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SUSTAINABLE DEVELOPMENT

Resource Demand Management Techniques for Sustainable Development March 1998

ENVIRONMENT AGENCY

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Executive Summary

Increasing demand for services such as water, energy and waste disposal can be met either by expanding supply or by managing demand. Resource Demand Management (RDM) seeks to ensure that the right balance of demand-and supply-side options is achieved. Since in most areas decision-makers have in the past concentrated resources too heavily on the supply side, RDM typically leads to more investment on the demand side, often bringing both environmental and economic benefits. This convergence of benefits links closely with the environmental and economic dimensions of sustainable development.

There are a number of principles for effective RDM. Among the most important of these is the need for appropriate unit pricing of resources, in order to provide consumers with the right economic incentives for demand management. But despite strong evidence that water metering and variable waste charging are highly effective in reducing demand, householders in the UK typically do not face unit pricing either for water or for waste collection/disposal. The Agency could improve price signals for the resources which are its own responsibility, especially for abstraction licences and discharge consents, and for other resources it could work with industry regulators (such as OFWAT) and other parts of Government. However, introducing unit pricing is likely to result in losers as well as winners. The distributional consequences of pricing as a demand management measure have been significant limiting factors on its wider application, along with other costs such as the resource costs of meter installation.

Even where constraints to pricing are overcome, price alone often is not enough to ensure efficient use of resources in the context of regulated industries and constraints on a competitive market in natural resources. RDM redresses some of these system failures through providing incentives for actors other than consumers to manage levels of demand or information and other means for consumers better to respond to price signals. RDM can comprise not just a set of techniques, but also a distinct culture involving a new way of thinking and new conceptual and operational tools.

Demand management has often been associated in the US with measures that are mandated by statute and are carried out by (or on behalf of) utilities. There has been some progress in this direction in the UK with the imposition (in the 1995 Environment Act) of a duty on water companies to promote efficient use of water by their customers. However, if price is to be used as the principal policy tool for promoting demand management, eg through the introduction of water meters, this provides greater incentives for consumers to manage their demand but means there is less justification for intervention in the form of regulated RDM. Price measures introduce private incentives to utilities at the supply end, ie there is an incentive to fix leaks as they will only obtain revenue for water sold, but no incentive to reduce demand. This contrasts to the current situation where water utilities might increase net revenues through reducing the demand of un-metered dwellings.

Even where pricing measures are used, however, there may still be market failures which justify policy intervention (such as the very high implicit rate of return that is usually required before consumers implement demand management measures). In this case, it is likely to be more appropriate to give responsibility for RDM measures such as retrofitting of efficient appliances and information provision, to a third party. Where unit pricing of resources is used, giving utilities responsibility for RDM is likely to be undesirable, since under these circumstances, companies are likely to have adverse incentives, encouraging them to discharge their duty by carrying out ineffective demand management.

In a number of areas, the Agency may be able to help bring about RDM by dialogue and information provision: in exercising its statutory waste regulation and pollution permitting functions, for instance, the Agency could promote waste minimisation techniques in industry; whilst in carrying out its water quality and water resources functions, the Agency may be able to facilitate better use of treated effluent as a resource (by substituting it for raw water). It is particularly important for the Agency to work with the land use planning community to ensure that both the location and water intensity of new development takes account of the availability of the local resource.

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1. Introduction

1.1 Background and Objectives

This report has been prepared by Environmental Resources Management (ERM) for the Environment Agency (the Agency) as the *Final Report* of the national R&D project on:

Least Cost Planning (LCP) and Resource Demand Management (RDM) Techniques for Sustainable Development.

The project's main aims are:

- to review existing Resource Demand Management (RDM) techniques, describing their main features and success in achieving environmental, social and economic objectives;
- to examine how RDM could contribute to the Agency's discharge of its responsibilities and support its contribution to sustainable development; and
- to assess the opportunities and barriers for the Agency in promoting RDM, including recommendations for action.

1.2 Report Structure

Section 1.3 (following this one) introduces the concept of resource demand management (RDM) and briefly reviews its relationship to other related concepts. Section 1.4 concludes with an overview of how RDM has developed in the UK.

Section 2 examines the relationship between RDM and sustainable development. It introduces the Agency's role in promoting sustainable development, including a set of 13 principles and techniques for sustainable development contained in the Agency's most recent guidance in this area. It also examines briefly the extent to which these principles and techniques are compatible with RDM and presents some of the available evidence for the effectiveness of RDM as an approach to the implementation of sustainable development in the areas of water, energy and waste.

Section 3 is a review of UK and international experience of RDM, focusing on:

- water and waste, because of the Agency's functions in these area; and
- energy, because of the substantial volume of experience which exists in the United States in this area, and which holds lessons for RDM in other sectors. Energy use is also relevant to some of the Agency's pollution control functions.

Flood defence is also addressed as a potential area in which RDM might be applied as a concept, because of its importance as a proportion of the Agency's total budget. Brief reviews of experience in transport demand management, and of the scope for promoting 'sustainable lifestyles' as a means of reducing the resource-intensity of consumption patterns, are also included.

Section 4 presents an analysis of what elements are necessary for RDM to be successful. It discusses a number of general principles for - or features of - the RDM approach which must be understood in order to promote it successfully; it sets out the economic principles which provide users of services with the right incentives to undertake demand-side measures; and examines what institutional arrangements are necessary in order to give suppliers of services an incentive to undertake demand-side measures.

Section 5 offers an analysis of the opportunities and barriers facing the Agency in promoting RDM. It presents an overview of generic policy instruments for promoting RDM, and maps these against the key Agency functions where RDM could play a role. It examines policy instruments that are directly and indirectly available to the Agency, and presents a brief discussion of the opportunities and barriers in implementing each one. Suggestions for how the Agency might take these ideas forward are also included.

Finally, *Section 6* presents the report's conclusions and recommendations. It evaluates the usefulness of RDM as an approach for the Agency in promoting sustainable development; identifies the key principles for effective RDM identified in the report; and summarises the key recommendations for the Agency arising from the study.

1.3 What is Resource Demand Management?

Resource demand management is the generic term used in this report to describe techniques and policy instruments which involve matching supply with demand by influencing demand rather than just by increasing supply. The term applies principally to managing demand for infrastructure (eg transport infrastructure) and the commodities that infrastructure networks provide (water, energy and waste management in particular). RDM techniques can be applied at many steps in a product's or resource's life cycle in a way that reduces overall resource use or limits environmental effects. RDM allows the same (or a similar) quality of service to be provided – be it in heating, washing, or access to goods, services and people – at a lower resource cost.

RDM policies emerged as a reaction to conventional supply-side approaches, which treated energy, water and other resources as low-cost commodities, or even free goods, to be provided as of right by monopoly suppliers (whether publicly or privately owned). Whilst it may seem obvious today that managing demand for services is a necessary complement to increasing supply, this change in outlook has only become established comparatively recently in the UK, although recognition of the need for demand-side approaches elsewhere in the world and in the academic literature is at least forty years old. (*Section 1.4* below charts the emergence of RDM in the UK). The fact that these opportunities exist suggests the existence of market failure. Under current arrangements firms may not have the incentive to find least cost supply options (eg fixing leaks versus building new reservoirs), nor consumers the incentive to limit demand, because of the absence of clear price signals or information about techniques for reducing demand (as well as other possible market failures).

RDM is of interest to the Agency because of its potential to achieve environmental and economic benefits at least cost to the economy as a whole. Provided that social criteria are also taken into account, RDM has an important contribution to make to sustainable development in its environmental, social and economic dimensions – see *Section 2.2* below.

RDM does not, however, mean managing only demand. Rather, RDM involves consideration of both demand and supply side options, weighing up their relative environmental, economic and social costs and benefits on an equal footing. As an example, it is clear that historic levels of leakage in water distribution have left ample scope for economic leakage reduction measures; to achieve zero leakage, however, is clearly uneconomic – the question is where the balance should lie. In this regard RDM fits well with the Agency's duty to consider costs and benefits in discharging its functions.

For the Agency, RDM can be targeted through policy measures which seek directly to influence consumer demand or via institutional arrangements which provide utilities and other network providers with private incentives to reduce demand. RDM principally refers to non-price-based instruments – of which least cost planning is one example – but also encompasses some price-based instruments, such as user charging for water and waste collection/disposal. Instruments which operate by influencing existing market prices (such as the taxation of externalities) have not in general been considered in this project.

Other terms which are also used in the context of RDM are defined below:

- *Least Cost Planning (LCP)* – refers to techniques which explicitly consider both demand- and supply-side options in infrastructure planning, and by evaluating these on an equal footing enable the least cost solution to be identified.
- *Integrated Resource Planning (IRP)* – is indistinguishable from LCP in conceptual terms. In practice, however, IRP is a term which was used mostly for energy markets in the United States to describe a process of LCP which utilities were required to perform by their regulatory authorities (see *Section 3.2.2*). The term may also mean 'integrated water basin management', which typically refers to an integrated approach to managing water provision in a given river basin, by considering the effects of forestry, agriculture, urbanisation etc on the hydrography of the area. This type of integrated approach may incorporate both supply- and demand-side measures.
- *Demand Side Management (DSM)* – refers to any measures which aim to manage demand rather than supply. DSM differs from LCP and IRP in that it does not encompass a comparison of demand-side and supply-side options, and is thus not necessarily focused on least cost. The term is generally used to refer to RDM programmes that are run by utilities themselves (as distinct from measures which households or industry may take on their own initiative).

Eco-Efficiency – is a term which can easily be understood to encompass RDM. The term was coined by the Business Council for Sustainable Development (1) in its report to the UN Conference on Environment and Development in Rio. Crudely, it can be defined as 'doing more with less' – RDM achieves this by providing the same or similar service to users but with lower resource use. This idea is explored further in *Section 2.2* below.

- *Total Water Management* in which the whole resource chain is managed and consideration is given to opportunities for influencing the supply/demand balance at numerous stages within the water cycle.

RDM does not refer only to public policy measures: instead, RDM is really an approach to resource management in which many societal actors, working at different geographical scales, have a role. Consumers must play an active part in managing their demand, which involves cultural change as well as simply responding to price signals (eg no longer viewing water as a free resource); land use planners will have to consider more seriously the stress on infrastructure networks at both strategic planning and development control levels; engineers will need new techniques to assist in reducing demand.

1.4 The Emerging Logic of RDM

The past decade has seen a remarkable shift in the regulation and management of water, energy and transport. In a brief period of rapid activity, new technologies, regulatory regimes, management styles, marketing strategies, environmental priorities and commercial goals have emerged, dramatically re-configuring patterns of infrastructure provision.

The emergence of RDM in the electricity sector is largely due to a combination of regulatory, commercial and economic factors. The electricity industry's economic regulator, OFFER has weakened the 'demand driver' – that translated increased sales into higher levels of profit for distribution companies – in the pricing regime, at the same time as granting electricity supply companies an additional revenue allowance of £1 per customer to fund energy efficiency projects. Critically, this has led to an internal industry debate about the economic costs of continuing to increase capacity. With suppliers concerned to avoid supply capacity that cannot be translated into profit, privatisation has focused utilities' interest on the efficiency and commercial effectiveness of their distribution networks. RDM activities have emerged as an important response to these concerns, a process further reinforced by the commercial benefits of utilities engaging with their most lucrative and profitable customers. The gradual introduction of technical innovations such as 'smart' metering systems that allow for interactive network control will greatly facilitate this process. These three shifts have also been mirrored by growing awareness of the environmental costs involved in a supply-led context and pressure groups, such as Association for the Conservation of Energy and Friends of the Earth, have highlighted the environmental benefits of RDM strategies in both CO_2 and SO_2 abatement. Similarly the fuel poverty lobby, including Neighbourhood Energy Action and National Consumers Council, have actively promoted energy efficiency. There are, however, important countervailing forces as well: the generating companies still have every incentive to increase profits by selling more electricity; whilst the imminent emergence of retail competition in electricity is also likely to spell cheaper electricity, thus increasing demand. As long as the costs of electricity generation exclude external pollution costs, it appears unlikely that it will be possible to arrive at the correct set of incentives for electricity users.

Within the water sector, it is mainly shifts in the regulatory regimes of the water industry's economic regulator, OFWAT and the Environment Agency that have promoted the emergence of an RDM logic. OFWAT is measuring the economic efficiency of water companies against rigorous standards of performance, judged via the comparative regional 'cost' of water delivered by each company; and direct pressure for demand-side measures was introduced with the OFWAT's requirement for water efficiency plans in June of last year. Equally, the Environment Agency is tightly controlling new abstraction licenses to encourage water companies to increase the efficiency of their networks, mainly through reduction in leakage (distribution losses can amount to more than 25% of total water supplied). At the same time there is increasing concern about the environmental impact of new reservoir schemes in terms of lost land, diminishing green belt area, natural sites and buildings of scientific interest. Social resistance to proposed reservoir developments such as Broad Oak in Kent has highlighted the difficulties of pressing supply-oriented options. Those water companies in areas of severe water stress, particularly in drought-prone areas such as the south-east, are now embracing RDM oriented options in response to these new pressures.

(1) In 1994 the Business Council for Sustainable Development (BCSD) merged with the World Industry Council of the Environment (WICE) to form the World Business Council for Sustainable Development (WBCSD), which is the principal body now promoting and developing eco-efficiency on the part of business.

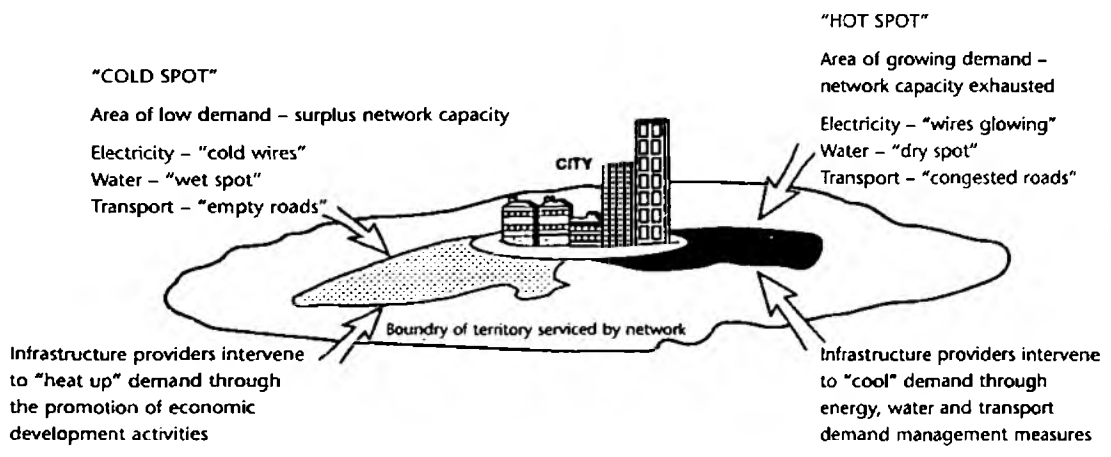
There appears to be a comparable shift in the assumptions underpinning the management of road space in urban areas. There is growing recognition of the economic costs of continued road network expansion and wider questioning of the efficacy of constantly building more roads which seems merely to accelerate car-use. Environmental concerns are also playing a part as transport, in particular car travel, accounts for 20% of the overall CO_2 emissions in the UK. Demonstrations of public opposition to road building projects, such as at Twyford Down, mark a new chapter in the political debate around infrastructure planning and send influential signals to the Department of Environment, Transport and the Regions (DETR) on the acceptable scale and form of future infrastructure investment. In light of such economic, political, social and environmental concerns funding applications from local authority planners to the DETR have been re-drawn to cover integrated 'packages' of public and private provision, steering local transport planning policies away from a focus on road-building alone. Similarly, the DETR has issued planning guidance commending local land use plans which spatially harmonise domestic, leisure and working patterns. With demand for travel accelerating, transport planners at national and local level are increasingly turning to demand-management strategies.

Awareness of the economic and environmental costs of supply oriented investment has prompted widespread social resistance to new infrastructure plans. Social and political concerns have reinforced the economic questions about whether supply-side measures are least cost and represent the best use of scarce capital resources, in opportunity cost terms. While the rate of emergence of this new demand-oriented logic varies between sectors, similar social and spatial issues seem to be surfacing in each. RDM approaches to infrastructure management create a new context for action within which a much closer form of engagement between production and consumption interests is being tested. These shifts are profoundly altering established assumptions about the management of infrastructure networks and the relationship between users and utilities.

RDM, Networks and Territory

Figure 1.1 illustrates the implications that RDM has for the management of cities and regions. Utilities are looking closely at the technical and economic performance of each part of their distribution networks and planning improvements rather than simply expanding networks irrespective of cost. In electricity distribution, for instance, 'hot' parts of the network that have insufficient capacity to meet peak demands could be subjected to intense energy efficiency measures to reduce the level of peak consumption, or shift the timing of consumption to reduce the ratio of peak to average demand. Similarly the water sector is more likely to adopt RDM measures in areas suffering from water stress. Supply-led options are no longer the preferred mode of management as water companies are forced to examine the efficiency of the network, reduce leakage and examine ways of helping customers to conserve water before considering expanding supply through new resource extraction. Transportation planners are focusing on the peak demands when road networks become congested. In this way, infrastructure networks are likely to be treated in very different ways according to the local demands placed upon them, with RDM most likely to be adopted where systems are under most stress. By contrast, where the network is running 'cold', with spare capacity, initiatives may well be developed to stimulate demand (with potentially negative environmental consequences). Transport planners have historically sought to improve the

FIGURE 1.1 TERRITORIAL MANAGEMENT AND THE RDM LOGIC



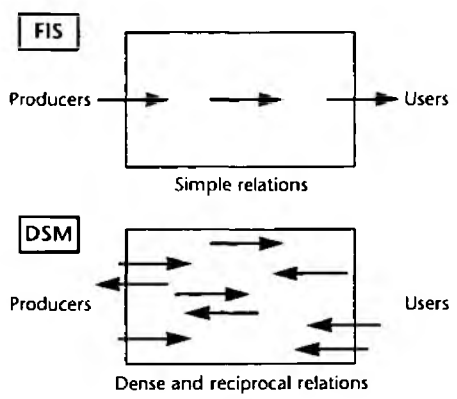
Source: Guy, S. and Marvin, S., Centre for Urban Technology, University of Newcastle

accessibility of under utilised commercial and industrial areas; 'load-building' programmes have been used by electrical utilities in the United States to make the best use of spare transmission and distribution capacity.

RDM and Relations with Users

Figure 1.2 illustrates how the traditional separation between production and consumption interests is challenged by an RDM logic which generates a more reciprocal and synchronous relationship with users to more accurately balance infrastructure supply and demand. While the conventional logic viewed users as a largely passive form of demand whose growth was met with supply oriented options, RDM seeks a closer form of engagement with particular types of user. The managers of infrastructure networks are finding new ways of differentiating between users on their networks focusing on their commercial attractiveness, their impact on the technical efficiency of the network and their potential for maximising RDM opportunities. Electricity companies are now marketing targeted energy services to industrial and commercial companies rather than indiscriminately selling units of electricity. Some privatised water companies are similarly keen to discriminate between customers based on their level of consumption and service needs. Transportation agencies are translating the needs of major trip generators in more flexible transport packages.

FIGURE 1.2 RE-CONFIGURING RELATIONS BETWEEN PRODUCERS AND USERS OF INFRASTRUCTURE NETWORKS



FIS – Facilitating Infrastructure Supply

Source: Guy, S. and Marvin, S., Centre for Urban Technology, University of Newcastle

There are also new forms of differentiation between users on stressed networks. As infrastructure providers attempt to alleviate stress on congested networks or stimulate demand on under-utilised networks they are likely to engage with the larger and more demanding users. These are likely to be commercial and industrial users whose changing behaviour on the demand side is most likely to alleviate stress on the networks. In seeking to 'bond' with their favoured customers regional electricity companies are beginning to venture 'beyond the meter' by offering free energy audits and other energy services. Such initiatives signal a major refashioning of relationships between electricity customers and utilities within which energy savings activities can flourish.

- Large users of water services in areas of water stress are developing new ways of modifying water demands in partnership with the Environment Agency and water companies. Many water companies are offering free water audits and free repair of leaking supply pipes, largely in response to regulatory and political pressure.
- In the transport field, the government has recently given its backing to 'Green Commuter Plans' in which employers aim to promote alternatives to car-based journeys to work. Increasingly extra demands are placed on particular types of users as the network providers seek to develop new ways of balancing supply and demand on their networks.
- Demand side activities present considerable public relations opportunities for infrastructure providers in various sectors through being environmentally responsible or providing good customer service.

2. RDM and Sustainable Development

2.1 The Agency's Role in Promoting Sustainable Development

The Environment Agency has a duty to contribute to sustainable development. Section 4 of the Environment Act 1995 defines the principal aim of the Agency as follows:

It shall be the principal aim of the Agency (subject to and in accordance with the provisions of this Act or any other enactment and taking into account any likely costs) in discharging its functions so to protect or enhance the environment, taken as a whole, as to make [a] contribution towards attaining the objective of achieving sustainable development [...].

The concept of sustainable development is defined in the Government's consultation on sustainable development [1] as ensuring a better quality of life for eveyone, now and for generations to come.

From this definition it is clear that economic, environmental and social factors are central to sustainable development.

The Agency has an internal guidance document setting out how the organisation interprets its duty to contribute to sustainable development. It expands on what sustainable development means in general terms, what it means in more specific terms for each of the Agency's functions, and presents a set of principles and techniques that should guide the Agency in implementing its sustainable development duty.

Section 2.2 below presents evidence for how RDM can contribute to promoting sustainable development. However, it is also important to consider the principles and techniques that the Agency has developed in pursuit of sustainable development, in order to identify which principles or techniques might also apply to RDM.

Box 2.1 below presents the Agency's 13 principles and techniques for sustainable development, highlighting in italics those which are of particular importance to RDM. The relevance of these is as follows:

- *Collective action* – RDM by its nature requires action from many different groups (regulators, utilities, consumers, industry, agriculture etc).
- *The polluter pays principle* – ensuring that users pay the full costs of services or resources is an important tool for RDM.
- *Taking a holistic approach to environmental objectives* – means considering the environment as a whole, and integrating different functions of the Agency across traditional barriers. The opportunities presented by the Agency's integrated status are important for RDM.
- *Working with a long-term perspective* – is also important in developing an RDM approach, since there are large sunk costs in existing infrastructure and shifts in practices are inevitably long term.
- *Contributing to the protection of the global atmosphere* – is one of the main motivations for RDM in the energy sector.

BOX 2.1 PRINCIPLES AND TECHNIQUES FOR SUSTAINABLE DEVELOPMENT

- *Because the environment is shared, collective action is necessary*
- Decisions should be based on the best possible scientific information and analysis risks
- Where there is uncertainty and potentially serious risks exist, precautionary action may be necessary.
- Ecological impacts must be considered, particularly where resources are non-renewable to effects may be irreversible
- *Cost implications should be brought home directly to the people responsible – the polluter pays' principle*
- *A holistic approach should be taken to environmental objectives*
- *A long term perspective should be taken*
- Biodiversity should be conserved and enhanced and natural heritage protected
- *A contribution should be made to protecting the global atmosphere*
- *The scope for reconciling the needs of the environment and those of development with regard to regulated organisations should be investigated*
- *Close and responsive relationships should be developed*
- High quality information and advice should be used by the Agency and provided to others
- Judgements will have to be made about the weight to be put on these factors in particular cases

Source: Environment Agency, *Introductory Guidance on the Agency's Contribution to Sustainable Development*, Environmental Strategy Directorate, December 1996

- *Reconciling environment and development for regulated organisations* – there may be winners and losers as a result of RDM policies, but overall RDM should enable similar services to be provided at lower cost, thereby (in general) enhancing the environment without slowing economic development.
- *Close and responsive relationships* – between the Agency and its stakeholders are particularly important if RDM is to be successful (because of the need for collective action – see above).

A set of principles for RDM similar to the Agency's principles for sustainable development is elaborated in *Section 4*. However, this initial analysis suggests that sustainable development and RDM are mutually reinforcing in both their objectives and the principles by which they may be implemented.

(1) Opportunities for change, consultation paper and revised UK strategy for sustainable development.

2.2 The Effectiveness of RDM for Sustainable Development

RDM enables the same or similar service to be delivered to customers using fewer resources (although not necessarily at the same price). Most water efficiency measures aim to deliver the same functionality to their users but with less water: toilet flushing, washing, and irrigation are all areas where water-efficient equipment can deliver the same function with less water than conventional equipment. 'Doing more with less' is likely to achieve both environmental and economic benefits in most circumstances.

This argument suggests that RDM, like the related concept of 'eco-efficiency', may offer an important contribution to sustainable development, providing that economic and environmental benefits are not achieved at unacceptable social costs. Measures which reduce demand by pricing services whose marginal cost to the customer was previously zero (such as the introduction of variable charging for household waste) are particularly likely to have adverse distributional impacts.

This section presents some of the evidence that RDM approaches can promote sustainable development in water resources, energy and (solid) waste management.

2.2.1 *Water*

The former NRA's 1995 consultation document 'Saving Water' illustrates the potential for water demand management measures. About 80% of resource-relevant abstractions in England and Wales are for public water supply, and of the total put into distribution, it is estimated that over 20% could be saved by cost-effective demand-side measures such as better leakage control, low flush WCs, urinal controllers and efficient washing machines. All these measures are calculated to be less expensive than the equivalent resource development costs (although some analysts have questioned this conclusion) [1] . On financial grounds alone the scope for RDM is thus large; environmental benefits are likely to be correspondingly important, especially as resources become more stressed. An indication of the potential environmental benefits of RDM measures is provided by the NRA's 1994 water resources strategy (*Water – Nature's Precious Resource*) which found that with low demand growth and increasing demand management, no strategic water resource developments would be needed for 30 years. Other net environmental benefits are also likely to be experienced as a result of less abstraction and the resulting improvement in river flows in times of water scarcity [2] .

Box 2.2 presents a case study of a successful RDM programme in the USA. Other case studies from the USA [3] indicate favourable benefit-cost ratios for RDM programmes, even excluding environmental costs, combined with deferral or indefinite postponement of planned supply enhancements. The success of such programmes is unlikely to be replicable on the same scale in the UK, where domestic demand is much lower and institutional arrangements are different, but they nevertheless offer an indication of what can be achieved.

The efficacy of domestic metering as a means of reducing demand for water, and especially peak demand, is largely established: 'all the evidence, from Britain and abroad, shows a significant and enduring impact effect from a switch to domestic metering'. [4] Results of the UK national metering trials indicate a fall in average annual demand of 10.8%; peak monthly, weekly and daily demands are reduced by 25-35% in hot summers, with lesser reductions in wetter summers (reflecting the concentration of largely luxury outside use during certain times in summer).

The concerns about domestic metering focus on its acceptability in political terms and its distributional impacts on those who might not be able to afford to pay for water. Here, too, the evidence suggests that metering is likely to have relatively little impact: a 1993 study for OFWAT by the Institute of Fiscal Studies [5] found that, of a number of different options for domestic water pricing, metering would hit the poorest 10% of the population least hard, with the average household in the bottom decile losing only about £2 per annum (in 1991-92 prices). Nevertheless, it is clear that the social impacts of water metering are of considerable perceived importance and that tariff structures must be designed to avoid regressive effects.

(1) eg UKWIR/Environment Agency (1996), Economics of Demand Management, Main Report, p. 76.

(2) There is at least one exception to this rule, however. Where water is abstracted from a resource-rich catchment, used, and then returned to another where water is scarce, reducing water use in the former catchment may result in a net environmental cost.

(3) Water Demand Management Centre (1996), Final Report: Water Conservation Planning USA Case Studies Project.

(4) Herrington, P. (1997), 'Pricing Water Properly', in O'Riordan, T. (Ed.), *Ecotaxation*, Earthscan, 1997, pp. 263-286.

(5) Institute of Fiscal Studies (1993), *The Distributional Effects of Different Methods of Charging Households for Water and Sewerage Services*, OFWAT, cited in Herrington, P. (op. cit.). The result cited here must be interpreted with caution, since it masks the differential impacts on different types of low-income household: single pensioners, for instance, would generally gain from the shift to water metering, whilst families could end up paying substantially more.

BOX 2.2 CASE STUDY: MASSACHUSETTS WATER RESOURCES AUTHORITY

The Massachusetts Water Authority (MWRA) supplies water and sewerage services to nearly 2.5 million people in the metropolitan Boston area. It was created in 1984 as a public authority to improve the planning and management of wholesale water and sewerage services in metropolitan Boston, serving 47 municipally-owned water utilities and 43 municipal sewerage utilities. The Act which created the MWRA included a statutory objective to promote water conservation.

In the mid-eighties when the MWRA was established, the annual average safe yield for the system was 1136 Ml/day. Demand often exceeded this safe yield by over 100 Ml/day and was forecast to rise at 1.6 percent per annum to reach 1744 Ml/day in 2020. In 1986, the MWRA was therefore faced with the choice of developing large-scale, costly water supply and treatment programmes, or adopting a demand-side approach. The scale of leakage from the system (48% of distribution input unaccounted for in 1987), and the high level of domestic water use (over 265 litres per capita per day), made a demand-side approach attractive.

Following trials, it was established that a demand side approach would be cost-effective. The resulting strategy consisted of the following elements to provide users with incentives to implement demand-reducing measures:

- *improved metering and monitoring* of flows in distribution, to assist in management of leakage and of utilities buying water from the MWRA;
- *encouraging conservation pricing* and banning utilities from using declining block tariffs – in 1995 nearly half of the utilities served by the MWRA used inclining block tariffs, with only one using a fixed fee (99% of water users in the MWRA area are metered);
- including *demand management criteria in utility contracts* for the bulk purchase of water, eg conditions on pricing and participation in RDM programmes, etc. (although it is not clear how well this is enforced);
- providing technical assistance to enable large industrial-commercial-institutional organisations to carry out *water efficiency audits* (including projects delivering combined water and energy audits in conjunction with local electricity utilities); and
- *public information and outreach*, including work in schools. The aim of the programme was as much to achieve public support and participation as to induce behavioural change.

The following measures were directly implemented:

- *leak detection and repair*, requiring utilities to conduct leak detection surveys at least every two years, and assisting them to do so, with the aim of reaching leakage targets;
- a *domestic device retrofit programme*, achieving 6-8 percent water savings in the 340,000 households that took part, at a total cost of about £18 per household; and
- 1000 *low flush toilets* given for installation in public buildings.

Since the programme was initiated in 1987, system demand reductions total nearly 300 Ml/day, or about 23% of current distribution input. 39% of this reduction is attributable to better leakage control. The costs have not yet been precisely determined, but it is clear that the benefit-cost ratio exceeds four (based on the avoided financial costs of supply options against the costs of the programme to the utility). The environmental costs of major supply options would also have been significant, as indicated by the public opposition to them, when they were initially proposed.

Source: Water Demand Management Centre (1996), *Final Report: Water Conservation Planning USA Case Studies Project.*

It is also worth noting that the absence of domestic metering may provide water companies with an incentive to reduce final demand. Where customers are paying for connections rather than quantities consumed, greater profits can be made by delivering less water. This may be a more effective way of encouraging demand reductions where there are information constraints which limit consumer action.

2.2.2 *Waste*

The scope for environmental and economic benefits from RDM in the waste sector are also well-documented. In relation to household waste, it is apparent from international experience that the introduction of variable charging is a powerful tool for encouraging the reduction of waste for final disposal, raising recycling rates and, to a more limited extent, encouraging waste minimisation. For instance, one study from the United States (where there are now over a thousand unit pricing schemes in operation) found an

average reduction of 40% in the tonnage of waste sent for final disposal in 21 US cities, following the introduction of unit pricing [1]. It is important to recognise, however, that unit pricing cannot stand alone as a policy measure: it must be introduced alongside other measures to give people opportunities to reduce the cost of their waste, such as better waste minimisation, recycling and composting facilities. (The same conclusion also applies where water metering is introduced.)

Experience of industrial waste minimisation in the UK has also amply demonstrated the scope for measures with both environmental and economic benefits. In March 1992, prompted by a report from the Centre for Exploitation of Science and Technology (CEST), a waste minimisation project was launched in the Aire and Calder valleys with £400,000 provided by HMIP, the NRA, Yorkshire Water, the BOC Foundation for the Environment and the participating companies themselves. Total annual savings of £3.3 million were eventually realised at 11 sites from 671 measures. The Aire and Calder experience resulted in a large number of similar follow-on initiatives; one of these, Project Catalyst in Merseyside, identified potential annual savings of £8.9 million at 14 firms based on measures with payback periods of no longer than a year. *Box 2.3* presents the experience of one such scheme in more detail.

2.2.3 *Energy*

There has been considerable controversy surrounding the experience of RDM in US electricity markets. Some commentators have suggested that methodologies associated with the estimation of savings are not robust, and in particular that *ex ante* predictions of savings were often not realised in practice – but that this failure was not picked up because of the absence of adequate *ex post* evaluation.

The balance of evidence, however, appears to suggest that utility-sponsored demand-side management in the US was generally cost-effective in financial terms (leaving aside any consideration of environmental externalities). The Energy Information Administration (EIA) has collected data on utilities' RDM activities since 1989. It is clear from the EIA's figures that the scale of RDM activity in the US has been impressive: over 200,000 GWh of energy savings in the period 1989-1994, with energy savings in 1995 equal to the equivalent of 1.9 percent of annual electricity sales to final consumers, and $2.4 billion spent on utility-sponsored RDM in that year.

The question, however, is whether these savings are cost-effective. A number of evaluations based on *ex post* assessments and/or large data sets, and therefore thought to be more reliable than previous assessments, appear to indicate that utility-sponsored RDM has been cost-effective. [2] Total resource costs of US$0.04-0.06 per kWh are typical, generally less than the long-term avoided cost of supply (although not less than short-term avoided costs for utilities with an excess of supply, which are only about US$0.02-0.025 per kWh).

The overall conclusion from the US experience is therefore that the programmes probably were cost-effective overall. However, given the inadequacies in some utility-sponsored RDM programmes, the potential for savings may be greater than that which was observed in practice. *Box 2.4* presents a case study of a joint programme initiated by gas and water utilities in the Las Vegas area, to replace inefficient shower-heads with low-flow substitutes, in which the anticipated cost-benefit ratio was extremely high. The emergence in the UK of utility companies providing water and energy to the same customers points to the possibility of introducing similar measures in the UK.

(1) Miranda, M.L., Everett, J.W., Blume, D. and Barbeau A.R., Jr (1994), 'Market-Based Iniatives and Residential Municipal Solid Waste', in Journal of Policy Analysis and Management, Vol. 13, No. 4, 1994, pp.681-698. The literature on variable waste charging does not appear to report problems of gains being lost as the initial impact of charges on household behaviour wears off, but this may reflect the relatively short time for which most unit pricing schemes have been in existence.

(2) Nadel, S. and Geller, H. (1996), 'Utility DSM – What have we learned? Where are we going?' in Energy Policy, Vol. 24, No. 4, April 1996

BOX 2.3 THE LEICESTERSHIRE WASTE MINIMISATION INITIATIVE

One of the earliest waste minimisation projects in the UK was the Leicestershire Waste Minimisation Initiative (LWMI), in which potential savings totalling £3 million were identified among 10 companies. The project aimed to demonstrate and disseminate the commercial as well as the environmental benefits of waste minimisation, and was sponsored by:

- the former Waste Regulation Section of Leicestershire County Council;
- the former NRA (both now part of the Environment Agency);
- the BOC Foundation for the Environment;
- Leicestershire TEC; and
- Severn Trent Water.

In the first year of implementing waste minimisation projects (1993), savings through lowered waste disposal and resource costs were £0.75 million, rising to £1.3 million in the second year. Environmental benefits included a 10% reduction in water use and effluent generated, and a halving of air emissions and solid waste to landfill.

One of the participating companies was a major manufacturer of snack foods. The company originally thought waste generation not to be a significant problem but a three-week analysis of material consumption and waste streams showed that the site was producing nearly 1300 tonnes of waste per annum at a cost of £940,000. Three waste reduction programmes brought a reduction in waste of around 375 tonnes per annum, with associated financial savings of nearly £180,000 per annum – a 30% reduction by weight, and a 20% saving by value. Further savings were realised when a few factory was built on the site.

Following the success of the LWMI, a dissemination programme was launched in 1995, focusing on demonstrating the benefits of waste minimisation techniques to small and medium-size enterprises (SMEs) in the East Midlands. More than a hundred companies and business support organisations from a wide cross-section of industry attended seminars where representatives of the participating companies shared their experiences. The seminars were followed by six one-day training workshops attended by 53 companies.

Source: *Environment Agency (1997), 'Waste Minimisation'*
(annex to 'The Agency's Contribution to Sustainable Development')

3. Review of UK and International Experience of RDM

3.1 Water

3.1.1 *International Experience*

One of the roles of the Environment Agency's Water Demand Management Centre (WDMC) is to collate international experience in relation to water demand management, and the former NRA's consultation report 'Saving Water' incorporates a review of international experience in the area. The principal conclusion of this review is that, whilst there have been significant developments worldwide in water demand management, they are often on a piecemeal basis: 'Few countries appear to have coherent national strategies covering the whole range of demand management options'. The exceptions cited are Canada and Israel, but no lessons for England and Wales are drawn out from their experience. National strategies notwithstanding, there is nevertheless a wide range of countries in which water demand management is a major issue and which could provide a fertile source of ideas for UK initiatives.

For instance, a demonstration township has been successfully developed in South Africa to show what is possible by incorporating best practice water demand management measures in land use planning and building design. A number of ideas that are considered radical in the UK context are in common use elsewhere (such as the use of treated effluent for irrigation in the United States). In some cases, this may reflect a valid difference between conditions in the UK and those elsewhere; in others, it may reflect poor understanding of the potential for water-saving measures (and their true costs).

The WDMC has also commissioned specific work examining water conservation planning in the United States,[1] where there is a substantial body of experience of water demand management approaches dating back twenty years or more. The conclusions of this work, assessing the relevance of the US experience to the UK, are summarised in *Box 3.1* overleaf.

(1) Demand Management Centre(1996),
Final Report: Water Conservation Planning USA Case Studies Project, June 1996.

BOX 2.4 JOINT UTILITY LOW-FLOW SHOWER HEAD PROGRAMME

At the end of 1994, gas and water utilities came together to offer a highly effective programme of replacement shower heads in the Las Vegas area. Southwestern Corporation is a private company providing gas in the Las Vegas area; the Las Vegas Valley Water District (LVVWD) supplies water in the area. The programme aims to replace existing inefficient shower heads by exchanging them for new, more efficient units, selected through a tendering process with manufacturers.

There are about 77,000 hotel rooms in the area, of which more than 85% were built prior to a low-flow shower head building requirement. The programme is targeting 65 hotels with just under 60,000 rooms, all of which have high occupancy rates. It is estimated that around 6,500 units should be replaced each year at an average cost of $15 each. Hotel managers are offered a choice of two units, at no charge, and are required to fit them within 60 days.

The ex-ante case for the programme is strong: the benefits of avoided supply costs are estimated to exceed the total costs of the programme by 45 times, achieving annual energy savings of 33 GWh of natural gas and water savings of over 380 megalitres. This benefit-cost ratio is particularly impressive given the low avoided costs of Southwestern Corporation.

Southwestern is able to earn a rate of return on RDM investments, and recover the lost margins resulting from them by increasing its prices to offset the losses. This approach leads to fears that prices will rise for customers who have not benefited from the programme; Southwestern, however, believes that overall growth in the commercial sector and the more efficient utilisation of its transmission and distribution system will offset the lost sales associated with the programme.

Source: National Association of Regulatory Utility Commissioners (1995),
Gas Integrated Resource Planning and Demand-Side Management: A Compendium of Case Studies.

One question of considerable importance that is not addressed in 'Saving Water' is whether demand management measures can stabilise water consumption and thereby 'de-link' water consumption from economic growth. Herrington has recently presented an international review of experience in per capita demand, (1) analysing in particular the experience of Denmark, Germany and the Netherlands:

- in Denmark, demand appears to have stabilised as the result of a 65% increase in the costs of water services over the period 1983-92;
- in Germany, the industry reports 'a general decoupling of water consumption from economic growth', partly as a result of price increases, but also because of the growth of a strong 'green consciousness' in both water use and the design of water-using appliances; but
- in the Netherlands, evidence from diary studies by the water industry association suggests a large increase in domestic use from 1980-92 (primarily as a result of greater ownership and use of more water-intensive showers). More recent evidence, however, suggests that per capita consumption is now falling. (2)

Herrington concludes that 'in the absence of demand management, domestic demands will continue to rise at a substantial rate; however, in those countries recently showing a levelling off, it seems that economic factors may have been at work'.

(1) Herrington, P. (1997), 'Pricing Water Properly', in O'Riordan, T. (Ed.), *Ecotaxation*, Earthscan, 1997, pp. 263-286.

(2) According to figures published by VEWIN, the water industry association in the Netherlands.

BOX 3.1 RELEVANCE OF US DEMAND MANAGEMENT EXPERIENCE TO THE UK

- (Universal) metering is considered an essential demand management tool in the US.
- The opportunities for water savings in the UK may not be comparable to the US experience, where initial water consumption was generally much higher.
- The largest and most reliable savings in the US were associated with hardware (ie fixture retrofit and replacement measures) – education alone is not enough. US water efficiency standards for plumbing fixtures have recently caught up with and now exceed UK standards.
- Some of the efficient landscape irrigation programmes adopted in the US may be helpful in reducing the rise in outdoor water use currently being experienced in some parts of the UK.
- The US water industry appears to be more sensitive to political pressure to consider demand management options as many water suppliers are municipally governed or regulated by cost-conscious elected officials.
- The structure of the UK water industry is much more concentrated than the US industry (with about 60,000 water systems) – this could present either opportunities for, or resistance to, the introduction of demand management policies and measures.

Source: WDMC, *Final Report: Water Conservation Planning USA Case Studies Project*, June 1996

3.1.2 *UK Experience*

Spurred in part by the droughts of 1988-92 and the hot summer of 1995, water resources and demand management have attracted considerable attention from the public and policy makers alike in the last five years. *Table 3.1* presents the key developments in water resources and demand management policies since 1993. From the table it is clear that over this time, a great deal has been said about water demand management; until recently, however, few new initiatives had been announced.

Three of the most important developments in the regulatory environment over this period have been:

- recognition by the former NRA that demand management must play an important role in a national water resources strategy, and could help to prevent the need for any strategic resource developments over the next 30 years;
- the introduction in the Environment Act 1995 of a duty on water undertakers to promote the efficient use of water by companies, and the consequent action by OFWAT requiring water companies (in June 1996) to submit water efficiency plans; and
- the 'Water Summit' held by the new government within weeks of gaining office.

At the summit the incoming Government pledged to review both the abstraction licensing system and the means by which water users are charged (the water charging system).

TABLE 3.1 IMPORTANT DEVELOPMENTS IN WATER DEMAND MANAGEMENT IN THE UK

Date	Publication / Event
June 92	*Managing the Drought and Water Resources*, National Rivers Authority Board statement. This statement was issued at the height of the 1988-92 drought, and was one of the first public indications of the NRA's commitment to demand management over supply augmentation. It stated the principle that the NRA would not grant licenses for new sources where water companies were not reducing leakage or carrying out effective demand management; and also that existing licenses would be amended or withdrawn where low flows could be shown to be due to excessive abstraction. Another important principle included in the statement was that in the long term, users should have enough water for their reasonable needs, but that they must be prepared to pay the real economic cost of water, defined to include the costs of environmental protection.
July 92	*Using Water Wisely* – A Consultation Paper, Department of the Environment and the Welsh Office. This paper aimed to consider, and initiate debate about, the scope for reducing demand for water as an alternative to major works to increase supply. It examined how water is used, how water resources are managed and the options available to augment them. It also presents in some detail a range of measures to cut waste and reduce demand, including economic instruments. A final strategy paper was published in August 1995 (see below).

Date	Publication / Event
June 93	*Water Demand Management Centre (WDMC) established,* National Rivers Authority Southern Region. The Centre was established to provide a focus for the then NRA's research work in relation to demand management, to disseminate information and advice to the NRA's Regional and Area offices – as well as to others concerned with water demand management. An important element in the dissemination strategy has been the publication of the Demand Management Bulletin. The Centre has operated with relatively little resource (fewer than the equivalent of 2 full time staff) until the recent review associated with the formation of the Environment Agency. The WDMC successfully made a case to continue in existence and has been allocated six full time posts.
Mar 94	*Water – Nature's Precious Resource (An Environmentally Sustainable Water Resources Development Strategy for England and Wales),* National Rivers Authority. This was the first national water resources strategy since 1973, and recognised for the first time that demand management had a significant role to play in such a strategy. The document sets out three different demand scenarios. On the low demand scenario – which reflects significant, but achievable demand management – it was concluded that no strategic developments would be required for the next thirty years.
July 95	*The Environment Act,* 1995. The Environment Act amended Section 93 of the Water Industry Act 1991 to impose a duty on water undertakers to promote the efficient use of water by their customers; and gave the Director General of Water Services the power to require water undertakers to take such actions, including the power to set overall standards of performance.
Aug 95	*Water Conservation – Government Action,* Department of the Environment and the Welsh Office. This strategy paper was developed following the publication of a consultation paper entitled *Using Water Wisely* in July 1992. The document set out the Government's position on a number of important issues, including: • *metering* – 'companies should extend the use of meters as far and as quickly as possible'; (1) • *abstraction charges* – in 1992 the Government announced its intention to publish a discussion paper on the possibility of introducing incentive charging and more flexible licensing arrangements for water abstraction in England and Wales: • *water bylaws* – deal with water supply installations within a customer's property: these are now set by the Secretary of State with guidance from the Water Regulations Advisory Committee. (2)
Sept 95	*Saving Water – The NRA's approach to Water Conservation and Demand Management,* National Rivers Authority. This consultation report reviews current water conservation and demand management practices in the UK and overseas, and presents indicative calculations of the potential for saving water in England and Wales. It considers elements of a water conservation and demand management strategy, possible responsibilities, and how such a strategy might be put into practice.
June 96	*Water Efficiency Plans,* Water Companies and OFWAT. Using its new powers under the Environment Act, OFWAT required water companies to submit water efficiency strategies to it by October 1996. The letter from the Director suggests a number of points which companies should bear in mind, including leakage control policy, the development of tariff structures to encourage water efficiency, customer metering in general and high water users (eg sprinkler users) in particular. Examples of company initiatives providing free meters and free repair of customer supply pipes are cited as indications of best practice.
Oct 96	*Water Resources and Supply: Agenda for Action,* Department of the Environment and the Welsh Office. This report reviews the current situation but adds little to it. The Government indicates that it is satisfied that the basic legal framework for the management of water resources is sound. The principal role envisaged for the Environment Agency is in developing and updating national and regional water resources strategies in consultation with the water companies, as well as being 'fully involved' with water companies' new resource development plans.
Nov 96	*Water Conservation and Supply – First Report of the House of Commons Environment Committee.* This report covers a very broad range of issues under seven terms of reference, as follows: • trends in the demand for water services, and in the capacity of water suppliers to meet those demands; • the extent of leakage and waste in both company and customer water distribution and supply systems; • an assessment of options for influencing trends in water use and losses, in both environmental and economic terms;

(1) It was however recognised that this process had not proceeded as rapidly as envisaged at the time of privatisation, and that provision would therefore need to be made for the continued use of rateable values as the basis for charging.

(2) The Committee has recently recommended, for instance, that a maximum flush volume of 6 litres should be permitted for WCs.

Date	Publication / Event
	• the costs and benefits of new water resource development and conservation, including large-scale water storage or transfer; • an assessment of the effectiveness of appeals for water conservation to households, business and other users; • the roles, achievements and policies of OFWAT, the Environment Agency and the DoE in relation to water conservation and supply; and • the implications for water conservation and supply of the proposed EU Framework Directive on Water. The report concludes with a large number of recommendations for the Government and others.
Feb 97	*Government Response to the Conclusions and Recommendations of the Environment Committee.* The Government response to the HoC report essentially leaves the management of water resources to the existing framework of responsibilities for the water companies, OFWAT and the Environment Agency, although it repeats the commitment to publish a consultation paper on economic instruments in abstraction charging. Specific proposals rejected by the Government are the establishment of a Water Savings Trust, and the suggestion that water companies should be given statutory responsibility for customers' underground supply pipes.
Feb 97	*Response to the Conclusions and Recommendations of the Environment Committee,* OFWAT. OFWAT regrets the failure of the Committee to support selective metering as a demand management tool, and its failure to endorse the payment of compensation by water companies for interruptions in supply as an incentive to maintain water supplies.
Feb 97	*Freshwater,* report of the UK Round Table on Sustainable Development. The Round Table calls on the Government (*inter alia*) to publish a national strategic framework for freshwater policy; to publish indicators to monitor sustainable development in water resources; to publish a new Planning Policy Guidance Note for water; for the Government to develop a national plan for saving water, including the suggestion to establish a Water Saving Trust; and for widespread metering to be introduced in conjunction with innovative tariff structures.
Feb 97	*1999 Periodic Review,* letter MD124 from the Director-General of Water Services to all water companies. The letter emphasises the role that demand management should play in companies' strategies. In considering how to regulate capital investment, it is suggested that 'the balance between leakage and demand control measures and new resources, including the use of bulk supplies, in maintaining a balance between supply and demand or enhancing security of supply' will be a consideration.
May 97	*Water Summit,* bringing together representatives of the water industry and others to respond to the government's ten point action plan. The plan is as follows: *Water companies:* • are to be given a statutory duty to conserve water in carrying out their functions; • 'must carry out with vigour, imagination and enthusiasm their duty to promote the efficient use of water by their customers'; • should provide a free leakage detection and repair service for supply pipes owned by domestic consumers; • should consider the role which the Government's Environment Task Force could play in improving efficiency of water use; • are expected to agree with OFWAT amendments to their licenses requiring them to pay compensation to customers affected by drought-related restrictions; • are expected to publish drought contingency plans agreed with the Environment Agency; and • should publish details of their performance in several areas, including water efficiency. *OFWAT:* • is to set mandatory leakage targets for total leakage (from both water companies' pipes and customer supply pipes); *The Government:* • will review the abstraction licensing system and arrangements for the bulk transfer of water; • will review the system of charging for water, including use of rateable values and metering policy; and • will make new water regulations including tighter requirements for water efficiency.

3.1.3 *The Scope for Water Demand Management*

It is now universally recognised that demand management has a vital role to play in any water resources strategy, although there is less consensus about the extent to which it can and should substitute for supply enhancement. *Section 2.2* sets out evidence of the scope for demand management measures in domestic water supply. The evidence is clear that metering must play an important part in any demand management strategy. It is important to note, however, that domestic metering is expensive: OFWAT reports average installation costs of £165 per property for internal metering, and £200 per property for the more common external meter. Given also the costs of operating meters (around £13 per year), universal metering is unlikely to be economic in areas where water is cheap. (1)

There is some evidence that industrial water use could also be reduced substantially. Research carried out for the NRA found that 'as investments are made in industrial plant and equipment there are considerable opportunities for major improvements to water efficiency at relatively little cost.' (2) The report suggests that these improvements are likely to be most cost effective when they are associated with the normal investment cycle, or investment that has to be undertaken for other reasons (such as to meet pollution control requirements). Evidence from elsewhere, however, suggests that significant savings may be made without substantial capital investment: the Aire and Calder waste minimisation project, for instance, cut industrial water use by 10-15% with water and effluent cost savings of £2.2 million. The potential for savings was at least 25% of initial water use, with most (96%) of measures having payback periods of less than three years.

Although accounting for only a small proportion of total abstractions, agricultural water use is of concern because it is highly concentrated both geographically (especially in East Anglia) and in time (over a few weeks in the summer). The use value of water to some agricultural users may be extremely high where irrigation is required to support high value-added crops (eg those being grown under contract to supermarkets or their buyers) – see *Box 3.2*. It may be possible to reduce agricultural water use significantly by reallocating it away from low value uses, but this could have important consequences for the environment by stimulating more intensive farming methods.

3.1.4 *The Proposed Water Resources Framework Directive*

The European Commission published a proposal for the Water Resources Framework Directive in March 1997. The draft Directive includes a number of provisions which could assist in the promotion of water demand management. The overall objective of the proposed Directive is to provide a framework for the protection of surface freshwaters, estuaries and coastal waters, and groundwaters which would:

- prevent deterioration of, and protect and enhance, aquatic ecosystems, as well as terrestrial ecosystems to the extent that they are dependent on water;
- promote sustainable consumption of water based on long-term protection of water resources; and
- contribute to the provision of a supply of water in the quality and quantity needed for the sustainable use of these resources.

The objectives of the draft Directive therefore include both demand- and supply-side aspects. The key provision of the proposed Directive in relation to water demand management is the requirement for water charges to be introduced by 2010 to recover the full costs of providing water services to households, industry and agriculture. The UK is cited as one of five Member States that is already well-advanced in this respect, but the Directive also provides for the Commission to bring forward proposals 'where appropriate' to ensure that the costs of environmental damage and resource depletion caused by water use are 'reflected' in water charges. If implemented, this proposal would result in the need for a much higher level of abstraction charges than currently exists; it is not clear whether it would require the universal introduction of domestic metering.

The Commission is hoping that the Directive will be implemented by the end of 1999, but this timescale appears improbable given the number of issues that it raises.

(1) Rees, J. (1997), 'Towards Implementation Realities', in O'Riordan, T. (Ed.), *Ecotaxation*, Earthscan, 1997, pp. 287-303.

(2) Rees, J. A., Williams, S., Atkins, J. P., Hammond, C. J. and Trotter, S. D. (1993), *Economics of Water Resource Management*, NRA R&D Note 128, 1993.

BOX 3.2 RESEARCH INTO AGRICULTURAL DEMAND FOR WATER

Research carried out for the NRA's 1993 R&D project on the *Economics of Water Resource Management* included a study of the agricultural demand for water in East Anglia, where the demand for agricultural irrigation is particularly strong. The researchers surveyed 72 abstraction licence holders to determine the use value associated with the water abstracted. This study, as well as the evidence of previous studies, suggested that the value in use of abstraction water for irrigation varies greatly between enterprises – some of the farmers surveyed, for instance, appeared to hold water abstraction licences as a form of insurance, or because they increase the value of the land, and so irrigate crops where the returns are marginal or even negative. This finding suggests that major efficiency gains could be achieved by reallocating available supplies between users, particularly as almost 30% of the surveyed enterprises appeared to be making lower returns from irrigation than from the potential option of dry farming winter wheat.

The researchers warn, however, that there are negative environmental consequences which might arise from a re-allocation of water from applications with a low value in use to higher value uses. This is because higher value uses tend to be associated with more intensive agricultural practices, and hence more use of agrochemicals and other resources. A re-allocation of water towards higher value uses would therefore be likely to result in an overall intensification of agriculture, in areas like East Anglia where problems associated with nutrient runoff are already serious.

Further research by Sarah Williams (a post-graduate student of Judith Rees at the LSE), has suggested that demand for irrigation in East Anglia may be increased substantially by the product specifications required for supermarkets (eg long straight carrots can only be grown in sandy soils which are prone to drought; particular requirements for baking potatoes result in a significant increase in irrigation needs). Understanding these ultimate drivers of demand is important if the Agency is to manage demand effectively.

Source: Rees, J.A. et al. (1993), *Economics of Water Resource Management*, NRA R&D Note 128; and Rees, J. A., personal communication

3.2 Energy

3.2.1 *RDM in the UK Electricity Market*

A New Culture of Electricity Provision in the UK

Following privatisation and liberalisation of the electricity network, regional electricity companies (RECs) are beginning to 'experiment' with RDM techniques. Abandoning a management strategy characterised by supply oriented engineering principles, new forms of energy service are emerging. (1) Vital to this new culture is renewed sensitivity to changing user needs and more refined product and customer differentiation. These developments are changing established assumptions about the relationship between customers and utilities and the role of utilities in the management of territory.

Signalling Change in the Electricity Sector

Utilities operating in competitive markets are keen to avoid costly supply investment. At the same time regulatory changes have weakened the demand driver (that translated increasing sales into higher levels of profit) in the regime governing prices for electricity distribution. These shifts have helped focus distribution utilities' interest on the efficiency and effectiveness of their distribution networks. Innovative RECs are therefore experimenting with new methods of network management by managing demand 'beyond the meter' through the retrofitting of energy conservation and efficiency measures. The Office of Electricity Regulation (OFFER) has encouraged this process by granting the RECs an 'energy efficiency' revenue allowance of £1 per customer to fund energy efficiency projects. Over four years this will finance nearly £100 million of new expenditure on energy efficiency. (2) At the same time new 'standards of performance' have been introduced to monitor energy efficiency spending. Total energy efficiency expenditure of the RECs will be expected to save over 5,000 gigawatt hours (GWh) by 31st March 1998. These 'standards' will be monitored by the Energy Savings Trust. (3)

(1) Redford, S.(1994) Management of Demand, Electrical Review, Vol.227, No.4, pp24-26.

(2) OFFER (1993) Annual Report

(3) OFFER (1994), Energy Efficiency: Standards of Performance

Driven by increasing levels of competition, RECs are also allocating costs more directly to different classes of customer and targeting value-added energy services towards more profitable customers. RECs are currently considering ways of utilising new smart metering technologies to create distinct packages of energy services. Many RECs are also diversifying into new energy services by offering 'shared-savings' schemes through which RECs can reduce the necessary capital investment of the user while ensuring returns on their own capital outlay. (1)

It is, therefore, important to raise the question of who is best placed to drive RDM initiatives: a separate body (such as the Energy Savings Trust), funded by a levy and with a clear objective to promote RDM; or RECs and others who are most closely involved in the energy business but have mixed objectives. There may also be scope for both mechanisms to co-exist.

Emerging Practices of Electricity RDM

Electricity RDM has to be seen as an 'emerging logic' of network management. Some RECs are innovative and experimental, others are more traditional and cautious. Manweb (now Scottish Power) is an example of an innovative company with a positive attitude to RDM as exhibited by their Holyhead 'Powersave' scheme. Here, with only two 33 KVA sub-stations meeting a peak demand of around 9 megawatts, growing 2% per year, expensive network re-enforcement, consisting of a new transformer and cables costing roughly £1 million, seemed inevitable. However, by reducing demand peaks by one megawatt through RDM techniques costing £0.5 million this infrastructure investment was avoided and a saving of £430,000 was made. Other benefits accrued in terms of reduced refurbishment outlay and beneficial publicity. Manweb is now taking a keen interest in the demand profile of different classes of consumer and on the basis of this information has offered particular customers energy audits and shared finance retrofitting of energy efficient appliances. Manweb hope this will have the twin impact of developing increased 'brand loyalty' as competition increases, at the same time as allowing closer control over network planning.

It is also important to recognise that there are still strong incentives for generating companies to improve profitability by selling more electricity; whilst the imminent arrival of competition in the supply of electricity to the UK's 25 million retail customers also raises the question of whether price competition will lead to greater overall sales of electricity.

3.2.2 *Integrated Resource Planning in the United States*

The United States has a long history of RDM in the energy sector (electricity and gas). In considering what lessons the US experience may hold for the UK today, it is important to understand the institutional and commercial differences between energy provision in the two countries. Both have well-developed electricity supply infrastructure; gas supply and distribution infrastructure, however, has historically been less developed in the US. The US utilities were not nationalised in the way that they were in the UK prior to privatisation and a wide range of ownership structures exists – however, the electricity industry today mostly consists of private companies.

The State Public Service Commissions (PSCs) are charged with regulating (*inter alia*) the provision of electricity, gas and water. This geographically, rather than industry, based approach to regulation contrasts with the UK regulatory environment, in which regulation of each of these industries falls to a separate national body (or bodies). One of the most important results of the US regulatory structure has been the ability for different States to adopt different approaches, and hence the emergence of a diverse body of experience.

Integrated Resource Planning (IRP) in the United States traces its roots back to the mid-1970s, when both Federal legislators and State public service commissions developed policies in response to two related factors: rising demand for electricity, greater capital costs and higher electricity prices; and growing public awareness of the need and opportunities for energy conservation particularly in response to fears about rising oil prices and the price shocks of 1973 and 1979. Building on three major items of Federal legislation which laid the technical basis for RDM programmes, (2) the Public Utilities Regulatory Policies Act of 1978 required State PSCs to consider price-setting regulatory approaches that encouraged end-use conservation, utility efficiency and equitable prices.

(1) Owen, G. (1994), From Energy Supply to Energy Services, Energy Savings Trust

(2) The Energy Policy and Conservation Act (1975), the Energy Conservation and Production Act (1976), and the National Energy Conservation Policy Act (1978).

Integrated Resource Planning emerged as the major tool used by PSCs in discharging this function, and the role of IRP in the regulation of utilities was confirmed by the Energy Policy Act of 1992, which required the PSCs to consider regulatory frameworks that, in turn, required utilities to employ IRP. The Energy Policy Act also, however, introduced greater competition in bulk electricity supply, and signalled the beginning of a process of fundamental restructuring in energy markets which is still continuing. Again, much of this process is driven from the State rather than the Federal level. The introduction of greater competition in electricity markets, and the concurrent move away from vertically integrated industry structures, has meant that 'traditional' IRP frameworks are under strong pressure to adapt to the new commercial realities.

IRP as a Regulatory Tool

Integrated Resource Planning developed as a means of requiring electric utilities to consider supply augmentation and demand management options on an equal footing; in some cases, it even led to a presumption in favour of DSM. It was implemented in a relatively stable commercial environment by large, vertically-integrated electricity supply companies, who were typically required to file plans with the State PSC, which had powers to require changes if the plans did not adequately demonstrate the application of IRP principles.

In this context, a number of States required utilities to introduce DSM programmes to encourage the uptake of energy efficiency and load management measures. Utilities were often expected to bear most of the costs of programme implementation, with various mechanisms by which the companies could recoup the costs of the programmes: both the capital costs of the measures, and the reduction in the company's revenues resulting from reduced demand. (1)

Electric utilities had an incentive to invest in new capacity as their revenue was constrained by an allowed rate of return on capital. The solution was to make expenditure on demand side management an allowable cost in the rate of return calculations.

DSM measures can be classified into the following categories:

- *Energy efficiency programmes* – reducing energy use during both peak and off- peak periods, without affecting the quality of services provided;
- *Peak load reduction programmes* – reducing load during periods of peak power consumption on a utility's system or in selected areas of the transmission and distribution grid: techniques used to reduce peak load include interruptible load tariffs, time-of-use pricing, direct load control and other load management programmes; (2)
- *Load shape flexibility* – similar techniques are used to manage loads outside peak load periods in response to minute-by-minute changes in power costs or resource availability; and
- *Load building programmes* – cannot truly be termed DSM since these aim to build demand for electricity, but they may be used to increase load during off-peak periods and thereby improve the utilisation of capital.

In 1995, a third of the 3,199 electric utilities in the US reported having DSM programmes, and these together accounted for 85% of the total retail sales of electricity in the US. Energy savings attributed to DSM in 1995 accounted for 1.9 percent of annual electricity sales to ultimate consumers. (3) Costs attributed to DSM programmes in 1995 were $2.4 billion. A recent analysis has suggested that large utilities have demonstrated a capability to undertake highly cost-effective large energy efficiency programmes in the commercial sector. (4) Some commentators, however, have suggested that ex-post validation of the success claimed for DSM programmes has often been inadequate to substantiate these claims. (5)

(1) In 1993, about 35 States had mechanisms in place to compensate utilities for DSM programme costs and lost revenues. Reported in National Association of Regulatory Utility Commissioners (1993), *Incentives for Demand-Side Management*, Third Edition, October 1993. Utilities suffer a reduction in profitability when DSM measures are introduced so long as their prices are set above short-run marginal costs, which they usually are.

(2) Interruptible load tariffs enable consumer load to be interrupted during periods of peak load, in accordance with contractual arrangements; time-of-use pricing sets different prices for electricity consumed at different times of day (real time pricing uses sophisticated metering technology to set electricity prices in real time so that prices rise as the system approaches saturation); direct load control enables the utility system operator directly to interrupt the power supply to individual items of equipment.

(3) 57,421 million kWh saved through DSM out of total annual sales to final consumers of 3,013,287 million kWh. Figures reported in Energy Information Administration(1997), *U.S. Electric Utility Demand-Side Management* 1995, US Department of Energy, Washington D.C.

(4) Eto, J. et al. (1995), *Where Did the Money Go? The Cost and Performance of the Largest Commercial Sector DSM Programs*, Berkeley, CA: Lawrence Berkeley National Laboratory, December 1995

(5) London Economics (1994), *Demand-Side Management* – A survey of US experience, OFGAS, December 1994.

A number of States have also required the explicit incorporation of environmental externalities in the integrated resource planning process. A recent report for the Energy Information Administration, however, suggests that this requirement 'had negligible impacts on the planned resource mix' in each of the three States studied. (1) Among the most important reasons why this has been the case are low natural gas prices, little need for new capacity, the lack of experience of renewable energies in the utilities studied, and difficulties which arise where utilities operate in more than one State.

IRP in Competitive Markets?

With the liberalisation of energy markets since the Energy Policy Act of 1992, 'traditional' IRP (ie IRP as a regulatory framework operating in highly regulated markets) has disappeared or is disappearing fast. Although not all public service commissions have formally abandoned IRP, all are reported to have done so informally. It simply is not possible to use the 'traditional' IRP regulatory framework, developed largely for regulating local vertically-integrated monopolies, in a context where generation, distribution and supply functions may be performed by different companies and electricity is a traded commodity.

However, IRP may continue to be used as an internal planning technique by some utilities; and, as in the UK, it appears that some utilities are beginning to integrate DSM activities into the core business as part of a package of energy services:

In today's competitive climate, [utilities] see themselves as low-cost providers of the highest value-added services, with a keen understanding of customers needs and wants. Defining their role within this context, value-added service could include functions described as a source of information, a coordinator or even manager of an energy-efficient project, and possibly even as a financier for worthwhile projects. (2)

One of the key challenges for the industry in this context is to integrate DSM activities and personnel into the core business, since they were often carried out by separate functions under the former regulatory regime.

Currently, some DSM activities are being continued, mandated by the State PSCs and funded by various forms of levy. Industry observers, however, suggest that this type of mandated DSM activity – which resulted from lobbying by environmental groups during the liberalisation process – is unlikely to survive in the medium term. Instead, non-mandated DSM activities are likely to emerge in competitive energy markets as part of packages of energy services, but (for electricity) with the focus on load management rather than energy efficiency.

In the UK, the electricity companies now have an incentive to sell as much electricity as possible. In this respect there is little difference between the current UK and US systems. The important difference between the current UK and old US systems is that the combination of RPI-X+Y price formulae and full competition in the supply business have the effect of driving down electricity prices.

The problem with the current UK system (and planned US system) is that anything which raises electricity costs will make a company less competitive and could result in loss of customers and revenue. The fundamental question is how to build incentives for the economic use of resources into a system designed to deliver cheap power through competition in supply.

The Emergence of Energy Services Companies

An interesting feature of the US experience of RDM in energy markets has been the emergence of third-party demand-management companies. These companies fall into two distinct types:

- those which bid as contractors to energy utilities to implement demand-side programmes, sometimes after a process in which demand-side 'resources' are compared with supply options; and
- independent companies (not funded by utilities) hoping to exploit the business opportunities offered by energy conservation, and using some of the savings to finance their operations. These companies are referred to here as energy services companies or ESCOs.

(1) Energy Information Administration (1995), *Electricity Generation and Environmental Externalities*: Case Studies, September 1995, US Department of Energy, Washington D.C.

(2) National Association of Regulatory Utility Commissioners (1995), *Gas Integrated Resource Planning and Demand-Side Management: A Compendium of Case Studies*, NARUC, Washington D.C.

The US experience of ESCOs has been reviewed in a report for OFGAS. [1] The report found that ESCOs offer a number of important benefits, including:

- *no cross-subsidies* – non-beneficiaries do not pay for demand management schemes;
- *correct incentives* – risks that energy savings will not materialise are not faced by a utility, but instead by companies who face the right incentives to generate the predicted savings over a long enough period of time;
- *minimisation of consumer information costs* – ESCOs develop competence in efficiency improvements which avoids the needs for consumers to do so; and
- *low regulatory costs* – since regulated revenues are not involved, regulation can be kept to a minimum.

The main disadvantage of the ESCO approach is its high transaction and contract costs, meaning that profitable contracts must be of a minimum size: it has been suggested that a saving of $50,000 is needed to make an ESCO contract viable. This constraint severely limits the scope of savings that can be made through the ESCO approach to RDM. Giving consumers adequate confidence in the ability of ESCOs to deliver on their promises has also proved problematic.

Nevertheless, the ESCO model provides an interesting example of how the private sector can be mobilised in exploiting cost-effective opportunities for demand management. There are known to be consultants offering similar water and waste minimisation services in the UK; providing support for this industry may offer an effective approach to capturing savings in some sectors.

3.2.3 *Conclusions*

The Environment Agency's role in relation to energy supply is minimal, although power stations and other parts of the energy supply infrastructure are subject to integrated pollution control. The relevance of RDM for the *supply side* of the energy sector is therefore in terms of lessons which might apply in other sectors where the Agency has greater responsibilities – notably in water (although there are important differences between electricity and water markets). There is, however, clear scope for the Agency to influence consumption of energy in some sectors – ie promoting RDM through activities on the *demand side.*

Conclusions for Supply Side Encouragement of DSM

The key lesson from the US experience appears to be that regulatory approaches which mandate integrated resource planning may be appropriate where the utilities in question are vertically integrated local monopolies, but is unlikely to be appropriate where utilities are operating in more complex and competitive markets, where supply is separated from distribution. However, there is evidence from both the UK and the US that DSM activities in the energy sector can be profitable where utilities face supply-side constraints. The extent to which DSM is pursued by the private sector is then determined by the extent to which the economic aspects of the regulatory framework encourage it. Designing regulatory regimes to favour DSM (up to the point where it is no longer economically and environmentally worthwhile) is thus vital – see *Section 4.4*. The UK experience of DSM in the energy sector bears out this conclusion.

Another point of interest is the use of an 'energy efficiency' revenue allowance with which regional electricity companies (RECs) are currently able to fund energy efficiency projects. This may represent a useful funding mechanism to promote the uptake of DSM measures, with the advantage that third-party implementation may be more effective than implementation by utilities whose incentives are to sell more electricity – and who are therefore unlikely to implement demand management well. The US experience suggests that attempting to make it in the financial interest of utilities to promote DSM is likely to be the most effective long-term strategy. Without this incentive, there is some evidence that utility DSM programmes are managed badly and with poor effectiveness.

Possible Demand Side Actions

The Agency has (or will have) a new mandate for promoting energy efficiency in industry as a result of the provisions of the Integrated Pollution Prevention and Control (IPPC) Directive: The scope for the Agency to promote industrial energy efficiency as a demand management measure is discussed in *Section 5.3.3*. It is also worth considering whether the Agency could play a role in encouraging the private sector to exploit opportunities for cost-effective demand-side measures in water and waste, along the lines of the US ESCO model.

(1) London Economics (1994), *Demand-Side Management – A survey of US experience*, OFGAS, December 1994.

3.3 Waste

3.3.1 *Introduction*

This section presents a summary of UK and overseas experience in:

- user charging for household waste; and
- industrial waste minimisation.

It also presents a summary of recent developments in relation to waste management in the UK and their implications for the Agency.

3.3.2 *User Charging for Household Waste*

User charging for household waste (ie charging households according to the amount of waste they generate) provides households with a financial incentive to minimise, reuse and recycle waste – and also, perhaps, an incentive to dump it illegally. At present, local authorities in England and Wales are not permitted, by law, to charge for domestic waste. There is, however, growing interest in the possibility of changing the law to enable user charging as a result of positive international experience in the area. At least one local authority is investigating the possibility of introducing a form of variable charging within the current legislative framework. This section briefly reviews the international experience of variable waste charging and examines the scope for the Agency to promote it in England and Wales as a form of RDM for waste disposal.

International Experience

Variable charging schemes for household waste have been reported in numerous countries including Australia, Austria, Canada, Denmark, Germany, Ireland, Korea, the Netherlands, Norway, Spain, Switzerland and the USA (where there are now well over 1000 schemes operating). Many different charging options have been used, ranging from highly sophisticated weigh-in-motion technologies which enable the contents of rubbish bins to be weighed as they are emptied, through to much simpler volume-based mechanisms, such as offering a choice of bin sizes at different costs or only collecting rubbish in 'expensive' rubbish bags.

In general, the reports of this experience are positive, showing substantial reductions in waste sent for ultimate disposal with few problems of fly tipping, burning or 'waste tourism' (in which rubbish is taken from one area with variable charges in place to another where they are not).

The clearest message from a recent literature review in the USA [1] was that unit pricing increases both recycling levels and recycling participation rates. The programmes are also likely to increase garden composting, but this is as yet unconfirmed by hard data. One study, for instance, found an average reduction of 40% in the tonnage of waste sent for final disposal in 21 US cities, following the introduction of unit pricing. This conclusion was confirmed at a recent workshop on the subject:

The international evidence presented appeared to indicate strongly that the introduction of variable charging for household waste was a powerful tool for encouraging the reduction of waste for final disposal, raising recycling rates and, to a more limited extent, encouraging waste minimisation. [2]

However, unit pricing for waste is not likely to be universally successful and relies upon a number of factors, and in particular the presence of widespread and user-friendly recycling and composting facilities, and a certain level of environmental awareness in the community concerned. It is also important to recognise that unit pricing needs to be accompanied by measures throughout the supply chain to reduce waste, so that consumers do not bear sole responsibility for changing practices. For instance, if consumers are to be given opportunities for waste minimisation, manufacturers must begin to provide low-waste products and packaging. Schemes must also be tailored to local conditions if they are to be successful (eg multi-tenancy buildings can present difficulties).

Variable Waste Charging in England and Wales

Box 3.3 overleaf presents the factors identified at the above DoE workshop that would be important in introducing variable charging in England and Wales. The overall conclusion from the workshop was that 'in spite of the potential problems, the concept of variable charging is worth exploring further'.

(1) Miranda, M. L., Bauer, S. D., and Aldy, J. E. (1996), *Unit Pricing Programs for Residential Municipal Solid Waste: An Assessment of the Literature*, report prepared for the Office of Policy, Planning and Evaluation, US Environmental Protection Agency, Washington D.C., March 1996.

(2) *Executive Summary* from the *Workshop on Variable Charging for Household Waste*, organised by the Department of the Environment and the School of Public Policy at the University of Birmingham on 5 November 1996.

Berkshire County Council, however, is already exploring taking the concept of variable charging further. At a seminar last year, variable charging was identified as an important potential element of a sustainable waste strategy for the county. The consultants who were responsible for the county's waste regulation functions prior to the formation of the Environment Agency are now developing a strategy for implementing unit pricing by providing a rebate against council tax waste costs, rather than a separate charge. The consultants are still awaiting confirmation that this approach does not present legal difficulties, but if not, it is intended to implement a pilot scheme to test the idea in practice. There are important issues to be addressed, such as how to assess a household's initial waste generation rate (against which to make a rebate), but it is thought that these can be resolved adequately enough to enable the pilot scheme to go ahead.

BOX 3.3 FACTORS TO BE CONSIDERED IN INTRODUCING VARIABLE WASTE CHARGING IN THE UK

- Cultural characteristics and the generally low awareness of waste issues in the UK mean that considerable promotional effort and political support would be required.
- A clear, flexible and tailor-made legislative basis would be necessary.
- Local authorities would have to be able to adopt schemes which suited their individual circumstances.
- Variable charging schemes could potentially entail strengthened enforcement of flytipping laws and increased effort in collecting payments.
- Secondary material markets capable of absorbing the increases in recyclable material would have to be developed.
- Reliable and cost effective charging administrations would need to be developed.
- Contractual rigidities of existing waste collection and disposal contracts would have to be eliminated.

Source: Executive Summary from Workshop on Variable Charging for Household Waste,
University of Birmingham, 5 November 1996.

If it is deemed to be legally viable, the pilot scheme would be of interest not only because it would be the first of its kind in the UK, but also because the use of rebates rather than charges would represent an alternative approach to charging of international interest. Given the Agency's role in waste management, it might be appropriate to consider a role for the Agency in supporting the pilot scheme. The Agency could also consider working with local authority associations to lobby government for a change in the law to enable local authorities to experiment with variable charging schemes.

3.3.3 *Industrial Waste Minimisation*

Section 2.2 presented the successes of the Aire and Calder waste minimisation scheme, Project Catalyst (funded by DEMOS) and the scheme established by Leicestershire County Council. Following on from DEMOS, the Environmental Technology Best Practice Programme sponsored three further waste minimisation clubs, on the basis that they offer particularly novel features. Since 1992, at least 25 regional waste minimisation projects are reported to have been launched, (1) most with some form of public support. The largest waste minimisation club to date, Environet 2000, was launched in February of this year with £5.4 million funding from the European Regional Development Fund.

However, since the economic rewards for waste minimisation are so great, large scale public funding for these schemes has been limited historically by Government policy that the onus should be on industry to exploit these opportunities. Indeed, when the potential savings are so large and payback periods so short, it is difficult to see why competitive pressures do not force firms to exploit the opportunities that are available. The main barrier to realising the savings is thought to be the lack of human resources and management time available (especially in smaller firms) for an activity that is not perceived as being core to the business.

(1) ENDS Report 265, February 1997, p.6.

3.3.4 *Other Developments in UK Waste Management Policy*

The Government's waste strategy for England and Wales, published as a White Paper in December 1995,[1] set new targets for household waste management, including the recovery of 40% of municipal waste by 2005, to accelerate centralised and home composting, and to extend the recycling infrastructure. Guidance at the end of 1995 [2] gave responsibility to the Agency for more frequent, more detailed and more methodologically robust surveys of waste arisings than had previously been carried out. On this basis, it was intended that the Agency should build up an understanding of the ability of companies to minimise, re-use and recover their wastes for advisory and planning purposes. On the basis of better data, [3] the Agency is expected to submit to the DoE recommendations for a statutory waste strategy based on the non-statutory White Paper. The Agency will also be able to use any results of life-cycle assessment research into waste management options that was passed over from the DoE when the Agency was formed.

In September 1996, the Department of the Environment published a consultation paper on waste planning which suggested an expanded role for the Agency in the planning process. [4] The core of the proposal is for regional fora to be set up, including the Agency and the waste planning authorities, working in consultation with the waste industry and others. The Agency is proposed as a statutory consultee in local authority's development plans and any proposals for the development of new waste facilities.

A group chaired by the Department of the Environment has advocated the establishment of 'municipal waste management strategies' to ensure that local waste strategies are coherent and conform to national and regional strategies. [5] The Agency could play an important role in informing the development of these strategies, although it would not itself be responsible for them.

Finally, a Private Member's Bill to enable local authorities to promote waste minimisation passed its Committee stage in the House of Commons in March, but failed to become law through lack of time. The Bill would remove fears that actions to promote waste minimisation are *ultra vires*, and has cross-party political support.

These developments in waste management policy are likely to give the Agency an important role in informing and directing waste plans and strategies for waste disposal and collection authorities, through a tiered set of strategies extending from the national waste strategy, through regional plans, to local municipal waste strategies. They may also create new fora where dialogue can take place both in relation to waste and other issues.

3.4 Flood Defence

The Agency's core function expenditure is dominated by flood defence: in 1997/98, it is planned that £260 million (48%) of the Agency's £543 million budget for its core functions will be spent on flood defence, compared to 32% on pollution prevention and control, and 15% on water resources. For financial reasons alone, it is therefore important to examine whether any of the RDM principles can be applied to flood defence.

There are at least two ways by which an RDM approach may be used to achieve economic and environmental benefits in relation to flood defence: [6]

- by increasing the ability of urban (and possibly other) areas to retain water during periods of heavy rain, so that rapid runoff may be reduced and the tendency to flood reduced; and
- by managing land use so that development does not take place in areas which are prone to flooding and hence likely to require expensive flood defences.

Both these approaches may enable 'demand' for flood defences to be managed, with consequent economic benefits. There may also be associated environmental benefits: for instance, household rainwater collection facilities not only reduce urban run-off, reducing the risk of flooding and also the risk of overflow of combined sewer systems, but also provide an additional water resource.

(1) HMSO (1995), *Making Waste Work: A strategy for sustainable waste management in England and Wales*, Cm 3040

(2) *Waste Management Planning: Principles and Practice*, HMSO.

(3) Agency R&D Project CLO201 is a review of household waste arisings in the UK, which was due to be completed in the near future.

(4) Department of the Environment (1996), Revision of PPG23, *Planning and Pollution Control*.

(5) Report of the Review Group on the Local Authority Role in Recycling, Department of the Environment, February 1997.

(6) There is an interesting parallel to demand management in flood defence in the management of subsidence damage to buildings as a result of changes in precipitation patterns. Insurance companies, in response to increased claims for subsidence damage, are seeking to minimise the impacts of prolonged dry weather by measures such as requiring the felling of trees near to insured properties.

The Agency is not responsible for overall policy on flood and coastal defence in England and Wales: this responsibility falls to the Ministry of Agriculture, Fisheries and Food (MAFF) in England, and to the Welsh Office in Wales. The Agency, however, is primarily responsible for implementing this policy, although local authorities and others also play a role.

Flood defence policy already incorporates some of the key principles of RDM, most importantly, it is recognised that:

Protection against flooding or erosion can never be absolute. A balance has to be struck between costs and benefits to the nation as a whole. For example, to attempt to protect every inch of coastline from change would not only be uneconomic but would work against the dynamic processes which determine that coastline and could have an adverse effect on defences elsewhere and on the natural environment. (1)

The Agency already has a defined role in ensuring that development does not take place where it is at an unacceptable risk of flooding. (2)

Professor John Pethick (of the University of Newcastle) has gone one stage further in developing a new approach to coastal zone management by arguing that a more active approach to 'designing' coastlines by understanding and influencing the natural processes that form them could provide a much more cost effective solution to long term coastal zone management than either the engineering or the managed retreat approaches. As an example, recent research carried out by his group has indicated that by reinstating a marshland on the Humber, the tidal range in the estuary could be reduced by one metre and savings of up to £2 billion made in avoided coastal defences over the long term. He has also criticised the fragmented approach taken to flood management, in which (for instance) the north and south banks of the Thames are managed by separate institutions.

It therefore seems that large savings *may* be possible as a result of new approaches to flood defence management.

3.5 Transport

In 1963, the Buchanan Report on *Traffic in Towns* concluded that, even with huge urban reconstruction programmes designed to increase road capacity, 'it is difficult to avoid the conclusion that for a long period ahead traffic will increase faster than we can hope to cope with it, even on the most optimistic assumptions of capital investment'. The period following the publication of the 1989 National Road Traffic Forecasts, predicting growth of 83% to 142% from 1988 to 2025, witnessed a rediscovery of this simple truth. By 1994, observers were able to say that 'over that period demand management quietly, but quickly, became part of the urban transport policy of every political party'. The Government's Green Paper on *Transport – The Way Forward* concluded that 'we need to change the way we think about transport', and a number of policy changes (such as the introduction of 'package' funding for local authority urban transport investment) indicate that this process is indeed underway. A similar change in approach has been seen in many other developed countries, as *Box 3.4* illustrates.

BOX 3.4 POLICY OBJECTIVES FOR URBAN TRANSPORT IDENTIFIED BY THE OECD/ECMT (3)

The problems faced by OECD cities are of two kinds. In the first are the familiar, long-established problems of congestion, casualties, emissions, the isolation of those without access to cars, and so on. Most existing policies have been geared to tackling them.

However, during the late 1980's, a second set of concerns began to crystallise in many Member countries. These included awareness of the impracticality of catering for forecast volumes of car travel, concern about resource consumption and anxieties about the possibility of climate change. This led in turn to the identification of a new set of policy objectives, which were not only more wide-ranging, but were concerned with the underlying causes rather than the symptoms of the problem – too much traffic in our cities.

Source: OECD/ECMT (1995), Urban Travel and Sustainable Development.

(1) MAFF/Welsh Office (1993), *Strategy for Coastal Defence in England and Wales*.

(2) R&D Project No. 685, completed in 1996, aimed to investigate the extent to which areas at risk from tidal flooding are subject to pressures for development, in order to develop a range of policy options. An earlier project (no. 426, completed in 1994) reviewed international experience in integrated flood plain land use and flood defence.

(3) The ECMT is the European Conference of Ministers of Transport, a body which works closely with the OECD.

The most recent milestone in transport demand management in the UK has been the passage of the Road Traffic Reduction Act, which received Royal Assent on 21 March. The Act, originally drafted by Friends of the Earth, the Green Party and Plaid Cymru, survived its passage through Parliament after national targets were dropped. It now obliges local authorities to produce reports assessing local traffic levels and to make forecasts of traffic growth, including targets to reduce traffic or its rate of growth unless good reasons can be presented for not doing so. Local authorities' plans will then form part of annual bids for funding to the Department of Transport. The Act therefore gives transport demand management statutory force.

The Agency, however, has little role in the development of transport policy or its implementation. (1) This project has therefore not considered transport demand management further.

3.6 Sustainable Lifestyles

Many policy makers are seeing real technical limits to achieving improvements in environmental quality. For many of the really intractable environmental problems changes in lifestyle are regarded as a crucial element of achieving improvements. Such problems include those relating to transport, home energy conservation and recycling.

The achievement of lifestyle change is complicated because of the requirement for communal action. Current lifestyle patterns are very often determined by societal norms rather than individual choices. This means that changing the lifestyles of individuals is difficult in the absence of similar shifts by other members of the community.

In a clearly related area of policy interest, a number of economists have been writing about the importance of path dependence in economic development. (2) Through historical accident or design society has proceeded down a particular development pathway. It could have taken another direction with equal (or greater) utility. However, changing from the current to the alternative path is no simple task. This notion of path dependency can be seen with respect to a range of environmental issues including development of transport systems, the layout of towns and cities, and the design of buildings. But societal behaviour appears to be equally path dependent, and these factors can be the target for policy makers in seeking demand-led adjustments to improving environmental quality.

A 1993 report for the Dutch Environment Ministry by ERM (3) sought to identify a number of principles for alternative lifestyles which might be attractive and lead to relative improvements towards sustainability. The principles were:

- *rationalise access* – infrastructure changes allowing greater efficiencies in access to goods and services;
- *act communally* – improving efficiency through achieving economies of scale in consumption;
- *circulate goods* – material and energy resource recycling and recovery; and
- *buy services not products.*

Although this and other studies were able to identify and, through limited life cycle analysis,(4) demonstrate some of the advantages of these alternative lifestyle approaches, there are considerable limitations on governments in achieving step changes in personal behavioural patterns. There are a range of 'social marketing' techniques that governments employ to encourage behavioural change relating eg to drinking and driving, but their success is limited by societal and peer pressures in the opposite direction.

Lifestyle change remains a desirable end-point for many policy makers but such changes are more likely to be achieved through measures which seek directly to alter private incentives (eg price instruments) than through direct marketing of the advantages of change.

(1) The Agency is however a consultee in road schemes and has recently completed an R&D Project (no. 706) developing a policy on highway schemes, with the aim of producing an integrated Agency policy and procedure manual which will enable a consistent and effective approach to road scheme consultations.

(2) See for example 'The Economics of QWERTY' in Paul Krugman (1994), *Peddling Prosperity*, New York: Norton.

(3) Environmental Resources Limited (1993), *The Best of Both Worlds: Sustainability and Quality Lifestyles in the 21st Century*, Report to the Ministry of Housing, Spatial Planning and Environment.

(4) Environmental Resources Management (1994), *Every Decision Counts: Consumer Choices and Environmental Impacts*, Report to the Ministry of Housing, Spatial Planning and Environment.

4. Principles for Effective RDM

This section sets out a number of principles which characterise successful RDM. Some of these may be more correctly described as features of RDM; others are principles which should guide efforts to promote it. *Section 4.1* introduces a set of general features of RDM which must be understood in order to promote it successfully; *Section 4.2* sets out the economic principles which provide users of services with the right incentives to undertake demand-side measures; *Section 4.3* presents a cost-benefit framework for the evaluation of what the optimal degree of RDM in water should be; and *Section 4.4* discusses in a preliminary way some of the issues associated with establishing a regulatory framework which encourages the optimal level of demand-side management by utilities. Applying these principles will require the participation of numerous actors other than the Agency; but it is important for the Agency to understand the circumstances under which RDM is likely to be successful in its dialogue with others, as well as in its own actions.

4.1 General Principles

This section sets out a number of general principles or features which characterise RDM; economic principles for successful RDM are explored in *Sections 4.2 – 4.4* below.

4.1.1 *RDM as a New Culture*

As argued in *Section 1.3*, RDM is not just a set of tools and techniques for public policy makers in pursuit of sustainable development: it involves a sufficiently new approach from a sufficiently wide range of social actors to justify the assertion that it represents a new culture or paradigm. Also, this process of changing attitudes and behaviours will vary over time and space, so a uniform approach will not be successful.

The first change is required of *service providers*. RDM is an important tool to encourage producers to think in terms of offering a range of services, (including eg waste minimisation and conservation advice), rather than products (eg water as an undifferentiated product), thereby delivering the same value to the consumer with lower environmental impact and resource use. The closer engagement between producers and consumers as producers seek to influence consumer behaviour 'beyond the meter' is at the heart of this process. As a result of the need for suppliers to understand and influence variations in demand, RDM therefore involves much more complex interrelationships between suppliers and users of services than the previous supply-side approach.

The second change in thinking is by *the public, industry, commerce, agriculture*, etc. Until recently, energy, water and waste services have been regarded as public services to which we are all entitled. In one sense, it remains true that there is a political commitment to ensure that no-one in society is excluded from supply with these basic services; however, the 'public service' model, with its language of rights, is changing into a more commercial model which speaks of 'customers' rather than 'citizens' or 'taxpayers', and expects those customers to pay according to the service they demand. This change has taken place alongside a rise in the cost of water and waste services (though not of energy), so that these resources are no longer perceived as being almost free. Householders' perceptions of their role as consumers of these services are changing as they are simultaneously asked to conserve water through changes such as water-efficient gardens and irrigation, whilst being charged for it as well for the first time. Gaining public acceptance of RDM is vital if it is to succeed, a process which will be assisted by various forms of public education and mechanisms for public participation. It will also be important to educate users of services to understand that environmental costs change over time – water taken in winter, for instance, is not the same product in cost terms as that taken at 6pm on a Friday night in a hot July.

Finally, *professional groups* such as land use and transport planners, builders, architects and the Agency's own staff are just beginning to understand RDM principles and practices, and this process needs to be accelerated. It is important not only to develop a new way of thinking, but also to develop the practical tools that are needed to put that new thinking into practice.

4.1.2 *Geographical and Temporal Variation*

In RDM approaches it is vital to understand variation of demand in order to be able to influence it. Hence the appropriate operating scales for demand and supply oriented approaches are likely to be different, with a finer geographical scale needed for effective RDM. In particular, standard approaches to RDM are likely to be unsuccessful – locally tailored solutions are needed (although these may be developed within an integrated overall framework).

Variation of demand in time is also important, since reducing needle peak demand allows better utilisation of production and distribution infrastructure. This form of demand management is likely to have only small environmental benefits (eg through reduced need for local storage capacity or treatment capacity, or reducing the pumping energy required to supply

water) but may lead to significant economic cost savings. Reducing seasonal variation in demand for water, however, may be associated with significant environmental as well as economic benefits.

4.1.3 *The Importance of Integration*

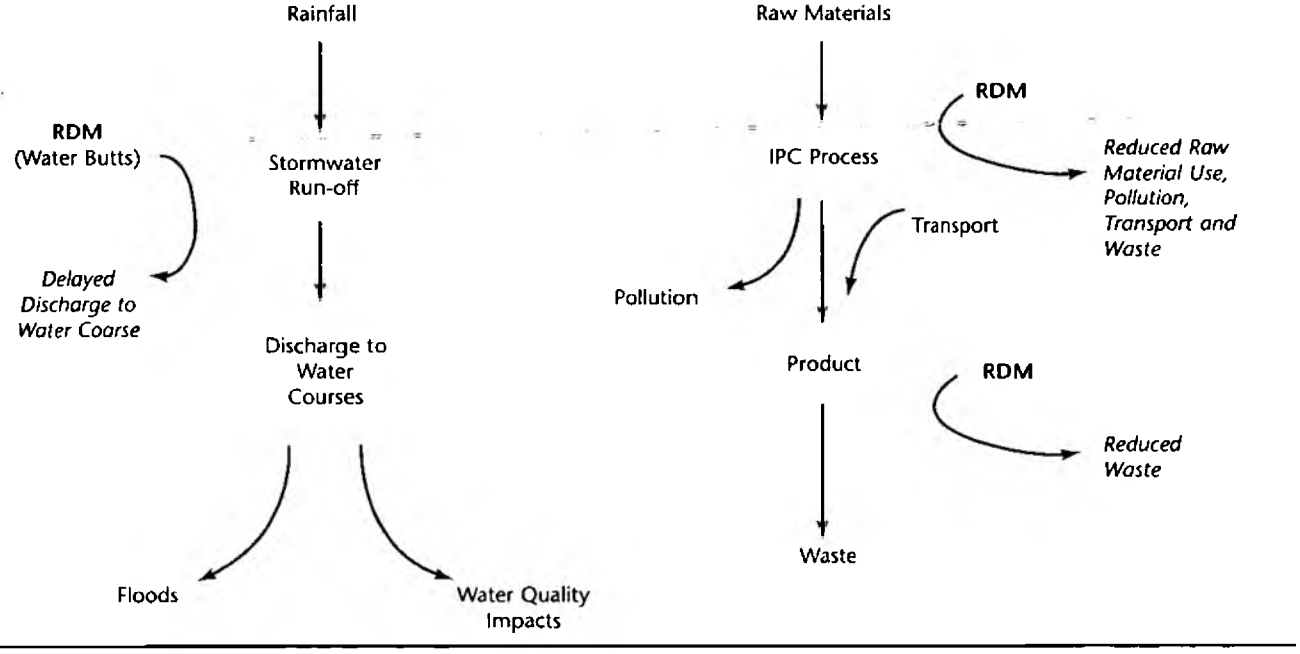
The concept of integration in environmental policy refers to two processes:

- *integration between media*, to ensure that positive environmental outcomes in one medium (such as air) are balanced against any negative outcomes in another medium (such as water) – this is the principle underlying the integrated pollution control concept; and
- *integration between institutions*, so that the environment is widely considered in decision-making, and not only by bodies with specific environmental responsibilities.

Two corresponding principles can be discerned in relation to RDM. Corresponding to the concept of integration between media, RDM initiatives in a particular area must be assessed for their likely impact in other areas, which may be either positive or negative.

- As a positive example, installation of rainwater butts may both reduce outdoor water demand and reduce polluting overflows from combined sewers in storm conditions.
- RDM applied to IPC processes may reduce raw material use, pollution from product manufacture, transport demand and waste arisings (see *Figure 4.1*).
- In contrast, restricting irrigation to higher value crops could lead to an undesirable intensification of agriculture (see *Box 3.2* on page 16).
- Water may be abstracted from one catchment, used, and returned to another. If this water is used for flow augmentation in the receiving catchment, measures to reduce water used in the catchment where water is abstracted may have unintended adverse consequences for the environment as flows in the receiving catchment fall correspondingly.

FIGURE 4.1 THE CROSS-FUNCTIONAL IMPACTS OF RDM



The second parallel arises from the need to understand ultimate drivers of demand if RDM is to be effective. This understanding may require the integration of an RDM approach in new institutional contexts. As an example, recent research (1) indicates that demand for irrigation in East Anglia may be increased substantially by the product specifications required for supermarkets (eg long straight carrots can only be grown in sandy soils which are prone to drought). Understanding this ultimate source of demand is vital if irrigation needs are to be reduced; this suggests that new dialogue with unconventional partners (such as supermarkets) may be appropriate.

Spanning both aspects of integration is the need for the Agency to promote RDM across its own media-specific and institutional boundaries. Experience suggests that institutional integration, whilst a simple concept in theory, is very difficult to achieve in practice. Giving existing organisations a duty to consult with others is not enough; the correct incentives must be in place to make it happen in practice.

4.2 Economic Principles

This section sets out very briefly the general principles which policy should follow in order to maximise welfare, and then goes on to examine the implications of these principles for the pricing of resources, in order to give their users (2) the correct incentives for RDM, without incurring other negative consequences. This is an area which is well understood, so the treatment of these issues is brief.

4.2.1 *General Guiding Principles*

There are three principles which can be used to evaluate the contribution of RDM (and, indeed, any policy instrument) to sustainable development: efficiency, effectiveness and acceptability. These correspond roughly with the economic, environmental and social dimensions of sustainable development.

Efficiency is the objective which economists most commonly refer to. It may be defined as achieving an allocation of resources which maximises both consumer and producer surplus, ie creates the maximum economic value for society. Economic theory argues that resources should only be used for a particular function up to the point at which the benefits of using an additional unit of resource are equal to the (marginal) opportunity costs of doing so. It is for reasons of efficiency that cost-benefit approaches are often used in evaluating the allocation of public resources.

Economic theory also suggests that in order to achieve allocative efficiency, resources should be priced at the marginal cost of supply. In principle, this cost should incorporate environmental as well as economic costs. There are costs associated with damaging the environment and corresponding benefits associated with protecting it. The challenge, however, is to place these costs and benefits on an equal footing with the more easily measurable economic costs and benefits. Because this is difficult to do, the principle of *effectiveness* is introduced to ensure that the environment is adequately taken into account.

The effectiveness of environmental policies refers to the extent to which they are successful in achieving their aim of protecting and enhancing the environment. This principle is needed for the Agency to ensure that, in exercising its duty to consider costs and benefits, it also gives priority to environmental protection.

Finally, the principle of *acceptability* means that policies must be assessed for their distributional effects: winners and losers must be identified. Economic efficiency, in principle, has nothing to say on this point; political and ethical concerns about distributional impacts, however, mean that policies must be assessed against this criterion. A number of economic measures promoting RDM have potentially major re-distributive effects and improving their acceptability is therefore of considerable importance.

4.2.2 *RDM as a Response to Market Failure*

In an idealised world of perfectly-functioning markets, the correct level of investment on the demand and supply sides would be reached by actors responding to price signals. There are numerous ways in which the real world diverges from that of economic theory, such as the existence of environmental externalities, monopolies, economies of scale, concerns about distribution as well as efficiency, and so on.

(1) Research carried out by Sarah Williams, a post-graduate student of Judith Rees at the LSE.

(2) 'Users' of resources include both ultimate consumers of services (such as water), and intermediate users (such as water companies), who use natural resources in providing services to their customers.

Some of these market failures are addressed by public policy. The main aim of the economic regulators of privatised industries is to protect consumers from the abuse of monopoly power, whilst obtaining the benefits of private-sector management of these industries. The question then arises: if utilities are regulated in an optimal way, why is there a need for specific measures to promote demand-side investment? What market failure justifies this intervention?

The first answer to this question is to point out that utilities may not be regulated in an optimal way – not only by the economic regulators, but also the environmental regulator (the Agency). For instance, they may not face the correct price signals regarding the resources they use, as a result of environmental externalities; or regulatory structures may not deal with supply- and demand-side investment equally – *Section 4.4* below discusses the institutional arrangements needed to promote RDM in the water sector. A second answer is that some users of utilities' services do not face the correct price signals: the marginal cost of producing a unit of domestic waste or of consuming an extra unit of water is zero to most households – *Section 4.2.3* below examines how services should be priced in order to send the right signals to users.

However, there remains a long-running debate in the RDM literature about why, even if faced with adequate price incentives, users of services such as water and electricity do not appear to undertake cost-effective investments in demand-side measures. Explanations include:

- *agency problems*, where the actor responsible for the demand-side investment (eg a landlord or property developer) does not capture the benefits of that investment (eg through higher rent) and consequently fails to undertake it;
- *information problems*, where there is a lack of concrete, reliable and independent information about the cost-effectiveness of demand-side measures;
- *fast payback requirements*, where consumers are economically rational but require very high rates of return on demand-side measures in order to undertake them, as a result of factors such as high uncertainty and the sunk/illiquid nature of demand-side investments;
- *qualitative differences*, where new technologies face consumer resistance such as reluctance to accept low-flow showers or compact fluorescent bulbs as alternatives to their conventional alternatives;
- distrust and lack of awareness of opportunities and distrust of service provider (particularly relevant to the water industry); and
- *non-rational behaviour*, where it is hypothesised that consumers are influenced by factors other than economic ones in making their decisions. Some householders may for instance have a cultural aversion to financing cost-effective demand reduction measures using credit (because of an aversion to 'getting into debt').

Some of these failures may also affect utilities themselves. Uncertainty about the effects of demand-side measures (because they are relatively new, and because they depend on consumer response), leads to greater risk associated with these measures. Part of this uncertainty may be unavoidable, and hence is not a market failure but a valid reason for preferring supply-side investments to demand-side ones which have the same expected cost-benefit ratio but greater uncertainty; part of it, however, may reflect the utilities' lack of experience with demand-side techniques.

The analysis of this market failure is important, since it provides the justification for consequent action. In the context of water and waste services in the UK, it suggests that correct pricing is a necessary but not a sufficient element in a strategy to promote the optimal degree of investment on the demand side.(1)

4.2.3 *Pricing Principles*

In order to achieve economic efficiency, theory suggests that resources such as water, energy and waste management should be priced based on the *short run marginal cost* (SRMC) and that marginal costs should be defined in opportunity cost terms. In general, this can be approximated by the unit cost of the next cheapest available resource. It is clear that for water, at least, prices are generally significantly below the efficient level at present, and that incentives for conservation are therefore too weak. The concept of the marginal opportunity cost can include environmental as well as financial costs, but finding a robust basis on which to include these may be difficult. However, pricing on the basis of the marginal opportunity cost presents the problem, where this is greater than the current price, of who should appropriate the 'scarcity rent' arising from the higher forward-looking price.

(1) It is however important to recognise that correct pricing itself has a cost associated with it. Where water is plentiful, the efficiency gains from metering may be outweighed by the costs of implementing it. 'Correct' pricing, when transaction costs are taken into account, may therefore have no volumetric element.

A second general principle is that, on economic efficiency grounds, prices should reflect *local* marginal costs. This is the expression in economic terms of the principle developed in *Section 4.1* above that demand management is best carried out at a finer geographical scale than supply-side approaches. At present there is very little local variation of prices in relation to costs: indeed, utilities and others are actively prevented from de-averaging costs. This is primarily because of the highly adverse distributional consequences of making rural users (and others) pay the true cost of supplying them. However, it also means that consumers are not given the correct incentives for decisions about location and the appropriate degree of conservation.

For instance, the marginal cost of increasing supply to rural users of services such as water and energy is significantly higher than the costs of supply to urban users (or, more strictly, those closer to the sources of supply). If these users were priced according to the local opportunity cost, there would be a stronger incentive for them to invest in the economically efficient level of demand management. An example of how demand management may be cost-effective when local supply constraints are encountered is provided by Manweb's Holyhead scheme (see *Section 3.2.1*). The challenge remains, however, to devise means by which service providers and consumers can be given the correct financial incentives in relation to local marginal cost, without dire adverse distributional consequences.

These principles have already been applied to the question of how water should be priced in order to provide better incentives for RDM, whilst avoiding adverse distributional consequences. *Box 4.1* presents a model developed by Herrington for pricing domestic water; *Box 4.2* presents the pricing model developed by Rees and Williams for water abstraction. They may also be applied to solid waste: the landfill tax may be justified not only on the basis of the externalities associated with landfill disposal, but also on the grounds of raising the cost of landfill to approximate more closely the marginal opportunity cost. Economic efficiency also dictates that households should face a weight- or volume-based charge for waste collection and disposal, to create stronger incentives for waste minimisation and recycling.

BOX 4.1 PRICING OF PUBLIC WATER SUPPLIES

Economic efficiency dictates that water should be charged on a volumetric basis – ie that it should be metered – so long as the economic efficiency gains from the introduction of metering exceed its transaction costs. Concerns in the UK focus on the distributional impacts of doing so, given that water is an essential service and that low-income households might not be able to afford to purchase enough to guarantee public health.

Herrington argues that it is not enough to leave the tax and social security systems to cope with any undesirable redistribution of income that might occur following the introduction of metering, and proposes instead a three-part charging system:

- a relatively low standing charge;
- a free or low price tranche of water, ideally based on the number of people in a household, but for practical purposes based on the assumption of one adult plus the number of children in the household (with the existing Social Security child benefit used to validate the latter); and
- any further water being charged on a per unit volume basis.

This approach, he argues, provides a good practical solution to the problem of how to protest the most vulnerable households without losing the economic efficiency benefits of metering.

Source: After Herrington, P. (1997), Pricing Water Properly', in *Ecotaxation*', Earthscan, London.

Economic efficiency suggests that all water users should pay the same marginal price for a given supply source, so that water goes to those who value it most highly. This would include both extractive uses and in-situ' uses such as in maintaining aquatic life, recreational uses, etc. In practice, however, there are strong financial constraints on the ability of those who enjoy in situ uses to compete against extractive users, and for this reason it is appropriate to decide politically what degree of environmental damage can be tolerated, and then to limit abstraction conditions accordingly.

Water, however, is not a uniform commodity (in the way that electricity is, for instance). Prices charged for abstraction should in theory reflect the various environmental dimensions of its use, including variation with:

- *time of use* – so that water abstracted in times when the ratio of demand to supply is high (eg in summer) should be more expensive than when it is low (eg in winter);
- *location of use* – water should be more expensive in upstream parts of a catchment, where opportunity costs tend to be higher;
- *quantity and quality of return flow* – ideally only units of consumed water should attract charges, not water which is returned elsewhere in the catchment in a useable form.

These factors are already taken into account in the existing charging system to some extent.

Abstraction charges should in theory be composed of three elements:

- *access fees* – flat rate charges to cover non volume-related costs such as administering the license system;
- *availability charges* – set to reflect the environmental and capital costs of providing or reserving the units of water and levied on the quantities of supply authorised to be abstracted; and
- *actual charged* – to recover the operating costs of the system and levied only on the units of water taken.

Normally it would be expected that the availability charges would form the largest element in the price structure. Unfortunately, however, many abstractors are unwilling to give up or reduce an authorisation, leading to the situation in which the unit price of water – once the availability charge has been paid – is effectively zero, and there is no incentive to manage demand. It may therefore be appropriate to increase the proportion of actual charges to account for this problem.

Setting the level of charges would be a difficult task, since the information requirements of charging according to the true opportunity cost of an abstraction are huge. One suggestion is that an incentive charging system could be based not on damage costs but on the costs of damage avoidance. Firstly, politically acceptable minimum flows could be established; then the costs of providing the necessary storage capacity or other flow and quality enhancement methods would be estimated. These costs would form the basis of the damage avoidance unit prices.

Source: *After Rees, J and Williams, S (1993), Water for Life: Strategies for Sustainable Water Resource Management', CPRE*

4.3 A Cost-Benefit Approach for the Evaluation of Outcomes

Whilst it may not be possible at this stage to specify the set of institutional and other arrangements that would lead to the efficient uptake of RDM by water companies, it may be possible to define the balance between demand and supply side measures that would represent an efficient allocation of resources. A major research project jointly funded by the Environment Agency and UKWIR has recently attempted to develop a methodology to do just this.

The *Economics of Demand Management* project aimed to 'develop a framework, useable by the industry and acceptable to the Regulators, to facilitate the optimum balance between –

- demand management
- the investment in (or deferral of) water resources development schemes
- operational options which may include changes in levels of service, tariff structures and education programmes.'

The result was a (partial equilibrium) cost-benefit methodology which aimed to include social and environmental factors. Social costs are defined as the sum of operational and capital expenditure, environmental costs and benefits, and welfare gains and losses due to changes in the water and sewerage services received. Both supply and demand side measures are then evaluated to calculate:

- the net present value of their social costs (A); and
- the (discounted) impact on water delivered (B).

The average incremental social cost (AISC) of each option is then calculated as A/B, and is used to rank the options considered. The lowest cost options should then be implemented, to reduce the deficit in the water balance (the difference between predicted supply and demand) as much as is needed.

This is a theoretically robust way to determine the ideal balance of supply and demand side measures in meeting society's needs for water services, and may be compared with the Integrated Resource Planning (IRP) process developed for energy services in the United States. In the US, however, IRP was initially developed as an activity mandated by the public utility commissions, rather than in the 'non-prescriptive' context of the EA/UKWIR project. The project report suggests that, rather than requiring utilities to operate a form of IRP, it would be more appropriate to change the incentives facing them so as to align more closely social and commercial objectives. However, it is now expected that the framework established by the project should be used as part of the justification for any major supply expansion proposals to the regulators, so that some form of statutory sanctions may be indirectly attached to it.

Problems implementing the approach are likely to be associated with:

- the difficulties of quantifying environmental and social costs;
- the uncertainties associated with the costs and the effectiveness of demand- side measures, of which the water industry has much less experience; and
- taking adequate account of the interlinkages between different options (eg a number of customer-side demand management options [1] may be much more effective in conjunction with domestic metering).

The Environment Agency and OFWAT will have to work closely together to evaluate any programmes proposed by water companies on the basis of the EA/UKWIR project framework.

4.4 Institutional Arrangements for RDM in Water

This section examines under what institutional arrangements and other conditions the incentives are strongest for water companies to carry out demand-side measures. The analysis is aimed at UK industry, but many of the arguments are more generic. The aim of this section is to provide some initial pointers for the Agency about the kind of regulatory structure that is likely to be needed for water companies to have an incentive (or at least not to have a disincentive) to promote demand-side measures.

In the United States, a number of approaches have been developed for energy supply which provide incentives for utilities to carry out demand side management.[2] Incentives are needed both to cover the costs of implementing DSM programmes, and also to cover the costs of lost revenue arising from the reduction in demand following programme implementation. Five types of incentive mechanism have been distinguished, as set out in *Box 4.3*. These may have some relevance to the UK water sector as the scope of metering is extended, since the monopolistic and vertically integrated nature of the UK water industry, combined with unit charging, would then resemble the US electricity supply industry at the time that these mechanisms were put in place. The water industry differs markedly from the electricity industry, however, in that the marginal costs of supply are rising rather than falling.

It is important to note that at present, water companies have some incentive to save water, whether in distribution or on the customer side, because of the low penetration of domestic metering. Since companies gain their revenue on the basis of a charge per household, there is some incentive, at least in the short run, for them to reduce the costs of supplying water to households, including by reducing customer demand. However, the ability of companies under the current regulatory regime to earn a rate of return on capital investment in the supply side that is not balanced by a comparable return on demand-side investments partly negates this incentive.

A fuller exploration of the regulatory structures that would be required to give water companies incentives to carry out DSM programmes is beyond the scope of this study. However, it is possible to set out a number of factors which will be important in determining what regulatory structures would be appropriate in different circumstances.

The purpose of regulating utilities is primarily to prevent the abuse of market power resulting from limited competition. Regulatory control therefore equates primarily to control of prices, although other aspects of utilities operations may also be subject to scrutiny. The current form of regulation – allowing

(1) The term 'customer-side' is used in the context of water demand management to describe those measures that reduce demand in end uses and by reducing domestic plumbing losses. It is used to distinguish customer-side management measures from measures related to the production and distribution of water, where losses can also be reduced.

(2) DSM in this context refers to the utility-run (or utility-sponsored) programmes designed to manage demand.

prices to be set so as to achieve a given rate of return on capital – tends to favour supply side investment. Allowing different prices to be charged according to the costs of supply and distribution in different areas ('de-averaging') is a change which may create stronger incentives for utility DSM.

Key factors affecting the choice of a regulatory system are:

- *Presence/absence of competition* – although competition in water supply is limited by the high costs of distribution, provision has been made for competition in supply to large water users, especially those on the border between water companies' territories (via so-called 'inset' agreements).
- *Presence/absence of metering* – as metering is extended, the incentives facing utilities will change significantly, working against utility-sponsored RDM.
- *Nature of industry cost structures* – the marginal supply cost in the water industry is rising; in other industries (such as electricity and gas), it may be falling. This difference means that models taken from other industries must be carried over with care.
- *Extent of current capacity constraints* – capacity may be constrained in various dimensions (eg by time of year, time of day, or location). Different incentives may be appropriate in relation to different kinds of capacity constraint (eg it may be easier to create incentives for utilities to reduce peak to average ratios than to reduce overall load).

Despite the difficulties in developing an ideal regulatory structure, there are a number of actions which could be taken to strengthen RDM within the current framework. Water companies could be given stronger incentives for demand side measures through, for instance:

- increasing supply costs by charging for abstraction and related impacts (eg groundwater depletion) – providing that these extra supply costs could only be passed on to consumers where cheaper demand-side options were not available; and
- making stronger use of OFWAT's comparative competition approach to publicise the relative performance of companies' water saving programmes (ie going beyond what companies are already required to publish). Making it clear that this performance would play a key role at price review would further strengthen this approach.

BOX 4.3 INCENTIVE MECHANISMS FOR UTILITY-SPONSORED DSM: US EXPERIENCE

There is considerable experience in the United States of mechanisms giving utilities incentives to implement DSM. These include:

- *Shared savings* – the utility is allowed to retain for its shareholders an agreed proportion of the savings resulting from DSM programmes, normally recouped through a general price rise (although payment on the bill by DSM programme participants is also possible).
- *Performance premium* – utilities are rewarded with a fixed cash bonus' per unit of resource saved. This approach rewards more cost-effective, as opposed to costly, measures than the other incentives may induce.
- *Return on equity adjustment* – the return on equity permitted by the regulatory authority is raised or lowered according to utilities' commitment to DSM programmes (as measured by the energy savings achieved, for instance).
- *Rate base premium* – DSM investments are eligible to achieve a greater than normal return on equity.
- *Mark up* – utilities are allowed to recoup DSM expenditures through higher rates to all customers, and they can also raise rates by an agreed further amount, to provide a positive incentive.

The former two mechanisms are generally acknowledged to create a better set of incentives than the latter three.

Some States have also introduced mechanisms to decouple' utilities' revenues from sales. In one approach, excess' sales (ie sales over the authorised amount) are channelled into a balancing account rather than translating into additional profit; and when sales are below expectations, the money from the balancing account is returned to utility to make up the difference.

Source: based on London Economics (1994), Demand-Side Management – A Survey of US Experience, report for OFGAS.

4.5 Conclusions

In an ideal world, correct pricing of resources would be sufficient to ensure an economically efficient balance between supply and demand management. However, in practice, imperfect information and other forms of market failure mean that pricing alone is not enough. Inefficient pricing and these other market failures are the justification for policy intervention to promote demand-side management, either by utility-managed schemes or by third-party schemes (eg by an independent body funded by some form of levy on utility revenues). The more the price mechanism operates efficiently, however, the more difficult it is to give utilities adequate incentives to encourage demand-side management by their customers. Under circumstances where pricing is efficient, either price alone will be sufficient to encourage demand management by consumers or, if distortions such as information gaps restrict price elasticities of demand, it is likely to be more effective to promote consumer demand management via a third party.

This analysis suggests that the Agency should:

- ensure that where it has control over resource pricing (eg of water abstractions), the pricing formulae send the right incentives to resource users;
- engage in dialogue with the economic regulators of the water and energy supply industries to ensure that resource pricing formulae achieve the best trade-off between economic efficiency and political acceptability;
- identify non-price market failures (such as lack of information) and work to correct these both through its own actions and through encouraging action by other organisations; and
- where prices fail to send the right signals and there is evidence of systematic over-investment in the supply side, lobby for the implementation of consumer demand management initiatives, either by utilities or by independent third parties.

5. Opportunities and Barriers

5.1 Introduction

This section draws together a number of broad suggestions for how the Agency could promote RDM, and examines both the opportunities they afford and the barriers which stand in the way of their successful implementation. Some of these ideas draw on past research commissioned by the Agency and other organisations; others have developed during the course of this project by Agency staff, researchers, and ERM. *Section 5.2* presents a framework for structuring considerations about possible action by the Agency; *Sections 5.3* and *5.4* present in more detail the policy instruments which might be used by Agency in pursuit of RDM.

5.2 An Inventory of Policy Instruments for RDM

This section presents an overview of generic policy instruments for promoting RDM, and maps these against the key Agency functions where RDM could play a role. The instruments considered here are those which are relevant to the Agency: there is a range of more specific techniques for managing the demand side, such as retrofitting of more efficient appliances, but these are not the focus of this section. This type of *technique* by which demand may be reduced is distinct from a *policy instrument* – a crude typology is presented in *Figure 5.1* below. Techniques for managing the demand side have been inventorised in a range of recent literature: the UKWIR/Environment Agency project on the *Economics of Demand Management*, for instance, lists more than 100 different techniques for managing water demand.

FIGURE 5.1 POLICY OBJECTIVES, INSTRUMENTS AND TECHNIQUES

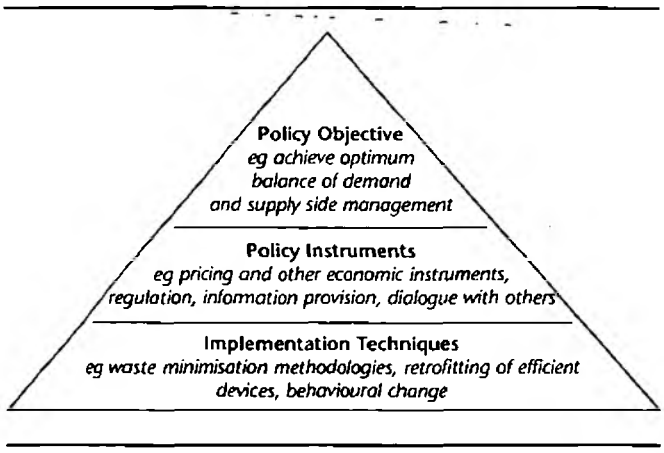


Table 5.1 below presents the Agency's functions split according to the relevance of RDM, with a brief explanation for the categorisation. Aspects of the RDM philosophy may be applicable in some of the functions listed under 'RDM unlikely to be relevant' (eg in avoiding the generation of radioactive waste as far as possible), but for the purposes of this study the application of RDM has been limited to those functions where it could play an important role in guiding the Agency's approach. *Table 5.2* notes a range of current activities which promote or encourage RDM.

TABLE 5.1 AGENCY FUNCTIONS IN WHICH RDM MAY PLAY A USEFUL ROLE

Agency Function	Comment
RDM Relevant	
• Water Resources	Key area for demand management
• Water Quality	Strong linkages with demand management in water resources
• Waste Management and Regulation	Possible to reduce demand for waste collection and disposal, both by reducing waste at source and increasing waste diversion rates
• Integrated Pollution Control	Scope for reducing demand for resources, including energy and water, and for waste collection and disposal, through industrial and other waste minimisation approaches
• Flood Defence	Scope for reducing demand for flood defence expenditure eg by land use planning to keep development away from flood-prone areas, or by improving the ability of urban areas to retain stormwater runoff
• Recreation	Management of demand for access to certain sites may be appropriate
RDM Unlikely to be Relevant	
• Navigation	Management of demand for navigation is set to increase, but there do not appear to be strong environmental reasons for trying to influence the changing pattern of demand
• Conservation	Some of the pressures on natural and man-made heritage may be open to demand management (eg water resources and transport), but these are best managed directly, rather than via the Agency's conservation function
• Fisheries	Same argument applies as for Conservation function; may also be scope for balancing supply-side approaches (stocking of watercourses) with demand-side approaches (restricting fish catch) – but this instance is of minor importance relative to RDM in other areas
• Contaminated Land	Difficult to see how demand management ideas could be applied (except for in avoiding creation of contaminated land in the first place)
• Radioactive Substances	The principle of avoiding the unnecessary creation of radioactive wastes is already firmly established – this is an example of the RDM philosophy

TABLE 5.2 CURRENT AGENCY ACTIONS AND THOSE OF OTHERS ENCOURAGING RDM

Policy Instrument *Agency Function*	Pricing & Other Economic Instruments	Regulation	Information provision/education
WATER RESOURCES			
Agency Measures	• Abstraction charging	• Abstraction licences	• Water Demand Management Centre
Measures by Others		• OFWAT regulatory framework	
WATER QUALITY			
Agency Measures	• Discharge consent charging (link to abstraction charging?)	• Discharge consents	• Water Demand Management Centre
Measures by Others	• Trade effluent charging		
WASTE MANAGEMENT AND REGULATION			
Agency Measures	• Waste management licence charges	• Producer responsibility	• Waste Minimisation Projects
Measures by Others	• Recycling credits • Landfill tax		
IPC/IPPC			
Agency Measures	• Authorisation charging	• BATNEEC/BPEO	• 3 Es [1]
Measures by Others			
FLOOD DEFENCE			
Agency Measures	• Flood Defence Levies		
Measures by Others	• Council Tax (Flood Defence Component)		

[1] Emissions, Efficiency and Economics – a structured technique to achieve improved environmental performance through process optimisation

RDM is not itself a policy instrument. As defined in *Section 1.3*, RDM means achieving the optimum balance of demand- and supply-side management. In this sense, RDM is more properly understood as a policy objective than as a policy instrument. This objective may then be achieved using (in principle at least) the full range of instruments open to policy makers. This conclusion is reflected in the approach taken to demand management in the Environment Agency/UKWIR study on the *Economics of Demand Management* (see *Section 4.3*).

The policy instruments considered here fall into three main types:

- pricing and other economic instruments;
- conventional regulation; and
- dialogue, education and information provision.

The remainder of this section presents an overview of the type of action which the Agency could take using each of these instruments; more detailed discussion of the opportunities and barriers for action by the Agency in support of RDM follows in *Sections 5.3* and *5.4* below.

Pricing

Ensuring that all actors face prices which provide incentives to reach an optimal balance of demand and supply side expenditure is vital. If water users are not metered, there is no incentive to reduce consumption; if water companies are not charged according to the amount of water they abstract, they have no direct financial incentive to conserve water. This example highlights that there are some prices which the Agency has a degree of control over, notably the cost of abstraction and pollution; other prices are set by other actors operating within their own set of constraints (eg the water companies operating within the constraints imposed by OFWAT). In the latter case, the Agency can nevertheless influence public policy (by the Government and OFWAT), as well as having some influence over water companies directly.

It is important to note, however, that incorrect pricing of resources is not the only market failure which must be corrected in order to achieve the optimum balance of supply- and demand-side investment. *Section 4.2.2* examines other possible market failures in more detail.

Other Economic Instruments

In addition to pricing mechanisms, other economic instruments may also be used in support of RDM. Tradeable permits are the classic alternative to charging mechanisms as a means of limiting use of environmental resources – tradeable permits for water abstraction have been proposed for the UK, and limited schemes are in operation elsewhere. A form of tradeable permit in waste (the packaging recovery note or PRN) is already coming into existence in the UK as a means by which those responsible for packaging recovery under the Packaging and Packaging Waste Directive can discharge their obligations.

The regulatory frameworks imposed by OFWAT and the other regulators (notably OFFER and OFGAS) are influential in determining the economic incentives facing utilities (especially for less competitive markets such as in water), and may therefore loosely be described as an 'economic' instrument – they achieve an economic outcome by regulatory means. The Agency has a role in scrutinising these frameworks to ensure that they promote rather than hinder RDM.

Regulation

Regulation refers to an approach whereby certain activities are either specifically required, prohibited, or permitted subject to some form of license or consent issued under statutory power. The Agency's own regulatory powers represent an instrument for promoting RDM in themselves, or they may provide the necessary underpinning for other instruments which promote RDM. An example of the former is the IPC authorisation process, which through its consideration of BPEO and BATNEEC (1) provides an opportunity for improving the efficiency of plant operations, possibly as part of a wider waste minimisation approach. An example of the latter is the abstraction licensing system, which would (probably) continue to be needed as the underpinning for any more elaborate system of abstraction pricing or permit trading.

Dialogue, Information Provision and Education

As emphasised in *Section 1.3*, RDM is not just a policy objective or a set of policy instruments and techniques: it is also a culture, a way of thinking. It typically involves new and closer relationships between suppliers and users and also between the agencies responsible for upholding the public interest in their respective spheres. For this reason, a key role for the Agency in promoting RDM is in dialogue, information provision and education. Dialogue about the technical and economic opportunities and barriers to demand management is needed between the Agency, the water companies and other abstractors, the regulators (especially OFWAT), the waste collection and disposal authorities, and the land use planning community; better internal dialogue between different Agency functions is also needed. Provision of information, in a proactive way, is an important means of disseminating best practice, and the Agency's position as regulator gives it authority in so doing. Finally, the Agency also has a role in advancing RDM through educating the public, planners, architects and others.

The Opportunities Afforded by the Agency's Integrated Status

There are a range of opportunities for promoting RDM in each of the Agency's functional units. These would not have been markedly different from the opportunities available to each of the organisations from which the Agency was formed. It is therefore important to identify the opportunities arising for synergistic benefits by promoting RDM across functional boundaries, for example:

- *Linking abstraction charging (Water Resources function) and discharge consents (Water Quality function).* Rates of abstraction as well as of discharge affect the quality of surface waters; similarly, discharges may affect the uses to which abstracted water can be put. There is therefore an argument for linking abstraction and discharge permitting more closely than is done at present.
- *Industrial waste minimisation.* If the results of early initiatives can be sustained, is likely to result in reduced emissions to some or all media, and also to result in more efficient use of resources – notably energy and water. This is a good example of where action in one area can have positive implications in another; there are also some counter-examples where an improvement in one area can have negative implications in another (see *Box 3.2* on page 16).

(1) BPEO is the Best Practicable Environmental Option; BATNEEC is the Best Available Technique Not Entailing Excessive Cost.

The following sections examine in more detail the opportunities and barriers for action by the Agency, looking at 'direct' and 'indirect' policy instruments respectively. Direct policy instruments are those which fall primarily within the scope of the Agency's powers and responsibilities; indirect policy instruments are those which fall outside the Agency's direct control, and which can only be applied by influencing another actor.

5.3 Direct Policy Instruments

This section presents a number of policy instruments which the Agency has directly at its disposal, or which it could have given a feasible change in the law. It follows the same categorisation as presented above and examines both the extent of the opportunities afforded by each option, and the barriers to these being realised.

5.3.1 *Pricing by the Agency*

This section considers three means by which the Agency could provide greater incentives for demand-side management using types of charge that it already levies: on abstraction licenses, discharge consents, and IPC authorisation licenses.

Water: Incentive Abstraction Charging

The opportunity exists to charge for abstractions so as to provide stronger incentives for abstractors (especially the water companies) to manage their demand for water. In addition to seasonal tariffs, charges could also be varied according to conditions (so that higher charges could be imposed during times of drought).

At present, license fees are:

- limited to a low level by the statutory constraint that the income generated from them must only be used to finance the Agency's water resource function; (1) and
- based only on the licensed, rather than the actual, volume of water abstracted (with the exception only of spray irrigation).

For some time the Agency has argued for the cost-recovery constraint on abstraction licenses to be removed. The review of the abstraction licensing system recently announced by the new government may provide a new opportunity for the Agency to re-state this case, as well as tackling the recognised problem associated with licenses of right (which is understood to be one of the central elements of the review).

There are a number of barriers that would have to be overcome in introducing an incentive licensing system, in addition to the need for statutory change:

- the cost of introducing metered charging systems (estimated at a one-off charge of £24 million and annual costs of £4.2 million for maintenance, site visits and billing); (2)
- the need to build on the current approach to develop a system that would take account of the varying environmental impacts associated with the abstraction (time of abstraction, supply source, location of use within catchment, quantity and quality of resource-relevant return flows), and yet be workable; and
- the potential difficulties associated with imposing significantly increased costs on water companies – although the cost implications of higher abstraction charges may be reduced by phasing them in over time.

Advocates of incentive charging believe that its environmental benefits would significantly outweigh its costs – but there is some potential for adverse environmental effects (see *Box 3.2* on page 16).

There is also some potential for the Agency to reform its existing abstraction charging system to ensure that it sends the correct incentives to abstractors, however small (eg to include consideration of whether groundwater abstraction is damaging, because of depletion, or beneficial, because of problems caused by a rising water table).

Possible next steps for the Agency: Develop a model of what an incentive abstraction charging system would look like and attempt to evaluate its costs and benefits; continue to lobby government for the introduction of such a system.

Water: Facilitating Transfer of Water Between Companies

A major issue associated with the effectiveness of water resources plans is the commercial context within which the water companies operate. It is quite possible for there to be an overall surplus of water, but for this not to be utilisable because the water companies involved are unwilling to trade bulk supplies of water. For instance, where a small water company could alleviate problems of water scarcity in its own territory by buying water from a larger neighbour, it may not wish

(1) The Environment Agency's 1997/98 Corporate Plan indicates that income to the water resources function (which presumably consists of revenue from abstraction licenses) more than covers the expenditure by this function.

(2) Although most abstractions are metered, the measurements taken are only used to ensure that abstracted volumes do not exceed licensed volumes and for statistical purposes, and the state of repair and accuracy of these meters is often poor. (The cost estimates cited here are from the Agency's R&D Project on *Abstraction Incentive Charging*, which focused on the practical implications of introducing a system of incentive charging for abstractions.)

to do so because of fears that dependence on its larger neighbour would increase the likelihood of it being taken over. At present, the Director General of Water Services has powers to determine disputes over bulk transfers of water, but only where requested to do so by a water company. This power has not been used, although there are a number of examples of where inter-company transfers have been negotiated by mutual agreement. The Agency's approach to water management, based on the premise that water transfers between companies will always take place where it is in society's best interests that they should, may therefore not be effective in practice because of the commercial pressures on water companies.

The Agency recognises this problem. In its evidence to the House of Commons Environment Committee, the Agency stated that it would like to have powers over transfer agreements between water undertakings where agreement cannot be reached, and to require water resource management agreements. (1) The ability to impose requirements on water companies may be necessary in order to overcome these commercial barriers to water transfers; although there is also an argument that restrictions on the availability of new abstraction licenses, combined with the power of the Director General of Water Services to dictate the terms and conditions of any transfer, should be sufficient. If the Agency is given powers to require transfer agreements, the strong commercial dimension to such transfers would mean that new powers in this area would have to be exercised with care. It has been suggested by water demand management researchers that better dialogue between the Agency regions and water companies is an important first step which might avoid the need for further regulatory powers.

An alternative approach floated informally by the Agency would be for the Agency to retain 'ownership' of water through the company which distributes it in bulk, until it reaches the company that will ultimately deliver it. The originating company would be treated as a 'common carrier' of the water, rather than having ownership of it up to the point of sale to the receiving company. This approach would circumvent the difficulties associated with the market power of large companies supplying their smaller neighbours. However, this approach does have a number of difficulties. Probably the most fundamental difficulty is that this approach would only be feasible where an originating company could transfer untreated water to its neighbour. Whilst this is possible in some areas, in others only transfers of potable water may be technically feasible. In these cases the Agency would have to take ownership of treated water (ie water whose value has been substantially enhanced by the originating company), rather than simply retaining 'ownership' of the same water that was initially abstracted. In addition to practical problems, there is also the question of whether this more proactive role for the Agency is appropriate for a regulatory body.

Next steps: The issue of transferring water between companies needs to be addressed. It is not clear, however, whether giving the Agency powers to require bulk transfer agreements between companies would be the most effective solution. Evidence that the Agency's existing powers are insufficient would be helpful if the Agency wishes to continue lobbying for new powers in this area.

Water: Linking Charges for Abstraction Licenses and Discharge Consents

There is a link between the impacts of abstractions and discharges on the environment:

- greater abstractions reduce the flow of water available to dilute polluting discharges; and
- discharges can provide an important additional resource if treated sufficiently and discharged at an appropriate point (or re-used directly).

The linkage is strongest for biodegradable substances for which total mass loads are of less concern than the immediate impact of the discharge on the receiving watercourse. For these substances there is the potential to provide appropriate incentives for water users by reducing charges (for either or both of abstraction and discharge) where the discharge is returned at a point in the catchment and in a form where it is suitable for further use. This approach would create an incentive for reuse of effluent.

The main barrier to implementing this suggestion is likely to be the difficulties of translating it into a workable system whose benefits outweigh the extra complexity of administering it. One approach would be to conduct a thorough review of the abstraction and discharge consenting processes with a view to creating an integrated consenting procedure; alternatively, more detailed criteria relating to the resource-usefulness of a discharge could be incorporated into the abstraction licence.

(1) House of Commons Environment Committee (1996), *First Report on Water Conservation and Supply*, HC 42-I, para. 279.

The existing approach to charging already aims to send the right price signals to abstractors and dischargers, although it could be improved in some important respects. Dischargers could be given stronger incentives to reduce their pollutant loads than exists under the current banding system, for instance. It appears unlikely, however, that there would be significant benefits in changing the system to link together charges for abstractions and discharges unless the cost-recovery constraint were removed, and higher charges could be set to reflect environmental costs. There would then be scope for basing charges for abstraction and discharge on a common approach to valuing environmental damage (see *Box 4.2* on page 31 for one suggestion of how such an approach might work).

Next steps: Carry out a more detailed analysis of the feasibility of implementing a more integrated abstraction and discharge licensing system.

Integrated Pollution Control: Authorisation Charging

At present, charges for IPC authorisations are primarily based on a system of 'components', with standard charges being levied for the authorisation of each component. Components are defined so as to act as a proxy for the time and resources spent on authorising each one: a large installation might typically consist of 2 or 3 components, with only the largest of works having as many as, say, 15. An alternative approach, based on charging for inspectors' time, is also available for staged or outline applications in which the precise form of plant is not determined at the time of application. Charges, once again, are set so as to recover the Agency's costs.

In principle, it should be possible to charge according to the quantity of pollution that a plant is authorised to produce, so as to give operators an additional incentive to reduce it. This option was specifically considered in a review of HMIP's component-based charging scheme that was published for consultation in October 1993, and was rejected in favour of the existing system. Pollution charging is seen as complex and difficult to implement, although once set up, a system based on authorised releases might not be more costly to administer than the current approach.

Despite its theoretical merits, it therefore appears unlikely that a pollution-based charging system for IPC authorisations is a feasible proposition, at least within the current cost-recovery constraint. The difficulties associated with administering such a system in a robust and equitable way, whilst retaining sufficient certainty in the Agency's revenues from the charges, are likely to outweigh any potential benefits resulting from its incentive effects.

Raising the overall level of charges, combined with the use of incentive charges based on the quantity of pollutant emitted, may prove more feasible, since the greater incentive effect of higher charges may justify the greater administrative expense of an incentive system. A number of other countries have implemented economic instruments in pollution control, including SOx trading in the United States, and air pollution charges in France, Japan and Sweden. (1) Further development of the Agency's chemical release inventory may provide a basis for charging. However, industry has already raised strong objections to the level of charges for IPC authorisations; the political feasibility of raising these further may be poor.

Next steps: At present, it appears unlikely that charging for IPC authorisations on the basis of the pollution intensity of the authorised process is cost-effective. However, the possibility should not be ruled out of future consideration.

5.3.2 *Other Economic Instruments*

Water: Tradeable Abstraction Permits

Tradeable permits have been proposed for water abstraction by a number of commentators. (2) The main advantages of such a system are that it :

- gives certainty to the total amount of water that can be abstracted;
- allows water to go to those users who value it most highly;
- does not require the Environment Agency to have good information about abstractor responses, in order to predict responses to charges; and
- does not impose costs on existing permit holders (assuming that permits are issued to those who currently hold them).

However, there are a number of disadvantages to a tradeable permit system for water, including:

- the need to protect third-party interests and 'in-situ' uses of water, given the potential environmental impacts of changes in the point of abstraction and transfers between catchments;
- the difficulty of distinguishing different water uses, with associated differences in return flows, in a permit system;

(1) See Opschoor, J. B., de Savornin Lohman, A. F. and Vos, H. B. (1994), *Managing the Environment: The Role of Economic Instruments*, OECD, Paris, pp. 57-59.

(2) The analysis here follows Rees, J. and Williams, S. (1993), *Water for Life*, CPRE, London, pp. 61-64.

- the likely existence of monopoly power;
- the existence of 'sleeper' licenses, ie those which are currently unused, but are likely to be brought into use through trading (it may be possible to deal with this problem by reviewing existing licenses prior to introducing trading);
- the adverse environmental, social and economic impacts of large scale transfers of water, especially where whole communities are dependent on a water-based economic activity; and
- the difficulty of raising revenue from a permit-based scheme (assuming that permits are grandparented and grant the right to abstract over many years).

A number of criteria have been suggested [1] to distinguish cases where tradeable permit schemes are likely to have the greatest benefits. Rees has concluded that the most appropriate test-bed for tradeable permits in England and Wales would be a limited system of tradeable permits between irrigators. Such a trial would not only test the feasibility of the tradeable permit concept in water abstraction, but would also enable an evaluation of the environmental consequences of the likely intensification of agriculture that would result from such a scheme.

Next steps: The Agency could press for authority from Government to implement a limited permit-trading scheme for irrigators, as part of the current review of the abstraction licensing system.

5.3.3 *Regulation*

This section focuses on the scope for using the Agency's regulatory functions as a springboard for information provision and education about possible demand-side actions. It can be argued that the effectiveness of education and information provision is likely to be greatest in those areas where the Agency has regulatory powers, because:

- there may be synergistic benefits of being able provide information on good practice as part of the regulatory function;
- regulatory sanctions provide additional incentives for companies to act on good practice information; and
- companies may view a regulator like the Agency as having greater independence than a body with a commercial interest in the company's actions (eg consultants, water companies etc).

Areas in which information provision may best be coupled with the Agency's regulatory functions are promoting best practice in water use through abstraction licensing and industrial waste minimisation through integrated pollution control (IPC). Another example is using the Agency's comprehensive waste survey as a vehicle for promoting waste minimisation. [2] Action has already been taken in all these areas. In relation to abstraction licensing, the Agency is (thought to be) [3] currently involved in a collaborative project to develop and apply water saving management methods within industries reliant on their own water resources.

In relation to IPC, the Agency now has a specific duty to promote waste minimisation as a result of the recently-enacted Integrated Pollution Prevention and Control (IPPC) Directive – see *Box 5.1* below.

BOX 5.1 PROVISIONS OF THE IPPC DIRECTIVE RELATED TO WASTE MINIMISATION

- Article 3 requires competent authorities to ensure that facilities are operated in such a way that waste production is avoided [...]; where waste is produced, it is recovered or, where that is technically and economically impossible, it is disposed of; and that energy is used efficiently'.
- Annex IV specifies the considerations to be taken into account in determining what constitute best available techniques'. These include: the furthering of recovery and recycling of substances generated and used in the process of waste' and the consumption and nature of raw materials (including water) used in the process and their energy efficiency'.

Discussions with Agency representatives suggested that the IPC authorisation and inspection process already incorporates elements which promote waste minimisation. Inspectors may often go beyond merely ensuring compliance with minimum standards in offering advice about cost-effective measures to reduce waste. The Agency's draft Integrated Pollution Control Strategy (dated 11 December 1996) confirms that this is seen as a valid role for the Agency. The strategy lists one of the short-term priorities (to December 1997) as being to:

further develop pollution prevention and control tools, including integrated waste-minimisation initiatives, projects relating regulation to emission, efficiency and economic benefits (3Es project) and input to the developement of LEAPs. Launch 3Es project nationally and case studies on the benefits in each region.

(1) See Rees, *op. cit.*, p. 63.

(2) ENDS Report 267, April 1997, p.14.

(3) The project was proposed to start in 1996/97 (ref. W6E(95)2), but its actual start has not been confirmed to the consultants.

However, there are two issues that arise in connection with incorporating a waste-minimisation function into the authorisation and inspection process:

- *Commercial confidentiality.* Where firms are operating in the same markets, inspectors may be constrained from providing information about best practice by concerns about commercial confidentiality. These constraints may be strongest when the techniques concerned offer the greatest potential for savings.
- *Regulatory capture.* HMIP was sometimes criticised for taking too much of a collaborative approach to its regulatory functions. Incorporating the giving of waste-minimisation advice into the regulatory function would therefore have to be done with care to ensure that inspectors remained objective in their judgements about environmental performance.

Discussions with Agency staff suggested that the 3Es project is currently seen as a short-term approach which will need to be supplemented by longer-term measures. These are likely to include technical support for waste-minimisation clubs in the form of generic tools, training materials etc; and, in the long term, educating future industrialists and business people about the importance of the environment on a business's bottom line.

The Agency has also funded an R&D project on agricultural waste minimisation 'to demonstrate the benefits to farmers of waste minimisation in order to encourage them to undertake improved waste-management practices to reduce pollution risk'.(1)

Next steps: The Agency should develop its policies in relation to its role in providing information to those it regulates. It should provide guidelines (or training) for inspectors on how they may be able to assist operators to improve resource efficiency and minimise waste, without compromising their regulatory function. Funding for R&D in waste minimisation and water demand management should continue to support this activity.

5.3.4 *Dialogue*

Dialogue between the Agency and other actors cannot, in general, be considered to be a 'direct' policy instrument. Improved dialogue with water companies, for instance, is likely to be helpful in drawing up meaningful water resources plans; but is unlikely to lead directly to the implementation of demand management measures. However, there are some cases where dialogue may lead directly to the implementation of such measures.

One possibility is for the Agency to facilitate greater use of recycled effluent by identifying uses of water where recycled water could feasibly be used, at both generic and site-specific levels. Where a potential user of recycled effluent is close to an effluent treatment plant, there should be potential gains to be had for both parties: the company abstracting water could obtain it more cheaply using treated effluent, whilst the effluent treatment plant would be able to charge for the disposal of some effluent as a resource (rather than being charged for releasing it as a pollutant). These gains would be magnified if abstraction and discharge license costs rose. The Agency is ideally placed to act as a site-specific 'arbitrageur' under these circumstances, since it must licence both the abstraction and the discharge in question. Bringing these two functions together internally will represent a challenge, however. Generic research would also be helpful to develop understanding of where recycled water can most effectively be used, and how to overcome the problems of doing so.

Next steps: The Agency could investigate the feasibility of setting up a formal mechanism for internal dialogue, to identify opportunities for the re-use of treated effluent by bringing together abstraction and discharge licence information. Dialogue with the external parties involved could then be initiated. Further research into re-use of treated effluent is also likely to be needed.

5.4 Indirect Policy Instruments

This section examines opportunities for, and barriers to, actions which the Agency could take to promote RDM by catalysing activities by others. Demands on resources for which the Agency has some responsibility cannot be divorced from the influences of other statutory bodies, government policy and the wider economy. There is therefore a need to integrate an RDM approach into wider decisions (such as in land use planning). Some of these co-ordination mechanisms may function through non-statutory consultation and dialogue; but some of the 'direct' policy instruments discussed above may also function in this role.

(1) R&D Project No. 668, completed June 1996.

5.4.1 *Pricing by Others than the Agency*

Pricing of water and waste collection/disposal are both areas where the Agency has an important regulatory role, but does not itself set prices for end users of these services. They are also areas where users currently do not face adequate price signals – for most households, the marginal cost of producing an additional unit of waste or of using an extra unit of water is zero. The Agency therefore has a role in:

- maintaining pressure on policy makers and others to introduce unit pricing in a staged and appropriate way; and
- informing the debate about the implications of different pricing mechanisms from an environmental perspective.

The Agency already has an established policy supporting the introduction of water metering. It also needs to work with OFWAT to continue placing pressure on the water companies to price water in such a way as to encourage demand management through sending the right price signals, without causing undue hardship to low income households (and other vulnerable groups) – see *Section 4.2.3*.

In relation to solid waste, the landfill tax has already gone some way towards increasing the cost of ultimate disposal to reflect more closely its full long-run marginal cost, including environmental costs – although there are indications that it may also have undesirable consequences, including an increase in fly-tipping. (1) Through the Agency's waste regulatory functions, it has an important role in advising Government on the response to this innovation (both positive and negative), and hence in influencing future tax levels. The Agency can also play a role in encouraging the development of unit pricing for municipal waste, which is likely to need a change in statute to enable trial schemes to go ahead (see *Section 3.3.2* for further discussion of this point).

Next steps: Continue to work with national and local government, OFWAT and the water industry to promote appropriate unit pricing for household water and waste collection/disposal.

5.4.2 *Regulation*

In addition to exercising its own regulatory powers to promote RDM, the Agency plays a role in influencing regulatory powers exercised by others. There are a few cases where the Agency plays a pivotal consultative role, such as in advising the Secretary of State for the Environment, Transport and the Regions in exercising his (or her) powers to grant drought orders. The Government's request to the water companies to draw up drought contingency plans in conjunction with the Agency will strengthen this role, and provide a mechanism for promoting appropriate short-term demand-management measures under drought conditions.

The Agency's role also extends, however, to commenting on regulatory structures where there is no statutory basis for consultation. Perhaps the most important example in this respect is the need for the Agency to scrutinise OFWAT's regulation of the water industry, to ensure that it provides companies with the right incentives to implement demand-side measures – see *Section 4.4*.

Next steps: Further develop dialogue with OFWAT concerning the environmental consequences of the regulation of the water industry. It may be helpful to develop greater in-house understanding of options for developing the regulatory system.

5.4.3 *Dialogue, Information and Education*

The importance of the Agency's role as a catalyst for change through dialogue with the many actors on whom successful RDM depends, and through the provision of information and education, should not be underestimated. This report has argued that RDM is not just a set of techniques and technologies, but a new way of thinking and working. The Agency has an important role to play in furthering this kind of structural change.

Better dialogue is likely to be needed between the Agency and the following 'primary' actors:

- *water companies* – in drawing up water resources and drought contingency plans and in developing demand-side strategies;
- *OFWAT* – in ensuring that the regulatory framework promotes rather than penalises RDM;
- *Government* – in lobbying for legislative changes which would promote RDM;
- *land use planners* – in raising the profile of water supply as a planning issue (see *Section 5.4.4* below); and
- *waste companies and collection/disposal authorities* – in developing strategies to promote waste minimisation, composting and recycling (see *Section 3.3.4*), preferably in conjunction with the selective introduction of unit pricing.

(1) Environment Business, 5 June 1997, p.2.

However, it is also important for the Agency to develop contacts with 'secondary' actors such as:

- *professional groups* – notably developers, architects and engineers, who are responsible for design of new development and industry, and who are therefore crucial to the resource demands created by that development;
- *industrial (and commercial and agricultural) groups* – who provide potential partners for the development of new techniques and practices, and channels for the dissemination of best-practice information;
- *environmental and consumer groups* – who play an important role in shaping public opinion, and so should be actively involved in attempts to promote RDM, in order to improve its public acceptability; and
- *schools and colleges* – who offer the best opportunities for influencing the attitudes and values of future consumers. In this context the Agency could develop links with existing groups who are working to incorporate environmental concerns into the National Curriculum.

Some of these groups are already brought together through the development of Local Environment Agency Plans (LEAPs), and there may be scope for strengthening and broadening these fora to cover a wider range of issues, including RDM. New fora are likely to be needed at different geographical levels, however, to open new channels of communication. The regional fora and local consultative bodies proposed in the government's consultation draft of PPG23 'Planning and Pollution Control', which focuses on waste issues, might provide a model for other sectors.

In this context, it is important that the Agency continues to fund research, collaboratively wherever appropriate, in order to maintain and enhance its status as a source of high-quality information and expertise.

Adequate internal communication channels are also necessary in order to maximise the realisation of cross-functional opportunities that arise for RDM measures (such as in waste minimisation and integrated abstraction/ discharge consenting). New mechanisms for this communication may be needed.

The following section examines how water demand management could be better integrated into land use planning, as a case study in improved dialogue and information provision.

Next steps: Carry out a review of opportunities for creating new fora – and also potentially re-focusing existing ones – where dialogue can take place, both outside and within the Agency.

5.4.4 *Promoting Water Demand Management Through Land Use Planning*

Integrating RDM into land use planning is essential if the full potential of demand management is to be realised. There are three key areas where the Agency could assist in developing linkages between RDM and land use planning:

- improving understanding of spatial variations in the level of stress placed on water networks and the appropriateness of demand-side measures;
- attempting to steer development towards areas enjoying spare capacity or, where this is not possible, making efforts to reduce the impacts of development through better water management; and
- creating local fora through which different actors can examine and debate the implications of potential RDM measures (see *Section 5.4.3* above).

Greater links could be made with the planning process through the institutional development of water as a 'material consideration' in the development plan as a whole and at the level of the individual planning application. This would allow the Agency to extend its sphere of influence in water management, but would require a change in policy at national level.

The Environment Agency already has considerable experience and strategic resources upon which it can build to help develop RDM in partnership with the land use planning system. Planning liaison officers, working to implement local Catchment Management Plans and the development of Local Environmental Action Plans, could act as a medium to encourage the re-direction of development volume at the regional level and to promote end-use efficiency at the local level. The Agency could build upon these current initiatives by:

- *Raising knowledge of water stress.* The Agency could play a vital role in helping to identify those areas where water networks are particularly stressed, and in which demand is rising and/or development activity is intense. This map of water stress would ideally be co-ordinated nationally and be developed at a range of spatial scales from individual towns and cities to wider locales and regions. Sensitivity to the market boundaries of differing water companies in relation to areas of excess water capacity and water stress would be vital to engage and co-ordinate potentially conflicting strategies of local water companies. This enhanced knowledge of the capacity of local water networks would provide helpful information in wider debates about the volume and location of housing and commercial buildings and their relative environmental impacts.

- *Advising on contextually appropriate technological strategies.* The Agency could usefully advise on the development of packages of technological measures aimed at both maximising the efficiency of water supply networks to areas of water stress, and in reducing local demand in existing buildings and in new developments. Providing advice at the planning stage on appropriate re-use strategies is of particular importance given the general lack of awareness of the technical possibilities. The Agency could offer basic technical advice on the suitability of particular technologies in specific locations and so assist in developing a strategy to better balance water supply and demand. For instance, given the relatively high cost of retrofitting efficiency measures in existing buildings, in most cases it is probably sensible to focus attention initially on reducing the water intensity of new development.
- *Promoting best water management practice in land use planning.* The Agency could help ensure that local and national planning guidance supports these innovative and context-specific styles of land use planning. PPG Notes should provide stronger, less ambiguous encouragement to implement RDM strategies, particularly in areas of water stress and high development activity. At the level of regional guidance this would aim to guide development towards area of spare capacity, while at the local level guidance would strongly encourage end-use efficiency to be monitored at the planning application level. The development and promotion of 'best practice' institutional procedures and technological initiatives could be disseminated through new, locally based institutional forums which could in turn help formulate and promote locally tailored water management strategies.

The proposed Directive on Strategic Environmental Assessment may also strengthen the integration of environmental issues into land use planning – see *Box 5.2* below – although it is not clear at present whether it would significantly change the approach used in areas where the environment already features strongly, such as for water and waste planning.

Next steps: Investigate the feasibility of developing maps of water stress; continue to develop Agency expertise in relation to water demand management measures; lobby government to change PPG Notes to provide for water stress as a 'material concern' in planning decisions, and work with local authorities to incorporate water stress as a factor in local and other plans.

BOX 5.2 PROVISIONS OF THE DRAFT DIRECTIVE ON STRATEGIC ENVIRONMENTAL ASSESMENT

The proposed Directive on Strategic Environmental Assessment, whose first draft was published in 1991, was revived at the end of 1996. Instead of requiring the environmental assessment of policies (as the first draft did), the new draft limits the scope of the Directive to new or modified land use plans and programmes' which:

- are formally adopted by a competent authority or prepared by an authority for subsequent adoption by legislation;
- form part of the land use decision-making process for the purpose of setting the framework for subsequent development consent conditions'; and
- contain provisions on the nature, size, location or operating conditions of projects.

Such plans are specifically defined to include plans and programmes in sectors such as transport (including transport corridors, port facilities and airports), energy, waste management, water resource management, industry (including extraction of mineral resources), telecommunications and tourism'.

The proposal would not require Member States to introduce formal procedures for the adoption of plans in any of these areas - the provisions of the Directive would only apply to plans and programmes that are subject to existing formal procedures. In the UK context, it would therefore certainly apply to structure, local and unitary development plans, as well as minerals plans and waste local plans. It would also presumably apply to the Agency's national and regional water resources strategies.

The proposal incorporates a number of specifications for strategic environmental assessments, including the need to consider alternative ways of achieving the objectives of the plan or programme and to explain why they were not adopted.

6. Conclusions and Recommendations

6.1 RDM and Sustainable Development

Sustainable development is a term which the Environment Agency and other organisations are increasingly seeking to turn into a practical objective for decision making. It involves elements of both good outcome and good process.

- In outcome terms the focus has been on the development of indicators which can measure limiting factors in the environment, stocks of environmental and other "capital", or progress with respect to other environmental, social or economic outcomes.
- In process terms the emphasis has been on integrating environmental concerns into other decision-making areas, for example through getting prices right (internalising environmental externalities) or through decision-making processes which require explicit consideration and balancing of all economic, environmental and social advantages and disadvantages.

In this report we have used the term Resource Demand Management (RDM) to describe a range of measures which can be taken to ensure that decision makers take account of the full range of managerial options in order to balance levels of demand with resource supplies, and that demand- and supply-side options are compared on an equal footing. In this sense RDM is an important element of sustainable development as a process.

An analysis of the 13 principles and techniques developed by the Agency in support of its duty to promote sustainable development also suggests a strong continuity with RDM, in terms of both objectives and approach.

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