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Mitigation of climate change: which technologies for Vietnam?

Giảm thiểu biến đổi khí hậu: Công nghệ nào phù hợp với Việt Nam?

Editorial

Chu, Thi Thu Ha*

Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Hanoi, Vietnam

Vietnam is one of the countries suffering from the most serious adverse effects due to climate change and sea level rise. The main cause of climate change is the increased activities generating greenhouse gases. Organic waste is the main source of carbon dioxide emission, which has the largest concentration among different kinds of greenhouse gases in the earth's atmosphere. The conversion of organic waste and biomass into energy contributes not only to supply cleaner energy but also to reduce emissions of greenhouse gases. Vietnam has a large potential of biomass and agricultural by-products. The technologies to turn biomass into different kinds of bio-energies were developed and applied all over the world. Biogas was called as "brown revolution" in the field of new energy. Biogas production technology now has been studied and applied widely in the world, particularly in developing countries with warm climate that is suitable for anaerobic fermentation of organic waste. The biogas digester can be built with any capacity, needs small investment and the input materials are widely available. The biogas energy is used for many purposes such as cooking, lighting, running engines, etc. It is a production technology quite consistent with the economy of developing countries and really brings to life more civilized and convenient to rural areas.

Việt Nam là một trong những quốc gia bị tác động nghiêm trọng nhất do biến đổi khí hậu và nước biển dâng cao. Nguyên nhân chính của biến đổi khí hậu là các hoạt động gia tăng tạo ra các khí gây hiệu ứng nhà kính. Chất thải hữu cơ là nguồn chính phát thải khí carbon dioxide có nồng độ lớn nhất trong số các loại khí gây hiệu ứng nhà kính khác nhau trong bầu khí quyển của trái đất. Việc chuyển đổi chất thải hữu cơ và sinh khối thành năng lượng góp phần không chỉ cung cấp năng lượng sạch hơn mà còn giảm phát thải khí gây hiệu ứng nhà kính. Việt Nam có một tiềm năng lớn về sinh khối và phụ phẩm nông nghiệp. Các công nghệ biến sinh khối thành các loại năng lượng sinh học khác nhau đã được phát triển và áp dụng rộng rãi trên thế giới. Khí sinh học được gọi là "cuộc cách mạng màu nâu" trong lĩnh vực năng lượng mới. Công nghệ sản xuất khí sinh học đã được nghiên cứu và áp dụng rộng rãi trên thế giới, đặc biệt là ở các nước đang phát triển với nhiệt độ khí hậu nhiệt đới phù hợp cho quá trình lên men kỵ khí các chất thải hữu cơ để sản xuất khí sinh học. Bình phản ứng tạo khí sinh học có thể được xây dựng với công suất bất kỳ, nhu cầu đầu tư nhỏ, các nguyên liệu đầu vào sẵn có. Năng lượng khí sinh học đã được sử dụng cho nhiều mục đích như thắp sáng, nấu ăn, chạy động cơ, v.v... Đây là hoạt động sản xuất khá phù hợp với nền kinh tế của các nước đang phát triển và thực sự đem lại cuộc sống văn minh hơn và tiện lợi đến các khu vực nông thôn.

Keywords: Biomass, biogas production, climate change, greenhouse gas

1. Introduction

Climate change is the change of the climate system, including the atmosphere, hydrosphere, biosphere and lithosphere at present and in future by natural and anthropogenic causes. The latest research by scientists around the world showed that climate change occurred on a global scale, causing increasingly powerful impact on every country and life on earth. Up to 90% of the causes for the climate change is anthropogenic activities. Vietnam is one of the countries that suffer from the most serious effects due to climate change and sea level rise.

* Corresponding author
E-mail: hachuthi@yahoo.com

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In Vietnam, there are 85 landfill areas. Among them, 76.7% of landfills are unsanitary, 9% of landfills follow biological treatment technologies including mainly compost production. Organic waste is the main source of carbon dioxide emission (75 Mio Mg $CO_{2\text{-equivalent}}$ per year), which has the largest concentration among different kinds of greenhouse gases in the Earth's atmosphere. In addition, the replacement of fossil fuels with biofuels to reduce air pollution and greenhouse gases emissions is an example of mainstreaming at an operational level. It is known that reduction of greenhouse gases has relation to mitigation of climate change. The conversion of organic waste and biomass into energy is contributing not only to supply cleaner energy replacing in part coal, oil and gasoline but also to reduce emissions of carbon dioxide, methane, nitrous oxide and other greenhouse gases. Therefore, the good management as well as sustainable use of organic waste and biomass is of very importance in slowing down the warming process of the earth's temperature.

The DAAD alumni workshop with the topic "Renewable Energy from Organic Waste and Biomass in Vietnam in Relation to Climate Change Mitigation" takes place in order to bring environmental scientists a chance of gathering to discuss about the potential on upgrading of organic waste management and sustainable use of biomass. It is expected that the improvement of researches focusing on this topic in future will contribute to reduce climate change effects on human life.

2. Effect of climate change

The main cause of climate change is due to an increase in activities generating greenhouse gases, the active exploitation of sinks and reservoirs of greenhouse gases such as biomass, forest, marine ecosystems and other coastal and inland ecosystems. It is estimated that by the end of the 21st century, the global average temperature increase at least 1.1 - 2.9^0C and could reach the highest peak at 2.4 - 6.4^0C. The sea level rise is expected to be at least 0.18-0.38 cm and could reach a highest peak of 0.26-0.59 cm (ISPONRE, 2009).

Climate change makes natural calamities and disasters, especially hurricanes, floods, droughts, earthquakes, tsunamis, increasing in frequency, intensity and scale. In recent years, due to climate change the devastating storms appeared more and more, causing damage to buildings, structures, crops, killed thousands of people. Tsunami risk always is threatening many countries around the world. Earthquakes, floods also have a tendency to increase.

The expression of climate change includes:

- Warming of the atmosphere and the earth in general.
- The change in the composition and quality of the atmosphere is harmful to human habitat and the creatures on earth.
- The rising sea level due to melting of ice led to the inundation of low-lying areas and small islands in the sea.
- The movement of the tropical climate existed for thousands of years in different regions of the earth leads to the risk of threatening the life of the organism species, ecosystems and human activities.
- The intensity changes of the atmospheric circulation, water circulation cycle in nature and geochemical cycles.
- Changes of biological productivity of ecosystems, the quality and composition of the hydrosphere, the biosphere, the atmosphere.

3. Solutions for mitigation of climate change

There are numbers of options for mitigation of climate change. Reducing global greenhouse gas emissions over the coming decades could offset the projected growth of global emissions or reduce emissions below current levels. For energy supply, efficiency of supply and distribute is improved. For transport, the solutions are use of some kinds of vehicles such as more fuel-efficient vehicles, hybrid vehicles and cleaner diesel vehicles. In addition, modal shifts from road transport to rail and public transport systems (IPCC, 2007). Replacement of fossil fuels with bio-fuels to reduce air pollution and greenhouse gas emissions is of much concern (UNEP, 2007).

Greenhouse gases are causing climate change because of their long atmospheric lifetime and trapping the heat in the atmosphere. A number of ways to lower heat-trapping emissions from energy sources include (IPCC, 2012):

- Improving supply-side efficiency of energy including combined heat and power.
- Improving demand-side efficiency in the respective sectors and applications.
- Utilizing CO_2 capture and storage (CCS) to prevent CO_2 generated by post-combustion or industrial process from entering the atmosphere.
- Changing behaviour to better manage energy use or to use fewer carbon- and energy-intensive goods and services.
- To shift from high- greenhouse gas energy carriers such as coal and oil to lower- greenhouse gas energy carriers such as natural gas, nuclear fuels and resources.

Currently on a global scale, biomass is the fourth largest energy source, accounting 14-15% of the total energy consumption of the world. In developing countries, biomass is usually the largest source of energy, contributing about 35% in average total energy supply. The increase of biomass potential to support ambitious renewable energy targets will contribute to the reduction of an estimated amount of greenhouse gas emissions from 400 to more than 600 Mt CO_2 in 2030 (EEA, 2006).

Vietnam has a large potential of biomass and agricultural by-products. It is estimated that the potential of wood biomass is up to 25.09 million tons and the potential of agricultural by-products is up to 53.43 million tons (Pham, 2005). The technologies to turn biomass into

different kinds of bio-energies were developed and applied all over the world.
Biomass combustion is the main technology that contributes to over 90 % of bio-energy in the world (Loo and Koppejan, 2008). In Vietnam, about 75% of biomass is used in the heat supply for cooking in household scale with low efficient. That causes health problem due to indoor air pollution. The World Health Organization (WHO) reported that about 1.6 million people die prematurely each year from exposure to polluted indoor air (WHO, 2006).

Ethanol production from biomass was a technology studied widely. Ethanol was used as fuel additive blended into gasoline instead of lead additive. Since 2011, Vietnam has a policy to use bio-fuel E5 (5% ethanol content) as an alternative material replacing for traditional gasoline A92. However, many people remain concerned because of the water absorption and susceptible to oxidation of ethanol can damage the combustion chamber of the engine.

Biogas was called as "brown revolution" in the field of new energy. Biogas production technology now has been studied and applied widely in the world, particularly in developing countries with climate heat (China, India, Brazil, Nepal, Kenya, Thailand, Vietnam, etc.) that is suitable for anaerobic fermentation of organic waste to produce biogas. The use of biogas as a clean energy is a current hot issue in the world and Vietnam. Developing biogas not only treats organic waste, cleans environment, but also provides residue that can be used as fertilizer increasing soil fertility with highly valuable for agriculture.

Back to the role of energy, the production of bio-methane can meet the demand for fuel, including electrification in rural areas. Biogas also contributes to reducing deforestation in developing countries, to reduce dependence on fossil fuels. Biogas production in Vietnam has developed strongly recently due to the subsidy from domestic government and abroad foundations through the research projects, especially the cost and technology support. The biogas digester can be built with any capacity, small investment, available input materials; it is quite consistent with the economy of developing countries. The biomass used for this purpose can be wood waste, sawdust, shavings, rice husk, straw, bagasse, coconut shell, etc. Each year the Red River Delta and Mekong Delta produce millions of tons of rice husk. The biogas energy was used for cooking, lighting, running engines etc. In biomass gasification, biomass is burned not quite producing some gases such as CO, H_2, CH_4, etc. These gases can be used as fuel for internal combustion engines, gas turbines to operate the electric generator or used to fire directly replacing oil in boilers. Producing and burning of biogas are considered as CO_2 balance processes because of the continuous cycle of carbon between crop/animal feed - animal manure - biogas. It really brought to life more civilized and convenient to rural areas. With a series of socio-economic and environmental benefits, biogas promises great potential in helping to solve the problem of fuel activities today in Vietnam.

4. DAAD alumni workshop on "Renewable energy from waste and biomass in relation to climate change mitigation"

The present DAAD alumni workshop on "Renewable energy from waste and biomass in relation to climate change mitigation" is funded by German Academic Exchange Service - DAAD (Germany) and Vietnam Academy of Science and Technology – VAST (Vietnam), and is organised by the Institute of Ecology and Biological Resources - IEBR (Hanoi, Vietnam). The workshop includes papers and presentations of environmental scientists on the improvement of environment quality through effective management of organic waste and sustainable utilization of biomass by using biological technologies, especially bio-energy production process.

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