deployment - the relevant policies having a considerable positive correlation with bioenergy generation (Figure 4).

Figure 4. Mapping Pearson Correlation Outputs



On the contrary, the outputs from the research's Multiple Regression statistical analyses demonstrated that the number of related policies in force within each country does not have any unique significant correlation with bioenergy. To conclude, uncertainty and instability of UK government policy is perceived as major barrier for the bioenergy sector so that they can learn from the Nordic countries to get the expected outcomes. Policy belongs to the macro-environment of the bioenergy industry while operating in the business depends on the vision and mission of the organization to take action in the future, which is below the forecast.

4. FUTURE FORECASTS

4.1 Vision For Bioenergy Transport

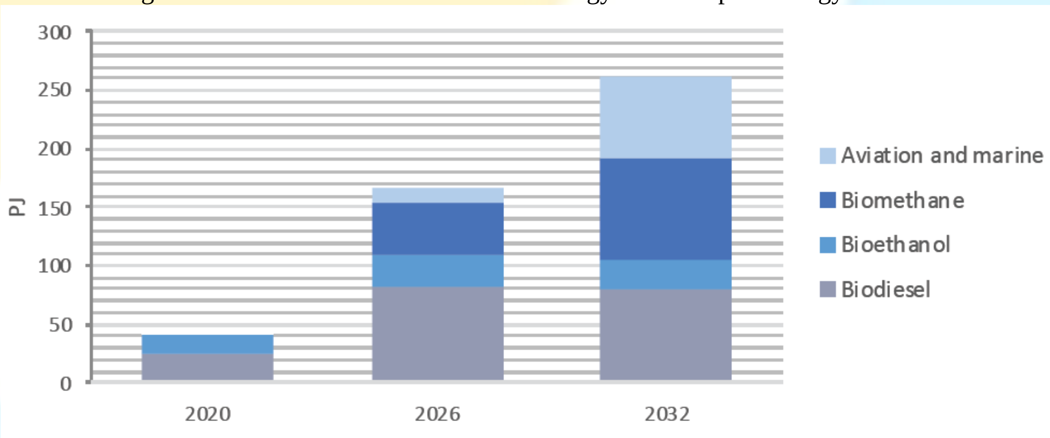
In the upper issues section, the author analyzed the challenges or risks that exist. The forecasting section is the yearly forecast for bioenergy, focusing on opportunities and bioenergy industry prospects in the future. Bioenergy can play a vital role in the transportation sector by providing alternatives to fossil fuels (An et al., 2011)[1]. In the long term, bioenergy tends to play an increasing role in low carbon transport systems, especially in urban areas and light passenger transport. Bioenergy solutions can add to use for long-distance and heavy-duty applications such as aviation and ocean freight.

An optimistic forecast scenario on the prospect of traffic electrification in the UK, penetration will be constrained by the speed of electric vehicle consumption and the relatively slow sales of vehicles due to changing consumer consumption habits. According to the BEIS reference scenario in the Energy and Emissions projections (2018), electricity in 2032 will only provide 2.6% of the UK's transport energy needs, compared to 4 biofuels), mean 93.4% of transportation. Table 1 and figure 5 summarise the potential contribution of bioenergy to UK transport energy supply from the opportunities discussed. Units of measure and conversion factors in appendix 5.

Table 1: Potential Bioenergy Transport Energy to 2032 PJ delivered fuel

	2021	2026	2032
Bioethanol	18	28	27
Biodiesel	24	82	79
Biomethane	0	44	87
Aviation and marine	0	13	68
Total	42	167	261

Figure 5: Potential Total Growth in Bioenergy for Transport Energy to 2032



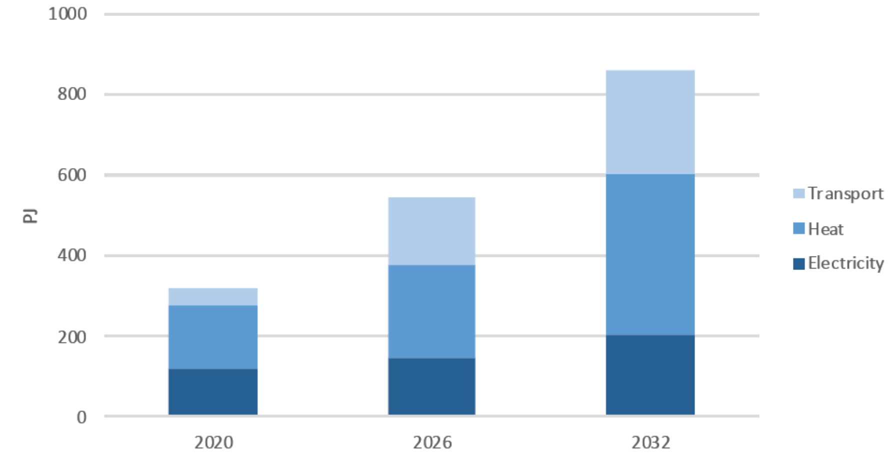
4.2 Vision For Bioenergy Contribution

Table 2 and Figure 6 summarise the potential contribution of bioenergy to the UK energy supply in the heat, transport, and electricity as discussed. The overall contribution to energy supply rises by a factor of 1.6 between 2020 and 2026, a factor of 2.6 by 2032.

Table 2: Contribution to UK Energy Supply (PJ)

	2021	2026	2032
Heat	159	219	376
Transport	42	167	261
Electricity	121	144	205
Total	323	530	843

Figure 6: Potential Overall Growth in Bioenergy to 2032

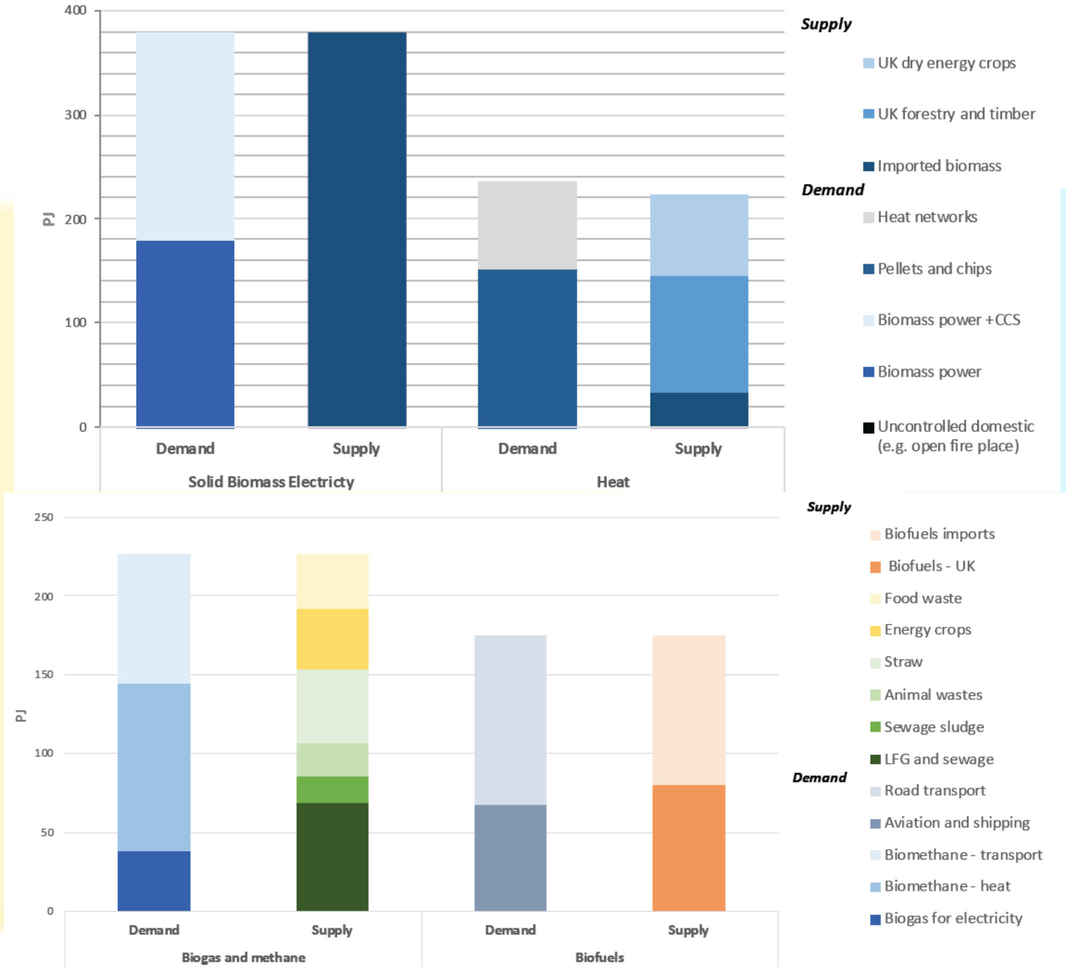


Growth aims at the heat and transport sectors, where bioenergy can play an extensive position in carbon reduction efforts. Groundbreaking milestones also encompass a vision in the roadmap of technology that can adapt to carbon storage when there is a need to increase the supply chain, which is a significant prerequisite for advancement. The overall share of bioenergy in end demand expanses from 5.5% in 2020 to 9.5% in 2026 and about 15% in 2032 (REA, 2019)[23].

4.3 Vision For Bioenergy Feedstock Requirements

In the UK, the bioenergy model uses a wide variety of raw materials such as municipal solid waste, waste gas, and landfill, wood and wood fuel waste, livestock waste and litter, Rice straw, along with some crops grown for energy. In particular, biofuel production with only a few dry crops such as miscanthus and short-term rotation forestry. Also, the UK uses imported raw materials in the form of biofuels for transportation and wood pellets for use in large-scale production. According to Ricardo's research, the use of fuels generated from potential sources from the forestry industries will help propel the UK to zero organic waste landfills by 2026. Additional liquid for shipping will need to come from international markets between 100 and 150 PJ, depending on UK volume availability. Figure 7 shows a simple pattern that shows the main ways the material is likely to use 2032.

Figure 7. Principal Availability and Use of Feedstocks – 2032 (PJ)



5. CONCLUSION

In summary, this paper has studied climate change issues, net-zero target by 2050, major issues, proposed solutions, and predicted reliable forecasts for the bioenergy industry in the UK context. After analyzing Porter's five forces and PESTLE, the problems appear with different alert levels, but they all present threats and threats if not resolved in the long term. The great thing is that analysis and forecasting frameworks for scientists, scholars, policymakers, and managers can recommend profound strategies, take advantage of drivers and overcome the barriers. In the future, it may be challenging to end climate change, but legislators and entrepreneurs should see it as a reference when making decisions when using renewable energy in a balanced manner organizational, environmental, socioeconomic, and regulatory aspects.

6. REFERENCES

[1] An, H., Wilherm, W. E. & Searcy, S. W. (2011). Biofuel and petroleum-based fuel supply chain research: a literature review, *Biomass Bioenergy*, Volume 35, Issue 9, pp. 3763 – 3774.

[2] Abdeen, M. O. (2009). Environmental and socio-economic aspect of possible development in renewable energy use, *In Proceedings of the 4th Int. Symposium. Environ. Athens, Greece*, pp. 90 – 100.

[3] Aquilani, B, Silvestri, C, Ioppolo, G & Ruggieri, A 2018, 'The challenging transition to bio-economies: Towards a new framework integrating corporate sustainability and value co-creation', *Journal of Cleaner Production*, Volume 172, pp. 4001–4009, viewed 16 March 2021, <https://search.ebscohost.com/login.aspx?direct=true&db=edselp&AN=S0959652617306066&site=eds-live&scope=site>.

[4] Alsaleh, M., Abdul-Rahim, A. S. and Abdulwakil, M. M. (2021) 'EU28 region's water security and the effect of bioenergy industry sustainability', Environmental science and pollution research international, Volume 28, Issue 8, pp. 9346–9361. doi: 10.1007/s11356-020-11425-4.

[5] Bellamy, R, Fridahl, M, Lezaun, J, Palmer, J, Rodriguez, E, Lefvert, A, Hansson, A, Grönkvist, S & Haikola, S 2021, 'Incentivising bioenergy with carbon capture and storage (BECCS) responsibly: Comparing stakeholder policy preferences in the

United Kingdom and Sweden', *Environmental Science and Policy*, Volume 116, pp. 47–55, viewed 16 March 2021, <https://search.ebscohost.com/login.aspx?direct=true&db=edselp&AN=S1462901120313411&site=eds-live&scope=site>.

[6] BEIS – Department for Business, Energy and Industrial Strategy (2018). *UK Energy Consumption in the UK.* [online] Available at: https://www.gov.uk/government/statistics/energy-consumption-in- the-UK

[7] Cross, S, Welfle, AJ, Thornley, P, Syri, S & Mikaelsson, M 2021, 'Bioenergy development in the UK & Nordic countries: A comparison of effectiveness of support policies for sustainable development of the bioenergy sector', *Biomass and Bioenergy*, vol. 144, viewed 16 March 2021, <https://search.ebscohost.com/login.aspx?direct=true&db=edselp&AN=S0961953420304219&site=eds-live&scope=site>.

[8] CCC – Committee on Climate Change (2019). *Net zero – the UK's Contribution to Stopping Global Warming*. [online] Available at: https://www.theccc.org.uk/wp-content/uploads/2019/05/ Net-Zero-The-UKs-contribution-to-stopping-global-warming.pdf

[9] Climate Change Act 2008 (2008). [online] Available at: http://www.legislation.gov.uk/ukpga/2008/27/contents

[10] FAO (2004). *FAO Statistical Yearbook 2004*. World food and agriculture.

[11] Gómez-Marín, N., & Bridgwater, A. V. (2021). 'Mapping bioenergy stakeholders: A systematic and scientometric review of capabilities and expertise in bioenergy research in the United Kingdom', *Renewable and Sustainable Energy Reviews*, Volume 137, viewed 16 March 2021, <https://search.ebscohost.com/login.aspx?direct=true&db=edselp&AN=S1364032120307826&site=eds-live&scope=site>.

[12] Ghosh, S.K., Lee, J., Godwin, A.C., Oke, A., Al-rawi, R. and El-hoz, M. (2016). Waste management in USA through case studies: e-waste recycling and waste energy plant. *In Proceedings of the 31st international conference on solid waste technology and management*, 3-6 April 2016, Philadelphia, USA. Pennsylvania: Widener University.

[13] Horschig, T., Schaubach, K., Sutor, C. & Thrän, D. (2020). 'Stakeholder perceptions about sustainability governance in the German biogas sector', *Energy, Sustainability and Society*, Volume 10, Issue 1, viewed 16 March 2021. <https://search.ebscohost.com/login.aspx?direct=true&db=edssjs&AN=edssjs.30DB84D0&site=eds-live&scope=site>.

[14] HM Government – Her Majesty's Government (2020). *UK sets ambitious new climate target ahead of UN Summit*. [online] Available at: https://www.gov.uk/government/news/uk-sets-ambitious-new-climate-target-ahead-of-un-summit#:~:text=Equinor%20aims%20to%20be%20a,towards%20a%20low%2Dcarbon%20future.&text=The%20UK's%202030%20ambition%20set,alongside%20government%20to%20deliver%20it.

[15] IPCC – Intergovernmental Panel on Climate Change (2018). *Global warming of 1.50C*. [online] Available at: https://www.ipcc.ch/sr15/

[16] Kriegler, E., Edmonds., J., Hallegatte., S., & Detlef P. V. V. (2014). A new scenerio framework for climate change research: the concept of shared climate change policy assumptions, Climatic Change, Volume 122, pp. 401 – 414.

[17] Levidow, L., Papaioannou, T. & Borda-Rodriguez, A. (2013). 'Innovation Priorities for UK Bioenergy: Technological Expectations within Path Dependence', *Science & Technology Studies*, Volume 26, Issue 3, pp. 14–36, viewed 16 March 2021, <https://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=93288401&site=eds-live&scope=site>.

[18] Levis, A. A., Papageorgiou, L. G. (2004). A hierarchical solution approach for multi-slte capacity planning under uncertainty in the pharmaceutical industry, Comput. Chem. Eng. Volume 28, Issue 5, pp. 707 – 725.

[19] Lin, C. C., Kang, J. R., Huang, G. L. & Liu, W. Y. (2020). 'Forest biomass-to-biofuel factory location problem with multiple objectives considering environmental uncertainties and social enterprises', *Journal of Cleaner Production*, Volume 262, viewed 16 March 2021, <https://search.ebscohost.com/login.aspx?direct=true&db=edselp&AN=S0959652620313743&site=eds-live&scope=site>.

[20] Mafakheri, F., & Nasiri, F. (2014). Modeling of biomass-to-energy supply chain operations: applications, challenges and research directions, Volume 67, pp. 116 – 126.

[21] Mohammad, R., Ric,. H., & Patrick, L. (2018). Investigating the future supply distribution of industrial grade wood pellets in the global bioenergy market, *Article in Biofuels*, pp. 871 – 884. https://doi.org/10.1080/17597269.2018.1432268

[22] Popp, A., Kriegler, E., Fricko, O., Riahi, K. & Vuuren, D. P. V. (2017). Land-use futures in the shared socio-economic pathways. *Global Environmental Change*, Volume42, pp. 331-345, doi: http://dx.doi.org/10.1016/j.gloenvcha.2016.10.002.

[23] REA – Renewable Energy Association (2019). *UK Bioenergy Strategy, Bioenergy in the UK – The State of Play*. [online] Available at: https://www.bioenergy-strategy.com/publications

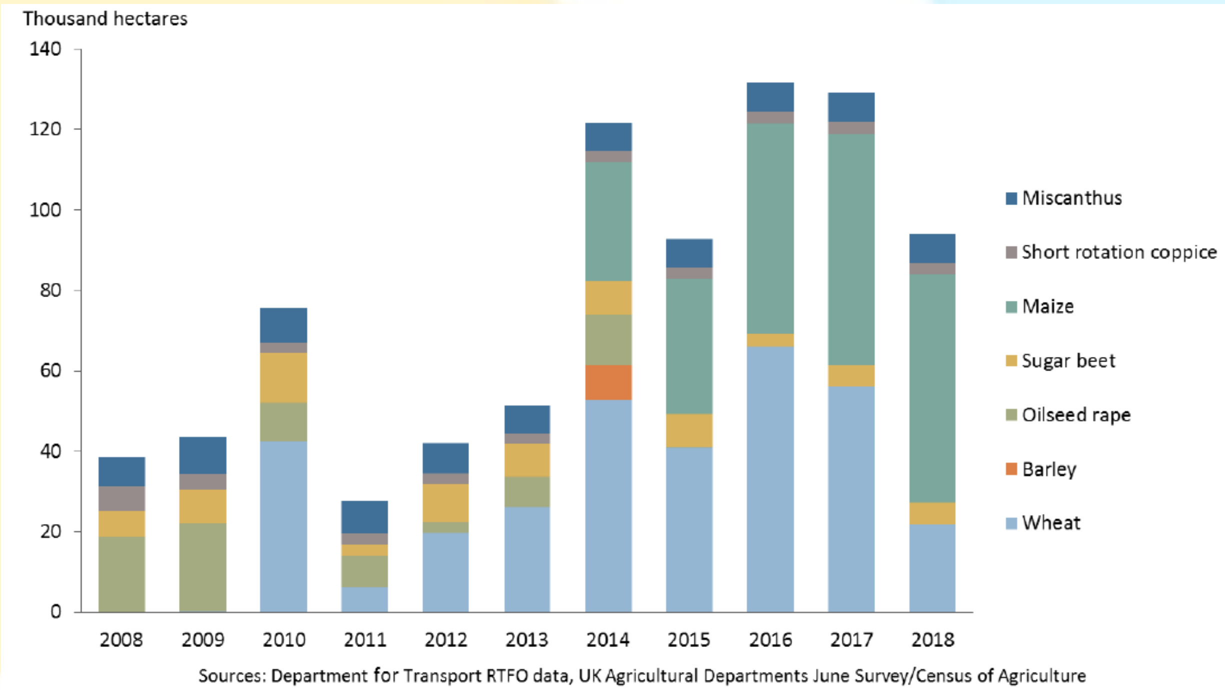
[24] Roder., M. (2016). More than food or fuel. Stakeholder perceptions of anaerobic digestion and

land use; a case study from the United Kingdom, Energy Pol, Volume 97, pp. 73 – 81.

[25] Zahraee, S. M., Shiwakoti, N. & Stasinopoulos, P. (2020). 'Biomass supply chain environmental and socio-economic analysis: 40-Years comprehensive review of methods, decision issues, sustainability challenges, and the way forward', Biomass and Bioenergy, Volume 142, viewed 16 March 2021, <https://search.ebscohost.com/login.aspx?direct=true&db=edselp&AN=S0961953420303123&site=eds-live&scope=site>.

Appendices

[Appendix 1] – Total area of crops grown for bioenergy, 2008 – 2018 (a)(b)



(a) Data for maize used as feedstock for anaerobic digestion only available from 2014

(b) Due to a changes to the RTFO dataset, 2018 covers 15th April to 31st December 2018 and is not directly comparable to previous years which covered a time period from April to April.

[Appendix 2] For 3.1 Operational challenge: Limited domestic bioenergy supply

Harvesting is typically done during a limited time at places that are committed to biomass production by means of some machines (e.g., combine harvesters). 10–20% of biomass loss is expected in this procedure.

Storage appropriately brings into line the generation plans of the conversion facilities with the certain calendar of biomass generation. The storing procedure can be performed simply in the forest or field, within some particular centered stores, on the farm, or within the conversion plants, prior to activities.

Preprocessing refers to useful activities done to handle (baling, pelletization) and enhance preservation (drying). The simplest procedures of baling can be performed on the field. After that, compressions and other transformation operations can be performed by means of some heavier tools and/or devoted sites.

Transportation operations like industrial logistics and a variety of other transportation methods are selectable. Normally, there is a limitation on the fleet of vehicles as well as the number of travels possible per period considering the range of the vehicle and the general regulations regarding the driving time. This is worth noting that transportation through the roads is typically the single way the production sites with limited accessibility have, and trucks are popular for these procedures because they can load and handle in a large amount. A typical BSC network is depicted.

[Appendix 3] For 4. Future forecasts

Units of measure
Kilo (k) 103
Mega (M) 106
Giga (G) 109
Tera (T) 1012
Peta (P) 1015
Exa (E) 1018

EJ – exajoule
GJ – gigajoule
kWh – kilowatt-hour
MJ – megajoule
GW – gigawatt-hour
TWh – terawatt-hour