Journal of Ecosystem & Ecography

Affan and Maaroof, J Ecosys Ecograph 2016, 6:3
DOI: 10.4172/2157-7625.1000206

Research Article Open Access

A Critical Evaluation of the UK Drax Power Station

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Abstract

In order to investigate whether converting the UK power stations to be based on biomass will reduce CO_2 emissions, and while it is in the way converting to biomass-based, Drax power station has been examined. Research regarding CO_2 emissions reduction percentage for the biggest UK power station will be shown. The effect on the UK and the biomass supplier climate will be also considered. Moral and material support, as well as sustainability in terms of outside supplier will also be looked at.

Keywords: Power station; Energy; Drax

Introduction

According to Vattenfall [1], the UK produced 3% of the world electricity generation from biomass and waste in 2008. It has been stated that the combustion of biomass to produce energy results in undesired emissions of CO_2. According to Smolker et al. [2] the amounts of CO_2 emissions produced from combusting biomass are considered to be neutral due to the fact that just about the same quantity is consumed during biomass growth. To investigate the issue in depth, Drax power station is to be considered as a typical example.

Drax presents the largest power station in the UK [2], with 5,000 personnel in site working to produce 4 gigawatts capacity [3]. It provides 6 million of the houses in the UK with electricity [3]. Drax used to be a coal-based power plant. It succeeded to convert one of its six coal-fired generating units to biomass by 2013, and it is arranging to convert two more units by 2016, spending £700 million in order to reduce 80% of the plant CO_2 emissions (from 22 million to 12 million tonnes of CO_2) [3]. According to the BBC [4], it was the energy secretary Ed Davey who has opened the biomass power plant of Drax power station in North Yorkshire. A £2 billion carbon capture and storage facility has been to set to reduce more CO_2 and protect the environment [4]. Even though the idea might seem unadulterated, however, opponents have come with opposite claims showing the negative impact of using biomass, claiming that it results in more net CO_2 into the atmosphere. In addition, disagreements have been introduced concerning the process sustainability, including the source of biomass, as well as the implications on the US system. This paper tries to shed some light on the mentioned situations, reviewing both the co and counter arguments.

Drax Development

Carbon capture and storage technologies of CO_2 emissions can effectively result in reduction in the amounts of CO_2 in the atmosphere, negative emissions is also a possible option [2]. According to Smolker et al. [2], planes and claims are being combined via the UK coal companies, optimistically, to flourish new 'Capture-ready' coal power stations or unites using biomass co-firing plans. Drax power station plan for 'Carbon reduction' involves an arrangement of large-scale biomass burning with Carbon Capture and Storage investments.

Drax used to combust huge amounts of biomass (more biomass than any other power station within the UK). Drax announced plans to convert half of its feedstock from coal to wood [2]. The new plan comprises pellets made from 20 million tonnes of imported wood (mainly from the United States) to be combusted annually in the power station [2,5]. The timber firm Plum Creek is the major private landowner in the US that provides Drax with wood [6].

In terms of monetary, Drax is attempting for public funding to build an additional unit of 426 MW that has the potential not only to co-fire sustainable biomass, but also to be fully equipped with Carbon Capture and Storage technology from the outset. Broadly, many European projects thus far have failed to meet deadlines and hence tackled sever charges, while the UK government has been chiefly strong in promoting Carbon Capture and Storage and has more future plans on a large-scale basis than any other European country [2].

In 2011, the publicly funded the Engineering and Physical Science Research Council with over than £21 million in order to develop a Carbon Capture and Storage research. Furthermore, another £0.97 billion has been collected to fund a commercial Carbon Capture and Storage project in 2012 followed by a £19.5 million worth project [2]. The government expects funding for biomass to be £442-£736 million in 2016/2017 [6].

Bioenergy

Bioenergy plays an important role in reducing CO_2 emissions, hence meeting the UK low carbon objectives by 2050 [6,7]. According to Gustavsson et al. [8], the reduction efficiency can be expressed in terms of reducing emissions per unit of biomass used, or in substitution costs per tonne of carbon. One of the risks and concerns regarding the use of bioenergy is the sustainability of the biomass. Therefore, the UK government has the responsibility to ensure that it is supporting the usage of bioenergy in the right circumstances [7]. A four principle based framework has been set by the UK government concerning the future polices on the usage of bioenergy. The principles take account of the followings: First of all is that the policies should support conveying unaffected carbon reductions in order to help the UK achieving low carbon emissions by 2050. According to the UK parliament [9], biomass in particular can deliver real cuts in the UK's carbon emissions. Secondly, a cost effective contribution should be made as a consequence to the bioenergy usage support. The contribution results in advancing the overall energy goals towards the UK carbon emissions objectives. Moreover, the support should look for maximising the overall benefits,

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Received June 20, 2016; **Accepted** August 24, 2016; **Published** August 31, 2016

Citation: Affan FB, Maaroof A (2016) A Critical Evaluation of the UK Drax Power Station. J Ecosys Ecograph 6: 206. doi:10.4172/2157-7625.1000206

as well as minimising the costs. Lastly, and at the time when the demand for bioenergy is increasing, the policy makers should consider and answer back to the influences of this increased arrangement on other areas, for instance on food security and biodiversity [7].

Biomass, or organic material based on plant, is the fourth largest energy resource in the world after oil, coal and gas. Biomass is renewable as well as can be sustainable [10]. Biomass is normally sourced from forests and agricultural residues [10]. Biomass sustainable sources are estimated to supply the world with 10-20% of energy by 2050.

By combusting biomass, Drax produces no net increase in the CO_2 amount in the atmosphere, due to the fact that the biomass consumes and produces similar amounts of CO_2 while growing and combusting. Moreover, biomass has the ability to produce noticeable reduction in CO_2 emissions in relation to coal-fired and gas-fired generation over its life cycle [11,12]. Energy from biomass is expected to play a crucial role in the UK's transition on the road to a low carbon economy [11].

Local Supply

Recently, Drax has been at the head encouraging the farmers and landowners in the UK to provide it with biomass in order to develop the UK supply chain of biomass. In 2009, Drax has established the 'Green Shoots' programme, a programme to source energy crops such as short rotation coppice willow and straw. Intended for electricity production, Drax has constructed one straw pellet plant which is currently processing straw purchased from local farmers into a readily usable form [11]. Although encouraging the local supply of biomass plays an important role in the UK economy, the imported biomass has its vital role in expanding the electricity generation from biomass. In addition, Drax has developed a sustainability policy to ensure that enough supply is imported [11]. To guarantee biomass sustainability, Drax requests all its biomass suppliers to provide it with their supply chain data in order to estimate an accurate 'field to furnace' calculation regarding greenhouse gas emissions. 'Field to furnace' analysis consists of the full life cycle of the biomass compounds from the land use to plantation, agriculture, gathering, processing, transportation and combustion [11].

More about CO_2 Reduction

In 2009, Drax power station estimated the amounts of the CO_2 emissions life cycle for the combusting biomass to be in the range from 40 – 250 Kg CO_2/MWh. This range has been found to be very small comparing to the life cycle of CO_2 emissions from coal and gas-fired power plants [11].

Significant renewable power can be gained from the usage of biomass technologies, which can make significant cuts in CO_2 emissions in the near future. The continued use of biomass promises of high percentages reduction in CO_2 levels; starting from 1990, a reduction of 34% is expected by the year 2020, and it is expected to reduce the emissions up to 80% by 2050 [11]. In addition, energy from biomass does not only cut CO_2 levels but also produced more electricity, as well as less waste, than any other renewable source in the period from 1996 to 2008 (ibid) (Figure 1).

According to Grant et al. [12], studies show that 0.015 kg/kWh of net CO_2 are being obtained from woodchip and 0.037 kg/kWh from wood pellets. Although the figures imply not exactly zero emissions, carbon emissions are around a one to ten of those from burning gas. However, it has been found that the process of combusting wood produces the same amount of CO_2 in the process of coal combustion, both about 0.46 kg/kWh of delivered heat (ibid). Grant et al. [12] have reached the conclusion that wood by itself is not a low carbon fuel. On the other hand, the same amount of heat but more CO_2 emissions are produced from combusting biomass than natural gas, due to the fact that the fuel energy comes from hydrogen rather than carbon, as well as the fact that it is more easily to combust gas than solid.

Supporting Drax

Dorothy Thompson, chief executive of Drax, stats that the government used to provide Drax with partial but graduated support in the time when Drax used to combust coal. On the other hand, she concludes that the support level will increase in the time when Drax will be converted into a biomass-fired power plant. She adds saying that the new strategic capital investment plan will cost them £700 million [13].

However, Harrabin [14] has a different opinion. He stats that campaign groups has carried out a report in which they warned that power plants combusting wood might delay the attempts to challenge climate change, especially in terms of economic. They confirm that it takes a long time for the trees to absorb the CO_2 emitted from combusting wood. The report also shows that 7 million tonnes of plant is being cuts to feed Drax annually, where 90% of it is imported from outside the UK, mainly from the United States.

From the Royal Society for the Protection of Birds (RSPB), Harry Huyton pointed out to the BBC News [4] that Drax will demand huge amounts of biomass that exceed the UK output of forests. His concern is that the forests and wildlife may not be protected for that reason.

On their part, Drax group [15] confirms that it produces low CO_2 due to its efficient shipping from the US by using load-boats than from Scotland, for instance, by the means of articulated vehicles. As a final point, Drax confirms that its energy production is legal and environmentally sustainable [15].

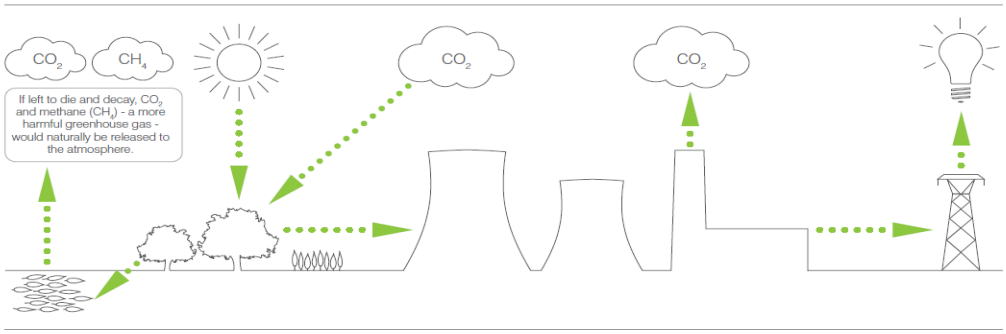

Figure 1: CO_2 life-cycle within a biomass power station.

The Consequences on the US Side

Drax [13] stats that America has a cheaper source of energy represented by the shale gas, hence it is not worthy for the US to depend on wood. However, a curious question for further research concerning sustainability would be 'what about constructions and other wood-based operations in America? Are wood prices going up in the US? Is the Americans wood enough for both a huge power station like Drax, and the country demand? And Is the US economy in danger?' It is also worth saying that, if the wood offcuts are not being fed into power stations, they would be combusted, as waste, or left to decay, producing methane and CO_2.

Drax opponents' stat that subsidising wood combusting is a waste of money, as well as it does not tackle climate change in the short term [6]. Furthermore, combusting wood is demolishing some of the finest forests in America. Then what about the US carbon level? The American forests balance CO_2 emissions in the atmosphere; the forests absorb the CO_2 emitted from houses and industries. Therefore, cutting the trees can result in reduction in the US 'carbon sink' [6].

Conclusion

Different opinions from different perspectives have been stated regarding the issue of using biomass (wood in particular) in producing energy. Debate around the situation in Drax, the biggest power station in the UK, has been examined. Support and fund were and still expected to be provided from different organisations, and even the public. It has been found that although several sources stat the negative impact of combusting biomass on the atmosphere, Drax confirms that utilising wood cuts CO_2 emissions by 80% less than combusting coal. However, the US atmosphere is in danger. Granting Drax and co-opinions claim that trees growth, others stat that it takes trees long time to substitute what has been cut. In regards to the source sustainability, many positions point out the risk of depending on imported biomass sources, nonetheless, Drax stats that the US has its own source of energy represented by the shale gas.

Most probably is that the issue will become clearer by the year 2016, where the second biomass-based unit will be operating. A clearer idea on the situation will be drawn, and a wiser decision will be made on whether to carry on converting the other units, keeping in mind the political situation between the two countries. Further research regarding the political situation would have enriched and enhanced the paper.

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Citation: Affan FB, Maaroof A (2016) A Critical Evaluation of the UK Drax Power Station. J Ecosys Ecograph 6: 206. doi:10.4172/2157-7625.1000206