Science for Environment Policy

Re-using resources in cities: a Dutch case-study

Dense urban environments have significant resource-saving potential and serve as good platforms for climate change mitigation. This study reviewed an initiative to improve use of energy and water in Rotterdam, highlighting factors important for success including exchanges in close geographic proximity and private-sector participation.

Over half of the global population now live in cities. In Europe the proportion is even higher — cities house around three-quarters of the population. Yet as cities expand, so do their environmental challenges. Home to increasingly large populations, cities use lots of natural resources. Cities also generate pollutants, namely greenhouse gases (GHGs). In fact, cities are responsible for over 70% of global energy-related CO_2 emissions[1].

Cities therefore have high potential for addressing environmental challenges. One way of doing this is by making better use of materials. A concept growing in popularity is that of 'urban symbiosis', which aims to break linear relationships between consumption and waste by returning outputs as inputs, e.g. converting waste heat into reusable energy, recycling wastewater or water from industrial processes. This has dual benefits; as cities improve the efficiency of their resource use, they also reduce their GHG emissions.

This study investigated how local authorities can improve resource management by adopting such an approach. The authors used Rotterdam Energy Approach and Planning (REAP) as a case study. REAP was initiated by Rotterdam's local authority in 2009, and aims to close resource-waste cycles by re-using energy and water. The initiative has three core steps (reducing energy consumption via architecture, re-using waste energy flows, and using renewable energy) and operates at four geographic scales (building, neighborhood, district and city).

REAP emphasises energy efficiency by exchanging waste energy flows between urban functions. In practice, this means using the energy that is already there, the harbour's waste heat for example. At the city scale, REAP feeds waste energy from harbour industries into the district heating grid. At the district/neighbourhood scale, the waste heat of offices and shops can be cascaded to homes, and energy can be exchanged between swimming pools (which require heat) and ice rinks (which require cooling).

To increase efficiency, REAP operates at these different geographic scales depending on the amount of resource. For larger resource exchanges, it focuses on the city-level while for smaller exchanges, it makes sense to focus on the building or neighbourhood level. For the remaining demand, REAP encourages use of renewable energy. REAP also includes water re-use and aims to reconfigure water networks to increase symbiosis between buildings, services and industries.

REAP has been applied to several projects in Rotterdam, including a large-scale retrofit of housing, offices and cultural spaces on vacant lots. It has also been applied in the EU Celsius Cities project to test smart energy planning in Cologne, Genoa, Gothenburg, London and Rotterdam.

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1. http://www.ghgprotocol.org/city-accounting

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A review of REAP was carried out via policy documents, site visits and in-depth interviews from 2012–2014 with representatives from Rotterdam's local authority, a local university, architecture companies, engineering companies, Amsterdam's Planning Department and the Ministry of Infrastructure and Environment. It highlighted a number of important considerations for designing and implementing urban symbiosis projects.

First of all, it showed the advantages of having **flexible geographic boundaries** depending on the type and amount or resource exchanged. Where large amounts of resources are concerned, such as industrial waste heat, the city-level becomes most important, while for smaller exchanges, such as waste heat from offices, the building or neighbourhood level becomes the focus. Secondly, REAP illustrated the importance of **involving those responsible for implementation** (private actors and civil society) early on in the process, as this improves ownership and engagement, and ultimately project success. In REAP, late inclusion of private actors led to lack of ownership, partial acceptance and ad hoc application. Ways to better engage with citizens include interactive workshops with local politicians and use of social media.

Thirdly, it revealed a common concern among people about becoming dependent on others for resources, as functions may change with time (e.g. offices/shops could relocate). To increase project acceptance, the authors recommend **dialogue, interactions and learning** to increase confidence in the approach. Developing new resource alliances (e.g. a middleman to coordinate resource provision) may also be beneficial. Finally, it showed the need for **local government involvement during implementation**. In order to encourage support for this, the authors recommend highlighting cost savings.

Despite its novelty, the REAP approach has already inspired sustainability guidelines in Rotterdam, such as those relating to water, materials and green space. As the climate changes and cities begin to revise their strategies for energy use, REAP provides a useful blueprint of how urban areas can improve their resource management. Further research should evaluate its longer-term impact in Rotterdam, and compare it to similar projects in other cities.

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