Sustainable supply-demand network for bio-waste management

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The design of supply-demand network is a critical component for optimising the transition of waste to product. The chain ranges from waste acquisition, waste transportation, waste storage, treatment process, resource production and delivery. For the anaerobic digestion, the organic waste, such as food waste and biomass, is being decomposed by microorganisms to produce biogas and digestate. The biogas can be harvested to produce renewable energy or upgraded to bio-methane. The digestate can be further composted to bio-fertiliser. The supply-chain design is focused on several aspects: (1) identification of the strategic locations for biogas plants and biomass storages (2) biogas storing or flexible biogas production (3) storage, processing, conditioning and transport (4) workflow on energy supply. Among these, the identification of optimal location and the energy supply from biogas are of high interest. Recent researches bring in new highlights on the importance on product storage, including both biogas and the biogas-converted energy. Storage options have been researched to store excess biogas or biogas-converted energy which is targeted to address the variation on both the supply side (i.e. biogas production) and demand side (i.e. energy usage). There is still limited study in addressing such variation on the supply and demand side in the context of waste storage. In such context, the supply side can be defined as the quantity and quality of the input waste whereas the demand side can be defined as the required quantity and quality of the stored waste to the treatment unit. The daily and seasonal variation on the stored waste can lead to suboptimal process efficiency and production of the end-product. This paper aims to review on the potential options for waste storage on storing time, improved digestibility and by-products. The reviewed options include ensilation, fermentation, bio-drying, drying and enzymatic treatment. The findings will be used to design a new concept on a "go-stay-leave lock" mechanism to be applied in an integrated AD-composting plant. The input waste will be channelled to AD (i.e. go) or remained stored (i.e. stay) for a maximum of time (i.e. the lock). After the stored waste excessed the maximum storage time, where the criteria are highlighted based on the review, it will exit the storage option and enter the composting site (i.e. leave). The identification of the "lock" mechanism enables optimal utilisation of the input waste and ensuring there would be substantial amount of feedstock for stable biogas or biogas-converted energy production. The "lock" can be expanded for multiple criteria assessment to include other parameters, such as costing, regional temperature, waste quality, digestibility, by-products and more in future work.