IEA Bioenergy
Technology Collaboration Programme

Integration of Anaerobic Digestion into Farming Systems

In Australia, Canada, Italy and the UK

Summary Series

IEA Bioenergy: Task 37: 08 2020

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Integration of Anaerobic Digestion into Farming Systems

The ambition of renewable energy technologies (including anaerobic digestion) is to reduce the carbon footprint of energy and eventually lead to a decarbonised world, ideally before 2050. Of issue for a net carbon neutral world are the hard to decarbonise sectors, such as agriculture. Agriculture is seen as a source of greenhouse gases, be it methane from belching ruminants, fugitive methane release from open storage of slurry, carbon release for tilled soils, desertification of agricultural land due to over use and droughts, reduction in soil organic carbon content, use of fossil fuels to make fertiliser, and N_2O release from agricultural lands. Futher environmental isssues relate to the volatilisation of ammonia, eutrophication, smells and ground water pollution.

This report assesses the role of biogas integrated into the farming system through examination of policy, practices and strategies in four very distinct countries with very different climatic conditions. These countries include Australia (6th largest country by area, driest inhabitated continent, low levels of population density), Canada (2nd largest country by area, incredibly cold in the north, while warm in the south, sparsely populated), Italy (mountain, continental and mediteranean climates with very fertile regions such as the Po valley with potential for year round agriculture) and the UK (well populated industrial country with temperate oceanic climate).

Practice is such that both Italy and the UK have mature biogas industries and in particular see biogas systems integrated into the farming system, to the extent that crop rotations are changed with the existance of a nearby digester. This is exemplified by the Italian concept of Biogasdoneright^{R} (BDR) whereby anaerobic digestion enables and strengthens food and fuel integration, but also that the changes made to farming systems have resulted in increasing photosynthesis (less land left bare), greater use of organic fertilizers, and increased adoption of precision and conservation farming practice.

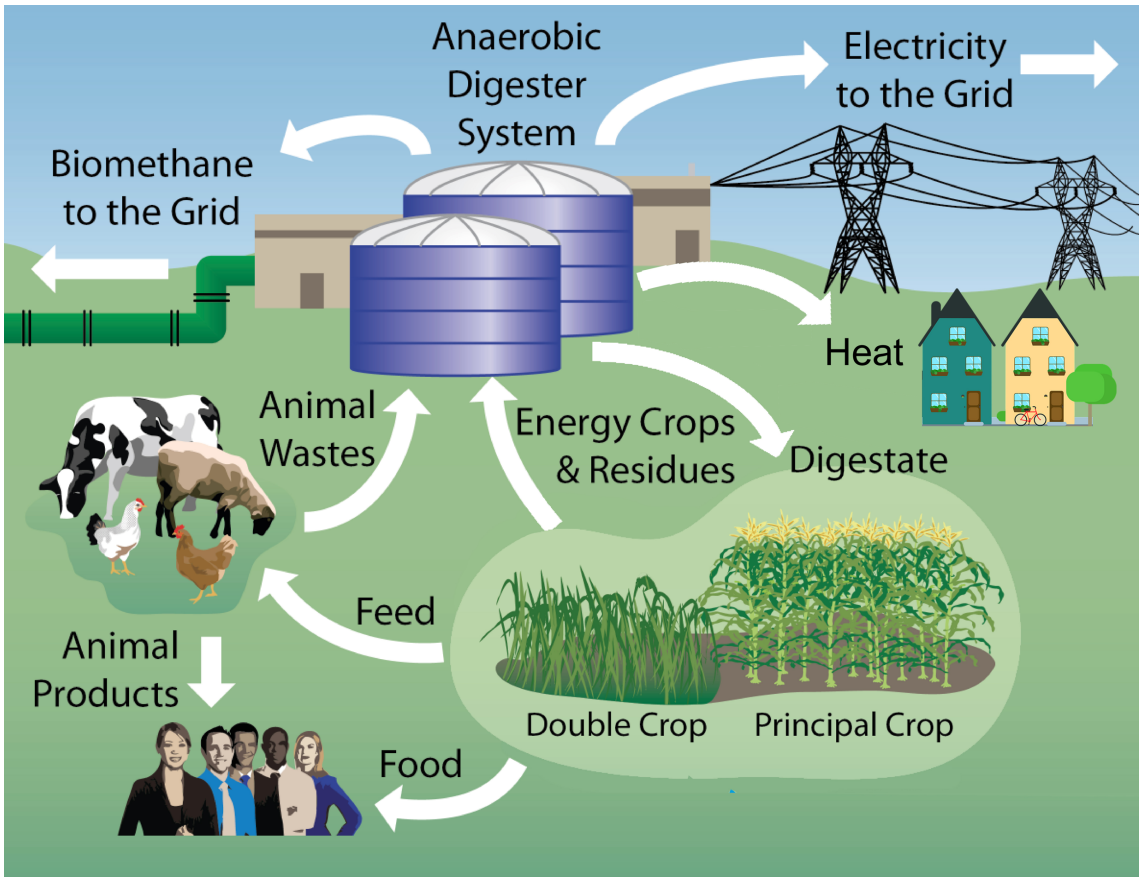
The opportunities offered by biogas systems associated with farming practices include:

• Reduction in fugitive methane emissions (with global warming potential (GWP) of 28) from livestock manure storage and associated sustainable manure management associated with biogas production and thence its use for combined heat and power and/or biomethane with full combustion yielding CO_2 (with a GWP of 1) and as such the entire circular economy system potentially yielding a neutral or negative GHG emission per unit of energy produced;

• Minimisation of mineral fertilizer use (and associated fossil fuel use) through replacement with digestate from biogas system coupled with adoption of precision biofertilizer/mineral fertilizer application, crop nutrient matching to soil N, P and K reserves;

• Use of fertilizer application techniques (such as trailing shoe instead of splash plate slurry spreading systems) that minimise N volatilisation and the generation of nitrous oxide (GWP of N_2O = 265 to 298 that of CO_2).

• Increase carbon sequestration and soil organic content, by the production and use of catch crops (fast growing crop grown between successive planting of main crop) which reduce periods of bare soil, increase photosynthesis and improve soil health. Catch crops can dispel food-fuel and land use change concerns as catch crop, slurries, and damaged primary crops (such as from drought) may be used as the source of biogas feedstock.



The Biogasdoneright[R] concept (from: Dale, et al., (2020). The potential for expanding sustainable biogas production and some possible impacts in specific countries DOI: 10.1002/bbb.2134; Biofuels. Bioprod. Bioref.)