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Title	Possibilities and barriers for recirculation of nutrients and organic matter from urban to rural areas: a technical theoretical framework applied to the medium sized town Hillerød
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Author(s)	J. Magid ¹ , A. M. Eilersen ² , S. Wrisberg ¹ , and M. Henze ²
Address	¹ <i>Plant and Soil Laboratory, Department of Agricultural Sciences, The Royal Veterinary and Agricultural University, Thorvaldsensvej 40, 1871 Frederiksberg C, Denmark;</i> ² <i>Department of Environment and Resources, Technical University of Denmark Bygningstorvet, building 115, DK-2800 Kongens Lyngby</i>
Telephone	+45 35283491
Fax	+45 35283461
Mobile	
E-mail	jma@kvl.dk
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Possibilities and barriers for recirculation of nutrients and organic matter from urban to rural areas: a technical theoretical framework applied to the medium sized town Hillerød

The project aimed to develop and evaluate technical solutions for increasing recirculation of nutrients and organic matter from urban to rural areas, in order to assess possibilities for developing a more integrated ecologically sustainable waste and sanitation management. Furthermore the project should assess the feasibility of the solutions in a specific medium size (app. 27.000 inhabitants) modern town setting – the municipality of Hillerød. 14 integrated systems were described based on well known technology, and assessed on the basis of their ability to meet requirements in relation to public health, comfort, costs, durability, user friendliness, energy use and recirculation potential. Of these 4 were chosen to 'retrofit' into the existing town structure of Hillerød and the resulting change in terms of energy balances, recycling and economic costs were modelled against a conventional 'reference' waste management system. For the chosen systems the energy saving corresponded to the yearly electricity consumption in 896 Danish households. Given the uncertainties it was estimated that the capital costs were approximately 10% higher and running costs for the systems was 17 % higher than for the reference system including the net energy savings. The reference system produced sufficient nutrients for fertilising 152 hectare of agricultural field, provided that the sludge is clean enough. In the alternative system the nutrients collected as sludge from biogas digester, human urine and sludge from the waste water plant were enough for fertilising 451 hectare of agricultural field, corresponding to 12 % of Hillerød municipality's area.

On the basis of this work it can be concluded that it is technically possible to design integrated ecological waste management systems, based on known technical components that may be operated at or close to the cost level of the current conventional sanitation systems. Such integrated systems need to be further developed and tested on a scale that will allow an interaction with farmers and their organizations, in order to evaluate their wider environmental consequences and to further integrate health and socio-cultural aspects in a learning process. The main drivers for change in countries with a fully developed centralized sewage and waste infrastructure would seem to be either government policy motivated

(sustainability drive) or motivated by grass root movements, since the economic incentives for technology change are currently uncertain and probably small. However in the middle income countries, including part of the developing world there is potential for considerable cost savings, and enormous need for development of waste and sanitation infrastructure, which would give impetus to more effective use of ecological sanitation.