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Energy and Carbon Implications of Rainwater Harvesting and Greywater Recycling

Project summary SC090018

A new report published by the Environment Agency estimates that approximately 40 per cent more carbon is emitted when using a typical rainwater harvesting system instead of mains water and potentially up to 100 per cent more carbon is emitted by most greywater recycling systems. The study was commissioned to quantify the carbon impacts of domestic and business systems so that in future, decision makers will have additional information with which to assess the overall balance between the social, economic and environmental benefits and drawbacks of the systems. The report highlights that there is scope to improve the efficiency and design of systems to reduce their carbon footprints.

The study does not explore the wider sustainability aspects of these technologies, but acknowledges that individual situations should be evaluated for their overall sustainability and applicability. Carbon emissions form one aspect of this.

Rainwater Harvesting (RWH) and Greywater Recycling (GWR) systems are methods of reducing the use of mains water supply by using rainwater harvested from building roofs and recycling water from basins, baths, showers etc, for non-drinking applications such as WC flushing and washing machines. RWH systems can also have further benefits including storm water reduction where there is sufficient tank capacity.

This study collated information about some of the different types of RWH and GWR systems available (e.g. material types, mass and energy consumption of pumps etc). From the information collected, the carbon emissions from generic/typical RWH and GWR systems for different building types and scales were calculated.

The study calculated carbon impacts across three timeframes 15, 30 and 60 years. In order to try to account for regional differences in rainfall and future potential climate change, three annual rainfall averages were used for the calculations. The carbon emissions from four different scenarios designed to reflect future changes in water demand, water leakage, system energy use, mains water carbon intensity and grid electricity carbon intensity were also modelled.

The study identified that applying rainwater or greywater systems to buildings gives rise to additional carbon emissions compared to buildings without such systems. For example over 30 years under a business as usual scenario, the carbon footprint of a rainwater system with a polyethylene tank applied to a 90m^2 three bed semi-detached house, in an area with medium rainfall, average mains water carbon intensity and slow grid decarbonisation is approximately 1.25 to 2 tonnes of carbon dioxide equivalent. This is similar to one year of energy-related emissions from a house built to Code for Sustainable Homes Level 3 energy efficiency standards. The footprints of systems applied to commercial buildings vary widely, but were found to represent around one month's energy-related emissions in the hotel, office and school studied.

Storage tanks account for a large proportion of the footprint of rainwater systems; slightly less for greywater. Pumps also make up a large proportion of the carbon footprints of the systems and the energy used to run the systems. Innovation in these and other areas could reduce carbon footprints. Manufacturers and suppliers should work quickly to reduce the footprints of their systems, and particularly to reduce the energy intensity of pumps and treatment systems.

This study identifies a 'carbon gap': an increase in carbon emissions and a building's carbon footprint from applying rainwater and greywater systems. This should be considered alongside reductions in mains water demand and foul water volumes, and other benefits such as reduced rainwater run-off, and increased 'resilience' from on-site collection and storage. The value of water demand reductions and the wider benefits of rainwater and greywater systems was outside the scope of this study. Bringing together the results of this study with work on the valuation of water-

related benefits could start to establish a basis for deciding when such benefits bridge the 'carbon gap'.

The report suggests that manufacturers and suppliers should improve their own understanding about the lifetime carbon impacts of their systems and publish this information for the benefit of consumers and decision-makers. The report also suggests that engagement and technical support from organisations like the Environment Agency, Energy Saving Trust, NHBC Foundation could speed up the process of producing, disseminating and raising awareness of such information.

This summary relates to information from Evidence Project SC090018, reported in detail in the following output(s):

Title: Energy and Carbon Implications of Rainwater Harvesting and Greywater Recycling

Report Product Code: SCHO061BSNC-E-E

July, 2010

Internal Status: Region
External Status: Public

Project Partners: Environment Agency, National House-Building Council (NHBC) Foundation and Energy Saving Trust

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Project manager: Jo Chadwick, Evidence Directorate

Research Contractor: AECOM

This project was funded by the Environment Agency's Evidence Directorate and the National House Building Council (NHBC) Foundation. The Evidence Directorate provides scientific knowledge, tools and techniques to enable us to protect and manage the environment as effectively as possible. The NHBC Foundation facilitates research and development, and shares pragmatic and relevant guidance and good practice to the homebuilding industry.

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