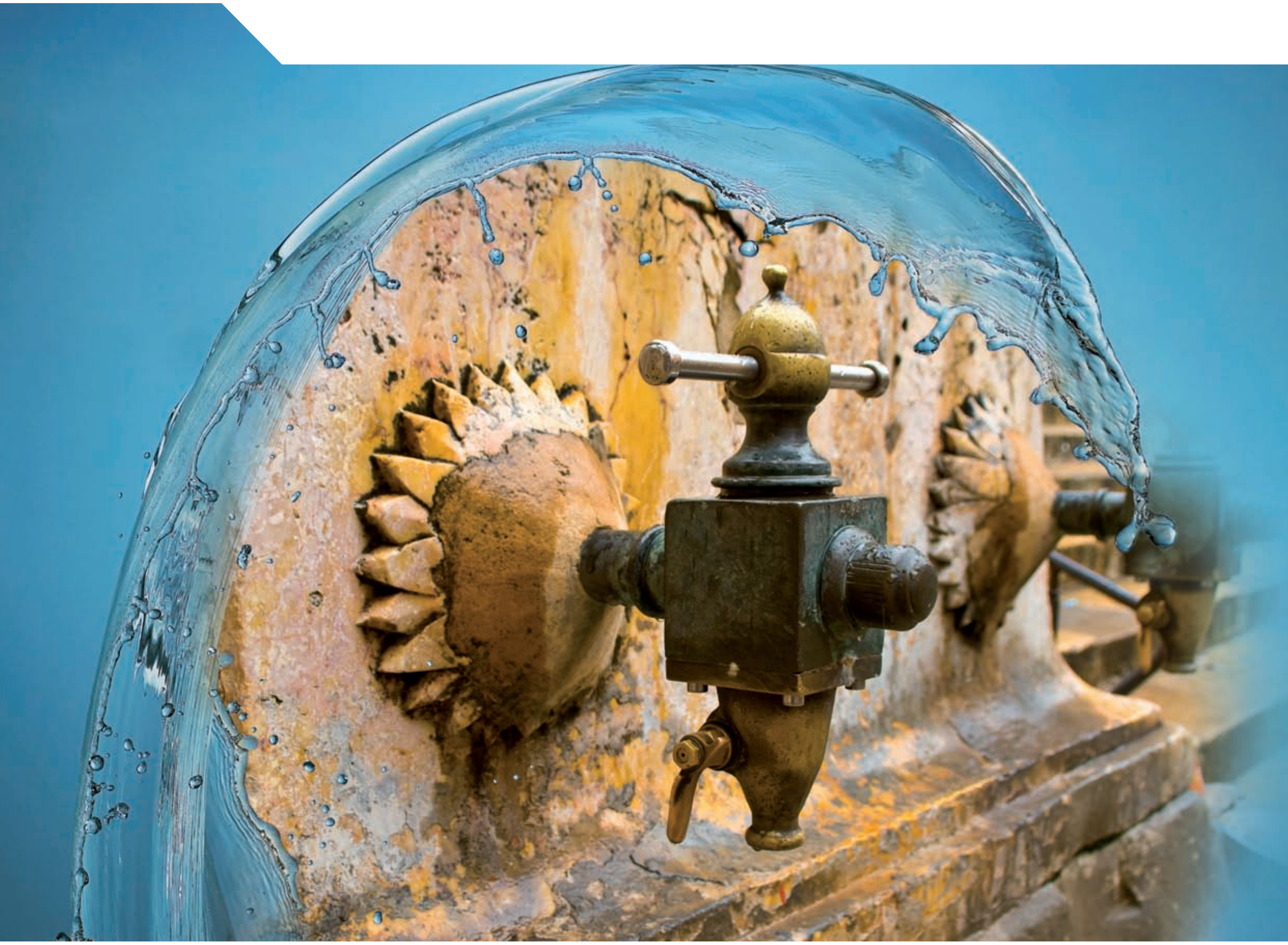
OECD Studies on Water

Meeting the Water Reform Challenge



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Preface

Good water management is fundamental to human and economic development, and to the maintenance of ecosystems.

Water policies around the world are in urgent need of reform. Despite improvements in some sectors and countries, progress on meeting national, regional and international goals for managing and securing access to water for all has been uneven. Rallying policy makers around a positive water reform agenda needs to be a high priority and calls for strong political commitment and leadership.

This report on *Meeting the Water Reform Challenge* brings together key insights from recent OECD work and identifies the priority areas where governments need to focus their reform efforts. Drawing on the *OECD Environmental Outlook to 2050*, the report shows that water demand is expected to increase by 55% over the next 40 years, with increasingly rapid urbanisation, population growth and changing economic dynamics putting increasing pressure on water resources. These trends and projections underscore the need for more ambitious policies and new ways of looking at the water challenges.

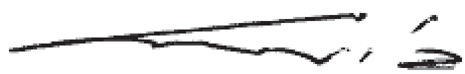
The report calls for governments to focus on getting the basics of water policy right. Sustainable financing, effective governance, and coherence between water and sectoral policies are the building blocks of successful reform.

The OECD has been a strong advocate for putting the question of sustainable financing for water supply and sanitation at the forefront of international policy discussions. Closing the significant gap between available funding and needed investment will require significant efforts by governments and the private sector. In developing countries, current spending will need to double to about USD 18 billion a year to expand water services and achieve the Millennium Development Goals for water and sanitation. Another USD 54 billion of spending will be needed every year to just maintain the existing water infrastructure in those countries. The report presents strategies on how finance for essential water and sanitation services can be mobilised, and identifies policy tools that can assist countries in obtaining sustainable financing.

The report also focuses on the challenge of multi-level governance of water policy, and highlights the importance of ensuring co-ordination within and across government institutions. Highly fragmented roles and responsibilities, low financial and technical capacity, and poor regulatory frameworks are important obstacles to reform design and implementation. Effective public governance is critical for regulation and for the appropriate mix of policy instruments that offer incentives to different groups of users to engage in sustainable water practices. Appropriate governance is also crucial for ensuring consistency between water policies and planning on the one hand, and engineering and infrastructure investments on the other.

There are options for enhancing policy coherence between water and other sectoral policies. Unfortunately, policies across water, energy, agriculture and the environment are often formulated without sufficient consideration of their inter-relationships. Agricultural support policies, fossil fuel subsidies, and support for some forms of biofuels are examples where there is a generally a high degree of inconsistency with water policies, with implications for the sustainability of the water resource base. Unravelling historical policy and institutional legacies, and sharing information are key steps in breaking down the barriers for more coherent policies.

One of the defining features of the water crisis is that many policy solutions do exist and are well-known. The real challenge lies in expanding the evidence base and implementing the solutions. This report on *Meeting the Water Reform Challenge* contributes to that process. It has been prepared for the 6th World Water Forum in Marseille on 12-17 March 2012 and I am delighted that the OECD is joining forces with other international organisations, governments, business and civil society to address the water challenge and promote better water policies for better lives.



Angel Gurría
OECD Secretary-General

Acknowledgements

This report brings together OECD work on water from the last three years that has been undertaken under the umbrella of the OECD Horizontal Water Programme (HWP). The HWP brings together expertise from the Environment Directorate, the Trade and Agriculture Directorate, the Public Governance and Territorial Development Directorate, the Directorate for Financial and Fiscal Affairs, and the Development Co-operation Directorate.

Preparation of this report was co-ordinated by Anthony Cox from the Environment Directorate. Inputs to the report were provided by: Xavier Leflaive and Anthony Cox (Chapter 1); Sophie Tremolet (Tremolet Consulting), Peter Borkey and Celine Kauffmann (Chapter 2); Aziza Akhmouch (Chapter 3); and Kevin Parris, Roberto-Martin-Hurtado and Anthony Cox (Chapter 4). The report draws on a number of recent and forthcoming OECD publications, including *Benefits of Investing in Water Supply and Sanitation* (2011), *Meeting the Challenge of Financing Water Supply and Sanitation: Tools and Approaches* (2011), *Ten Years of Water Sector Reform in Eastern Europe, Caucasus and Central Europe* (2011), *Water Governance in OECD Countries: A Multi-Level Approach* (2011), and *OECD Environmental Outlook to 2050* (2012).

The report also benefited from the presentations and discussions at the OECD Global Forum on the Environment: Making Water Reform Happen, held in Paris on 25-26 October 2011. The Rapporteur's report from the conference, prepared by Jim Winpenny (Wynchwood Economic Consulting Ltd), can be found at *www.oecd.org/water*.

Sama Al Taher Cucci assisted in the preparation of the report for publishing and Peter Vogelpoel did the typsetting.

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Acronyms and abbreviations

3Ts	Tariffs, Taxes, Transfers
AFD	*Agence Française de Développement* (French Development Agency)
AICD	Africa Infrastructure Country Diagnostic
AIDS	Acquired Immune Deficiency Syndrome
ANA	*Agencia Nacional De Aguas* (National Water Agency) – Brazil
ANU	Australian National University
BL	Baseline Scenario
BOT	Build-Operate-Transfer
BRIICS	Brazil, Russia, India, Indonesia, China and South Africa
CAP	Common Agricultural Policy
CCIEP	Co-ordination Committee for International Environmental Policy
CCIM	Inter-Ministerial Conference for the Environment
CEA	Cost-Effectiveness Analysis
CEDEX	*Centro de Estudios y Experimentación de Obras Públicas* (Centre for Studies and Experimentation of Public Works) – Spain
CFE	*Comisión Federal de Electricidad* (Federal Commission of Electricity) – Mexico
CIW	Committee on Integrated Water Policy – Belgium (Flanders)
COFEPRIS	*Comisión Federal para la Protección Contra Riesgos Sanitarios* (Federal Commission for the Protection against Health Risks) – Mexico
CONAFOR	*Comisión Nacional Forestal* (National Forestry Commission) – Mexico
CONAGUA	*Comisión Nacional del Agua* (National Water Commission) – Mexico
COST	European Cooperation in Science and Technology
CSP	Concentrating Solar Power
CTOOH	*Comité Técnico de Operación de Obras Hidráulicas* (Technical SteeringCommittee for Hydraulic Works) – Mexico
DAC	Development Assistance Committee
DALYs	Disability adjusted life-years
DWI	Drinking Water Inspectorate – United Kingdom

EA	Environment Agency – United Kingdom
EAP	Environmental Action Programme
EBRD	European Bank for Reconstruction and Development
EECCA	Eastern Europe, Caucasus and Central Asia
ERA	Economic Regulation Authority – Australia
ERSAR	Regulatory Agency of Water and Wastewater Services – Portugal
ET	Evapotranspiration
EU	European Union
FINDETER	*Financiera de Desarrollo Territorial* (Financial Corporation for Territorial Development) – Colombia
FPTWU	Financial Planning Tool for Water Utilities
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GLAAS	Global Annual Assessment of Sanitation and Drinking Water
GWI	Global Water Intelligence
HIV	Human Immunodeficiency Virus
IBNet	International Benchmarking Network for Water and Sanitation Utilities
IFIs	International Finance Institutions
IGME	*Instituto Geológico y Minero de España* (Geological and Mining Institute) – Spain
IIUNAM	*Instituto de Ingeniería de la Universidad Nacional Autónoma de México* (EngineeringInstitute of the National Autonomous University of Mexico) – Mexico
IMTA	*Instituto Mexicano de Tecnología del Agua* (Mexican Institute of Water Technology) – Mexico
IPOs	Initial Public Offerings
IWA	Israeli Water Authority
JMP	Joint Monitoring Programme (WHO/UNICEF)
LGUGC	Local Government Unit Guarantee Corporation
LPG	Liquefied Petroleum Gas
MDG	Millennium Development Goal
MEEDDM	*Ministère de l'Écologie, de l'Énergie, du Développement durable et de la Mer* (Ministry of Ecology, Energy, Sustainable Development and Maritime Affairs) – France
MEWR	Ministry of Environment and Water Resources
MIRA	Flemish Environment Report
NRW	Non-revenue water

NWL	National Water Law
NZ EPA	New Zealand Environmental Protection Authority
OBA	Output-Based Aid
ODA	Overseas Development Assistance
OECD	Organisation for Economic Co-operation and Development
OFWAT	Water Services Regulation Authority – United Kingdom
O&M	Operation and Management
ONEMA	*Office national de l'eau et des milieux aquatiques* (National Water Office and Aquatic Environments) – France
PACA region	France's Provence-Alpes-Côte d'Azur Region
PME	*Programa de Modernización de Empresas* (Enterprise Modernisation Programme) – Spain
PPI	Public-Private Infrastructure Database
PPP	Public-Private Partnership
PRODES	River Basin Clean-Up Programme
PSP	Private Sector Participation
PV	Photovoltaic
RBMPs	River Basin Management Plans
REW	Recycled Effluent Water
RIAS	Regulatory Impact Analysis Statement
RoW	Rest of World
SABESP	*Companhia de Saneamento Básico do Estado de São Paulo* (Water and Sanitation Utility) – Brazil
SAGARPA	*Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación* (Ministry of Agriculture, Livestock, Rural Development, Food and Fisheries) – Mexico
SDAGE	*Schéma directeur d'aménagement et de gestion des eaux* (Water Management and Development Scheme) – France
SEDESOL	*Secretaría de Desarrollo Social* (Ministry for Social Development) – Mexico
SEEAW	System of Environmental and Economic Accounts for Water
SEMARNAT	*Secretaría de Medio Ambiente y Recursos Naturales* (Ministry of the Environment and Natural Resources) – Mexico
SENER	*Secretaría de Energía* (Ministry for Energy) – Mexico
SFP	*Secretaría de la Función Pública* (Ministry of Public Administration) – Mexico
SFP	Strategic Financial Planning

SHCP	*Secretaría de Hacienda y Crédito Público* (Ministry of Finance and Public Credit) – Mexico
SISS	*Superintendencia de Servicios Sanitarios* (Superintendence of Sanitary Services) – Chile
SOURSE	Water Resources Prospective and Management Scheme – France
SSA	Sub-Saharan Africa
STOWA	Institute of Applied Scientific Research – Netherlands
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESA	Spanish Association of Electrical Industry
UNICEF	United Nations Children's Fund
US EPA	United States Environmental Protection Agency
WASH	Water, Sanitation and Hygiene
WFD	Water Framework Directive – European Union
WIS	Water Information Systems
WHO	World Health Organisation
WRM	Water Resource Management
WSS	Water and Sanitation Services

Executive summary

The need to reform water policies is as urgent as ever. Yet governments around the world face significant challenges in managing their water resources effectively. The problems are multiple and complex: billions of people are still without access to safe water and adequate sanitation; competition for water is increasing among the different uses and users; and major investment is required to maintain and improve water infrastructure in OECD and non-OECD countries. Population growth, urbanisation, and changing lifestyles as a result of economic growth are key drivers of these challenges, while increasing spatial and temporal water variability resulting from climate change will exacerbate these pressures. Despite progress on many fronts, including on reaching the Millennium Development Goals on water and sanitation, in 2008 an estimated 141 million city dwellers and 743 million rural dwellers remained without access to an improved water source, and an estimated 2.6 billion people without access to sanitation.

Making reform happen in the water sector requires governments to ensure the incentives are aligned for all stakeholders. Governments must put in place the conditions to ensure that the actions of all stakeholders – different categories of users, multiple responsible authorities, financiers, and various service providers – contribute to the long-term objectives of environmental sustainability and enhancing social welfare. It also often means generating sufficient information and support for policy change by making the case for reform – answering the question of "what is in it for society and individuals?"

Reform in the water sector can take a range of forms, from wholesale and fundamental changes to the way that water policies are designed and implemented (such as in Australia, which has undertaken a long period of water policy reform, and in Mexico, which recently initiated a Water Reform Agenda) to relatively marginal adjustments to refine existing policy settings and instruments in order to improve their effectiveness. While there is no "one-size-fits-all" recipe for water policy reform, understanding the political economy of reform means taking into account how decisions are made and in whose interest; how reform is promoted or obstructed and why. Learning from the experience of past and on-going water reforms can help to illuminate wider lessons that can increase the prospect of success for future water reforms.

This report proposes a three-pronged approach to making water reform happen in terms of financing, governance, and coherence between water and other sectoral policies. These broad areas represent the fundamental axes for ensuring that water policy frameworks are sustainable and durable, yet flexible enough to respond to changing conditions.

Framing the challenges

The *OECD Environmental Outlook to 2050* projects the trends and highlights the dangers faced if the business-as-usual approach to environmental resources continues. Increasingly rapid urbanisation coupled with population growth and changing economic dynamics means that the future will be characterised by increasing pressure on water resources, potentially acute competition for water, declining water quality, and a continuing need to further improve access to safe drinking water and sanitation.

Freshwater availability will be further strained in many regions, with 1 billion more people than today (nearly half the world's population) projected to be living in river basins experiencing severe water stress, especially in South America, North and South Africa, and South and Central Asia. Overall, water demand is projected to grow by some 55% due to growing demand from manufacturing (+400%), thermal electricity generation (+140%) and domestic use (+130%). In the face of these competing demands, there will be little scope for increasing water for irrigation and, under the baseline scenario, there is expected to be some reduction in water for irrigation as a result of no increase in irrigated land and improvements in water use and efficiency. If these do not eventuate, competition for water will be even more acute.

The combined effects of these pressures could imply water shortages that would hinder the growth of many economic activities. Groundwater depletion may become the greatest threat to agriculture and urban water supplies in several regions in the coming decades. Nutrient pollution from point sources (urban wastewater) and "diffuse sources" (mainly from agriculture) is projected to worsen in most regions, intensifying eutrophication and damaging aquatic biodiversity.

Notwithstanding this, most regions, except Sub-Saharan Africa, are likely to meet the Millennium Development Goal (MDG) of halving by 2015 the 1990 level of the population without "improved" water supply. However, this will still leave behind over 200 million people without access to water by 2050. **Of critical importance is the fact that access to an "improved" water source does not necessarily mean access to "safe" water fit for human consumption.** Over the last two decades, the number of city dwellers without access to water services has increased, as urbanisation outpaced efforts to connect people to water infrastructure. It is expected that the MDG for sanitation will not be met by 2015, and by 2050, 1.4 billion people are still projected to be without access to sanitation, mostly in developing countries.

The *Environmental Outlook to 2050* underscores the need for more ambitious policies and new ways of looking at the water challenges. **Water needs to be seen as an essential driver of green growth**. Investments in infrastructure and operation of water-related services can provide high returns for both the economy and the environment. It is also crucial to develop mechanisms for allocating enough water across uses and users, including for healthy ecosystems, and to develop alternative sources of water (rain and storm water, used water and desalinated sea or brackish water). The inverse is also the case, where economic and social development can be retarded by lack of water infrastructure and inadequate service provision.

There is also a crucial need to develop water information systems to support more efficient and effective delivery of sustainable water resource management and policies. In particular, the rapid development in water policy reforms has created an information imbalance in many countries, with implementation of water policy initiatives often supported by little data and information.

The *Environmental Outlook* highlights the urgent need to get the basics of financing, governance and policy coherence right in water policy. These factors are essential for reforms to succeed, as well as representing key areas of reform in their own right. They are inextricably linked and addressing them is the key to give water a higher priority in government policy and unlocking the potential of the water sector to meet the aspirations of governments and societies in developed and developing countries.

Meeting the water financing challenge

Securing sustainable finance for this wide range of services is an ongoing struggle for most countries, particularly in the current global economic crisis. Increasing access to water supply and sanitation, ensuring the environmental sustainability of water ecosystems, reducing the impacts of floods and drought, and maximising access to safe water for societal welfare require financial support.

Sustainable financing lies at the heart of many of the solutions to improved water management. Aligning incentives through the use of tariffs and water prices is a key feature, as is securing private sources of funding. The need for sound governance arrangements to underpin the financial sustainability of the sector is equally essential: good governance and financial sustainability are inextricably linked.

Understanding the benefits of improved water and sanitation helps to make the case for reforms to ensure financial sustainability. Access to clean drinking water and sanitation reduces health risks and frees-up time for education and other productive activities, as well as increases the productivity of the labour force. Safe wastewater disposal helps to improve the quality of surface waters with benefits for the environment (*e.g.* functioning of ecosystems; biodiversity), as well as for economic sectors that depend on water as a resource (*e.g.* fishing, agriculture, tourism). Such benefits usually outstrip the costs of service provision and provide a strong basis for investing in the sector. In **developing countries**, WHO estimated that achieving the MDGs for water and sanitation could generate an estimated USD 84 billion per year in benefits, with a benefit to cost ratio of 7 to 1.

The investment needs in OECD, transition and developing economies differ but all remain significant. Despite a high initial asset base, **OECD countries** confront huge costs of modernising and upgrading their systems, so as to comply with increasingly stringent health and environmental regulations, maintain service quality over time, ensure the security of water supplies in response to climate change, pollution and growing populations, and in some cases, overcome the neglect and under-financing of earlier years. This could cost 0.35%-1.2% of GDP a year over the next 20 years. In **EECCA countries** (Eastern Europe, Caucasus and Central Asia), much of the existing infrastructure is old and over-sized for present needs, and is ill-suited to economic and demographic realities. It is estimated that around EUR 7 billion would be required annually for operation, maintenance and capital investments, which was roughly double available financing in 2006. But the need for investment is perhaps the most urgent in **developing countries**. It is estimated that the annual investment to meet the MDG target is USD 18 billion, although this is dwarfed by the estimated annual cost of maintaining existing services of USD 54 billion. More than 75% of annual needs to attain the MDG target for water and sanitation relate to the maintenance and the replacement of existing infrastructure.

Closing the financial gap requires countries to mobilise financing from a variety of sources, which may include reducing costs (via efficiency gains or the choice of cheaper service options), increasing the basic sources of finance that can fill the financing gap, *i.e.* tariffs, taxes and transfers (commonly referred to as the "3Ts"), and mobilising repayable finance, including from the market or from public sources, in order to bridge the financing gap. While the case for such reforms to ensure financial sustainability has been largely accepted in recent years, there is still a long way to go to implement the mechanisms. For example, improving the efficiency of operations can help to redress important losses of funds within the sector. Operational inefficiencies include poor revenue collection, distribution losses (referred to as leakage or non-revenue water), labour inefficiencies and petty corruption. In addition, the choice of hardware and technologies can make a big difference to costs. In **OECD countries**, the regulatory regime in place can critically influence the selection of investment options, and the resulting investment cost. For many **developing countries**, particularly in Sub-Saharan Africa, it is necessary to examine the broad range of options along the service ladder in order to assess the tradeoffs between affordability and investment costs when delivering improved water and sanitation.

As is now well-recognised, the 3Ts are the ultimate sources of finance for water and sanitation services (WSS). The 3Ts can also be used to leverage, and eventually repay or compensate, other funding sources, principally loans, bonds and equity. Each country is likely to adopt a different mix of the 3Ts to meet their financing needs. Most countries have used public transfers (either from their own government or from external sources) to fund the development of WSS, particularly for capital expenditure. As countries develop and WSS become more mature, there tends to be a shift towards more use of commercial finance, reimbursed by growing cash flows from user charges (*i.e.* tariffs). The next crucial step lies in the further implementation of the 3Ts in a wider range of countries. But this can only be done in conjunction with broader reforms to ensure the appropriate governance and regulatory arrangements are in place. In addition, while revenues from the 3Ts can close the financing gap for water and sanitation services, repayable finance can be used to bridge the financing gap. WSS providers usually look to mobilise repayable finance in order to finance capital expenditure for repairs, renewals or expansion of water and sanitation systems while ongoing operating costs and ordinary maintenance are routinely financed from a mix of the 3Ts.

The private sector has a significant role to play in helping to mobilise financing for the water sector. Formal and informal WSS operators, private financial institutions, and private companies can all help by improving overall sector efficiency (thereby reducing costs and financial needs) and improving the sector's creditworthiness and ability to attract financing; financing investment costs (particularly when the public sector's ability to borrow is limited); and managing and enabling the capital programmes of public authorities.

The financing challenge goes beyond ensuring the financial sustainability of the water services sector and encompasses the financing of water resources management functions of governments. WSS sits within a broader water value chain and is critically linked both upstream and downstream to the water resource base. Government management of that water resource base is central to the environmental and financial sustainability of the sector. Looking across the range of functions that water resources management entails – both the "hard" infrastructure functions and the "soft" governance functions – it is clear that countries face important social choices related to financing water resources management. Identifying benefits and beneficiaries, distinguishing between public and private costs, and applying a range of instruments based on the user pays (or beneficiary pays) principle is key to meeting this financial challenge, in addition to seeking cost savings in water resources management.

Ultimately, it is essential for governments to take a strategic approach to financing water investments and services. Strategic financial planning must be carried out in the context of broader sector planning that address roles and responsibilities of government agencies, policy priorities and related legislative and regulatory reforms in order to ensure that a package of measures that can realistically be financed is being put forward. In order to deal with those challenges, governments have to set realistic objectives for the development of the WSS sector, checked against available resources, and agreed in a multi-stakeholder policy dialogue. Strategic financial planning provides a structure for a policy dialogue to take place, involving all relevant stakeholders including Ministries of Finance, with the aim of producing a consensus on a feasible future WSS. It illustrates the impact of different objectives and targets in a long term perspective, linking sector policies, programmes and projects. It also serves the important aim of facilitating external financing, providing clear and transparent data on financing requirements.

To provide support to governments and water and sanitation service providers, the OECD (in conjunction with a number of other international organisations) has developed a series of tools, including financial tools, benchmarking tools and guidelines with a view to improve the performance of utilities. These include:

- Strategic Financing Planning, based on the FEASIBLE tool
- The Financial Planning Tool for Water Utilities (FPTWU)
- The Multi-Year Investment Planning Tool for Municipalities
- Guidelines for Performance-based contracts
- Water Utility Performance Indicators (IBNet)
- The Checklist for Public Action for Private Sector Participation in Water Infrastructure.

Meeting the water governance challenge

While many of the solutions to meeting the water challenge (such as water pricing, water markets, financial planning) do exist and are relatively well-known, the rate and scope of take-up of these solutions by governments in OECD and non-OECD countries has been uneven, in short because they were not tailored to fit the local contexts.

Water is essentially a local issue and involves a plethora of stakeholders at basin, municipal, regional, national and international levels. In the absence of effective public governance to manage interdependencies across policy areas and between levels of government, policy makers inevitably face obstacles to effectively designing and implementing water reforms related to institutional and territorial fragmentation, badly managed multi-level governance, limited capacity at the local level, unclear allocation of roles and responsibilities, and questionable resource allocation. Insufficient means for measuring performance have also contributed to weak accountability and transparency. These obstacles are often rooted in misaligned objectives and poor management of interactions between stakeholders.

The trend towards the decentralisation of water policies in the past decades has resulted in a dynamic and complex relationship between public actors at all levels of government. To varying degrees, OECD countries have allocated increasingly complex and resource-intensive functions to lower levels of government. Despite these greater responsibilities, sub-national actors do not always have the authority over the financial allocation required to meet these needs, or the capacity to generate local public revenues. Meanwhile, the central government may not find it easy to develop and assess water resources and service strategies without obtaining information from sub-national governments and building, developing and reinforcing capacity at local level.

There is a pressing need to take stock of recent experiences, identify good practices, and develop pragmatic tools across different levels of government and other stakeholders Although institutions in charge of water management are at different developmental stages in different countries, common challenges – including in the most developed countries – can be diagnosed ex ante to provide adequate policy responses. The OECD has examined the issues arising from the multi-level characteristics of water governance in order to better understand *who* does *what*, at *which level* of government, and *how* in terms of water policy design, regulation and implementation. It also proposes a "reading template" to diagnose common multi-level governance bottlenecks for integrated water policy across OECD countries, as well as governance instruments adopted in response for managing mutual dependencies across levels of government and building capacity at the local level.

In order to move forward on addressing the multi-level governance challenges, **the OECD has proposed a tentative set of guidelines that are intended to serve as a tool for policy makers to diagnose and overcome multi-level governance challenges** in the design and implementation of water policy. These guidelines can help enhance the prospects for crafting successful water reform strategies in the future. They are intended as a step towards more comprehensive guidelines that may be built on in the future, based on in-depth policy dialogues on water reform with countries and recognised principles of water policy, economic bases and good governance practices:

- Diagnose multilevel governance gaps in water policy making across ministries and public agencies;
- Involve sub-national governments in designing water policy;
- Adopt horizontal governance tools to foster coherence across water-related policy areas and enhance inter-institutional co-operation across ministries and public agencies,
- Create, update and harmonise water information systems and databases for sharing water policy needs at basin, country and international levels;
- Encourage performance measurement to evaluate and monitor the outcomes of water policy at all levels of government;
- Respond to the fragmentation of water policy at the sub-national level by facilitating co-ordination across sub-national actors and between levels of government;
- Foster capacity-building at all levels of government;
- Encourage a more open and inclusive approach to water policy making through public participation in water policy design and implementation; and
- Assess the effectiveness and adequacy of existing governance instruments for co-ordinating water policy at horizontal and vertical levels.

Meeting the water coherence challenge

The nexus between water, energy, food and the environment presents significant challenges for water policy reform efforts, and has been attracting increasing policy attention in recent years. Increasing the coherence of policies across these areas is essential if governments wish to meet the range of policy goals while not undermining the sustainability of the water resource base.

The linkages between water and energy are important and pervasive. The importance of water in energy production and use (such as for hydropower, thermal power stations, biofuels) is matched by the importance of energy in water (through pumping and transfer of water, desalination). As countries confront water resource constraints, their arsenal of policy options has typically included energy-intensive solutions such as long-haul transfer and desalination. The corollary is also true: many countries address energy constraints with water-intensive options such as steam-cycle power plants or biofuels. However, this approach, whereby water planners assume they have all the energy they need and energy planners assume they have all the water they need, is not likely to work effectively in the future. Countries that deploy incoherent water and energy policies might find themselves with severe scarcity of one resource or the other, or both.

Similarly, **water and agriculture are inextricably linked**, not least because agriculture accounts for around 70% of water use globally. Support provided to lower the costs of water supplied to agriculture, for example, by not reflecting the scarcity value of water, can undermine efforts to achieve sustainable management of water, especially in situations experiencing water stress. Agricultural support policies linked to production can also exacerbate off-farm pollution through providing incentives to intensify and extend production more than would be the case in the absence of this form of support. But isolating and quantifying the overall economic efficiency and environmental effectiveness of agricultural support on water is difficult and further analysis on causation is needed.

Policies across water, energy, agriculture and environment are often formulated without sufficient consideration of their inter-relationship or their unintended consequences. The silo nature of many governments' approaches to policy development in the different areas is the key contributor to this incoherence. Institutional arrangements need to be re-engineered to create a greater intersection of policy development, implementation and monitoring in these areas. But differences in the institutional arrangements add to the complexity. For example, in many countries water regulation has been pushed towards sub-national jurisdictions (municipal and state water governments), while the majority of energy regulation and investments remain within the power of federal or national agencies. However, the emergence of environmental issues as a policy driver has also had impacts on institutional settings, with a number of countries creating ministries that combine energy and environment, or agriculture and environment.

The **key obstacles to moving toward greater policy coherence** can therefore be summarised as:

- difficulties and failure to adequately address the complexities of energy, agriculture and water linkages;
- differences in spatial and temporal scales between energy, agricultural and water policies (*e.g.* forward-looking water plans are often on the 50-60 year horizon, whereas energy plans are up to 20-30 years ahead, and agricultural planning is generally within a much shorter time horizon).

- incoherencies between certain energy and agricultural policies and current water policies, acting to constrain opportunities to move toward the sustainable management of water; and
- inconsistencies and rigidities in the institutional structures that govern the energy, agricultural and water sectors.

From a governance perspective, **policy coherence therefore requires ensuring vertical and horizontal co-ordination across and between levels of government.** It means addressing the whole life cycle of water policy across the different policy spheres to foster an overall strategic approach that can deliver effective, efficient and sustainable policies. Achieving this outcome requires strong mechanisms, tools and processes to manage and co-ordinate policy, budgeting and regulatory development, but also high political commitment and leadership, cultural changes, monitoring and learning from international experience and evidence.

Success in achieving greater coherence between energy, agriculture and water policies will ultimately depend on removing policy inconsistencies, especially where energy and agricultural support policies conflict with sustainable water management goals. The pursuit of policy coherence will also depend on developing relationships by connecting farm, firm, catchment, national and international scales of policies and institutions. This will inevitably involve a vast range of stakeholders who are unlikely to have interacted closely in the past. Encouraging greater co-operation across these stakeholders will require developing mutual understanding, so that policy and institutional coherence can be fostered to achieve the sustainability of energy, agriculture and water systems.

Options to enhance policy coherence include exploiting win-wins (such as taking steps to increase both water and energy efficiency), managing trade-offs where conflict cannot be avoided, and reconciling conflicts between sets of objectives. It will also require strong political commitment and leadership. Depending on national circumstances, pursuit of these options will require a significant re-calibrating of policy frameworks, including:

- Unravelling policy and institutional legacies and paying greater attention to current pricing and subsidy structures for agriculture, water and energy that may be currently reducing policy coherence and providing conflicting incentives;
- Examining the potential for institutional re-organisation, with a greater degree of co-ordinated planning;
- Enhancing data collection and analysis, and developing information support systems for stakeholders and a strong evidence base for policy makers;
- Greater public consultation, including the development of a shared vision among relevant stakeholders – farmers, water industry, environmental groups, the agro-food chain, and energy interests;
- Expanding the impact assessment of policy coherence through ex ante and ex post evaluations of policies;
- Increased use of regulatory analysis requirements managed by central and arms-length government agencies to improve co-ordination and facilitate a thorough examination of the optimal policy mix;
- Steps to improve policy coherence at the implementation end of the policy process; and
- Communicating the benefits of policy coherence.

More coherent policy approaches are slowly beginning to take shape in a growing number of OECD countries. This is particularly evident with climate change as many countries have started to co-ordinate the previously separated policy domains of energy policy, water policy, flood and drought management policies, and agri-environmental policies. For example, lowering overall agricultural support and shifting from direct production and input agricultural support to decoupled payments over the past 20 years in many OECD countries that has, in part, led to improvements in water resource use efficiency and helped to lower water pollution pressure from agricultural activities. But much more needs to be done in both OECD and non-OECD countries.

Chapter 1

Framing the water reform challenge

Access to clean water is fundamental to human well-being. Managing water to meet that need is a major – and growing – challenge in many parts of the world. Many people are suffering from an inadequate quantity and quality of water, as well as stress from floods and droughts and this has implications for health, the environment, and economic development. Without major policy changes and considerable improvements in water management processes and techniques, by 2050 the situation is likely to deteriorate, and will be compounded by increasing competition for water and increasing uncertainty about water availability. The policy solutions are often readily apparent. The key challenge lies in implementing reforms to existing water policies. This chapter highlights the reform challenges confronting governments drawing on the key trends and projections from the OECD Environmental Outlook to 2050*.*

Introduction

The need to reform water policies is as urgent as ever. Water is essential for economic growth, human health, and the environment. Yet governments around the world face significant challenges in managing their water resources effectively. The problems are multiple and complex: billions of people are still without access to safe water and adequate sanitation; competition for water is increasing among the different uses and users; considerable investment is required to reduce the risks from flood and drought; and major investment is required to maintain and improve water infrastructure in OECD and non-OECD countries. Population growth, urbanisation, and changing lifestyles as a result of economic growth are key drivers of these challenges, while increasing spatial and temporal water variability resulting from climate change will exacerbate these pressures.

Ensuring access to sufficient and sustainable quantities of adequate quality water to meet human, productive and ecosystem needs should be a fundamental policy goal for all countries. Water systems – including freshwater resources and water supply and sanitation – must be well-managed to provide the broad range of water functions and services upon which humans and nature depend. Well-managed water systems can also be an important driver for green growth. Yet significant gaps persist between the aspirations on water policy and the actual conditions on the ground.

Identifying appropriate policies and approaches for integrative and effective water policy is a necessary first step. There is no shortage of analysis and recommendations around the world on what constitutes a set of "sound" water policies. A plethora of international conferences have been held on the topic. Numerous think tanks and academic institutions have put forward wide range of solutions. Inter-governmental organisations (including the OECD) have conducted policy analyses, pooled country experiences, and developed guidelines to identify ways to improve the impact and effectiveness of water policy. The private sector has increasingly weighed in both through individual company efforts and through initiatives from the World Economic Forum and the World Business Council on Sustainable Development.

Yet, despite progress on many fronts, governments around the world are still confronted with the need to reform their existing water policies in order to meet current objectives and to ensure that the policies they have in place are sufficiently robust to respond to changing circumstances. For example, significant progress has been made on reaching the Millennium Development Goals on water and sanitation. However, in 2008, an estimated 141 million city dwellers and 743 million rural dwellers remain without access to an improved water source, and an estimated 2.6 billion people remain without access to sanitation. Of critical importance is the fact that access to an "improved" water source does not necessarily mean access to "safe" water fit for human consumption.

In another example, some countries have been at the cutting edge of water policy innovation and have developed sophisticated policy frameworks to address water challenges. Australia, for example, has had a long period of water policy reform and has implemented mechanisms such as water markets, water pricing, and government purchase of water entitlements for environmental flows. Yet Australia still faces significant political economy challenges in undertaking further changes to address emerging water security issues.

Reform in the water sector can take a range of forms, from wholesale and fundamental changes to the way that water policies are designed and implemented (such as Mexico's Water Reform Agenda initiated in 2011) to relatively marginal adjustments to refine existing policy settings and instruments in order to improve their effectiveness. In either case, making reform happen in the water sector requires putting in place the conditions to ensure that the actions of all stakeholders – different categories of users, multiple responsible authorities and various service providers – contribute to the long-term objectives of environmental sustainability and enhancing social welfare. It also often means generating sufficient support for policy change by making the case for reform – answering the question of "what is in it for society and individuals?" Understanding the political economy of reform means taking into account how decisions are made and in whose interest; how reform is promoted or obstructed and why. Learning from the experience of past and on-going water reforms can help to illuminate wider lessons that can increase the prospect of success for future water reforms.

The nature, pace and scale of water reform will vary enormously depending on countries' particular circumstances and needs. There is, therefore, no "one-size-fits-all" recipe for water policy reform: much will depend on the institutional, cultural, historical and political situation in each country. However, there are three fundamental areas that need to be addressed whatever reform agendas are contemplated. These areas relate to the financing of the water system, the governance and institutional arrangements that are in place, and coherence between water policies and other sectoral policies. While each of these broad areas presents significant reform challenges in themselves, they provide the basic structure for ensuring that water policy frameworks are sustainable and durable, yet flexible enough to respond to changing conditions.

Drawing on work that has been undertaken in the OECD in recent years on the economics and governance of water, this report addresses the role of each of these areas in moving the water policy to a more sustainable footing with respect to economic, social and environmental outcomes. It builds on the OECD (2009a) report, *Managing Water for All¸* that was presented to the 2009 World Water Forum in Istanbul by addressing the finance, governance and policy coherence aspects of policy reform. The remainder of this chapter draws on the OECD Environmental Outlook to 2050 to help frame the current and emerging issues for the water sector. Chapter 2 addresses the financing challenge that confronts governments for both water supply and sanitation, as well as for undertaking the broader water resource management functions. The governance challenge is examined in Chapter 3, focusing in particular on the co-ordination issues arising from the multi-level nature of governance in the water sector. The final chapter takes up the policy coherence challenges presented by the linkages between water, energy and agriculture.

Key water trends and projections

The OECD's *Environmental Outlook to 2050* highlights the key trends and projections for water under a range of scenarios and identifies the emerging issues that will need to be the focus of reform efforts in the future (OECD 2012). While access to clean water is fundamental to human well-being, managing water to meet that need is a major – and growing – challenge in many parts of the world. Many people are suffering from an inadequate quantity and quality of water, as well as stress from floods and droughts and this has implications for health, the environment, and economic development. Without major policy changes and considerable improvements in water management processes and techniques, by 2050 the situation is likely to deteriorate, and will be compounded by increasing competition for water and increasing uncertainty about water availability. This helps to frame the reform agenda that OECD and non-OECD countries need to pursue if water is to be a central driver of green growth, rather than a constraint on development options. The key trends and projections from the Outlook are summarised in Box 1.1.

Box 1.1. **Key trends and projections for water to 2050**

Water quantity

RED: The Outlook Baseline projects that by 2050, 3.9 billion people, more than 40% of the world's population, are likely to be living in river basins under severe water stress.

YELLOW: Water demand is projected to increase by 55% globally between 2000 and 2050. The increase in demand will come mainly from manufacturing (+400%), electricity (+140%) and domestic use (+130%). In the face of these competing demands, there will be little scope for increasing water for irrigation.

RED: In many regions of the world, groundwater is being exploited faster than it can be replenished and is also becoming increasingly polluted. The rate of groundwater depletion more than doubled between 1960 and 2000, reaching over 280 km^3 per year.

Water quality

RED: The quality of surface water outside the OECD is expected to deteriorate in the coming decades, through nutrient flows from agriculture and poor wastewater treatment. The consequences will be increased eutrophication, biodiversity loss and disease. For example, the number of lakes at risk of harmful algal blooms will increase by 20% in the first half of this century.

GREEN: Continued efficiency improvements in agriculture and investments in wastewater treatment in developed countries are expected to stabilise and restore surface water and groundwater quality in most OECD countries by 2050.

YELLOW: Micro-pollutants (medicines, cosmetics, cleaning agents, and biocide residues) are an emerging concern in many countries.

Access to water

RED: More than 240 million people (most of them in rural areas) are expected to be without access to an improved water source by 2050. The Millennium Development Goal for improved water supply is unlikely to be met in sub-Saharan Africa. Globally, more city dwellers did not have access to an improved water source in 2008 than in 1990, as urbanisation is currently outpacing connections to water infrastructure.

GREEN: The number of people with access to an improved water source grew by 1.8 billion between 1990 and 2008, mostly in the BRIICS, and especially in China. However, this does not necessarily mean access to water that is safe to drink.

RED: Almost 1.4 billion people are projected to still be without access to basic sanitation in 2050, mostly in developing countries. The Millennium Development Goal (MDG) on sanitation will not be met.

Water-related disasters

YELLOW: By 2050, the number of people at risk from floods, droughts and other water related disasters may rise from 1.2 billion today to around 1.6 billion (18% of the world's population). The economic value at risk is expected to be around USD 45 trillion – a growth of over 340% from 2010.

Source: OECD (2012).

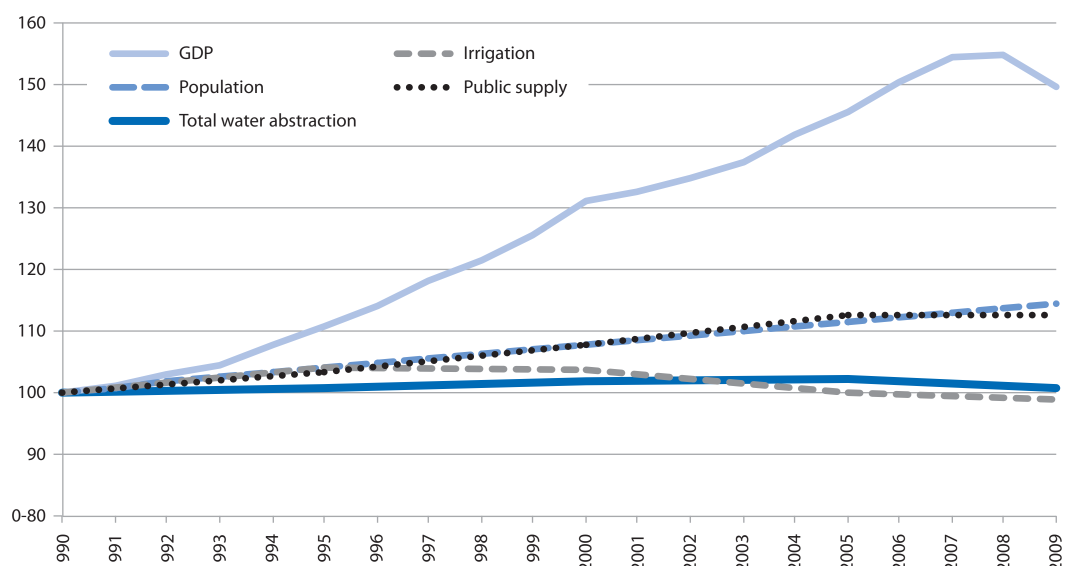
Changes in OECD water abstraction rates

Globally, it is estimated that water demand rose twice as fast as population growth in the last century. Agriculture was the largest user of water, accounting for about 70% of total global freshwater demand (OECD, 2008). The largest global water demand after irrigated agriculture in 2000 was for electricity generation, primarily for cooling of thermal (steam cycle) based power generation.

In the OECD area, total surface water abstraction has not changed since the 1980s (Figure 1.1). This is despite increases in abstractions for public water supply and, to a lesser extent, irrigation. This stability can be explained by more efficient irrigation techniques; the decline of water intensive industries (*e.g.* mining, steel); more efficient use of water for thermoelectric power generation; the increased use of cleaner production technologies; and reduced leaks from piped networks. More recently, this stabilisation also partly reflects droughts, which meant that water was physically not available for abstraction in some regions.

Figure 1.1. **OECD freshwater abstraction by major use and GDP, 1990-2009**

Index: 1990=100



Note: Data exclude Chile, Estonia, Israel and Slovenia

Source: OECD Environmental data.

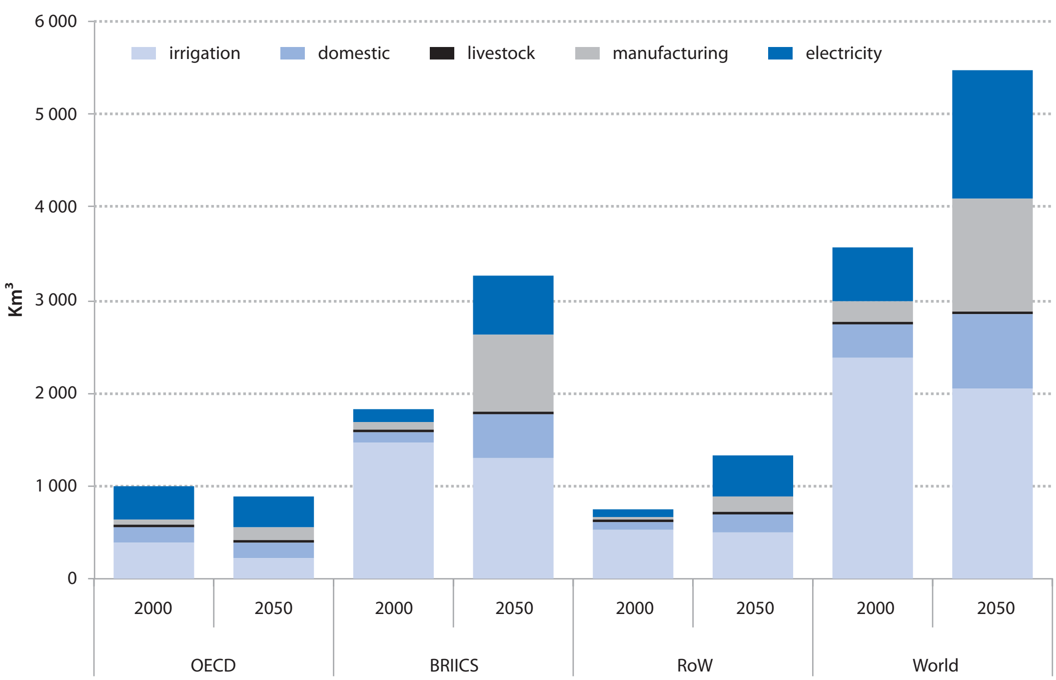
OECD agricultural water use rose by 2% between 1990 and 2003, but has declined since then. Irrigation accounted for 43% of total OECD water use in 2006. Much of the growth in OECD agricultural water use occurred in Australia, Greece, Portugal and Turkey – countries where farming is a major water user (more than 60% of total freshwater abstractions) and/or irrigation plays a key role in the agricultural sector (on more than 20% of cultivated land).

Although at the national level most OECD countries' use of water is sustainable overall, most still face at least seasonal or local water shortages and several have extensive arid or semi-arid regions where lack of water constrains sustainable development and agriculture. In addition, the principal concerns in OECD countries are the inefficient use of water (including waste, for instance through leaks from urban supply systems) and its environmental and socio-economic consequences: low river flows, water shortages, salinisation of freshwater bodies in coastal areas, human health problems, loss of wetlands and biodiversity, desertification and reduced food production.

Future global water demand is expected to increase significantly to 2050

The baseline projection in the *OECD Environmental Outlook to 2050* projects future global water demand to increase significantly – from about 3 500 km³ in 2000 to nearly 5 500 km³ in 2050 (Figure 1.2), or a 55% increase.[1] This increase is primarily due to growing demand from manufacturing (+400%, about 1 000 km³), electricity (+140%, about 600 km³) and domestic use (+130%, about 300 km³). However, demand does not automatically translate into abstraction, as a significant share of water is discharged back into water bodies after use, remaining available for use downstream, depending on water quality.

Figure 1.2. **Global water demand: Baseline scenario, 2000 and 2050**



Notes: this graph only measures blue water demand (see Box 5.1) and does not consider rainfed agriculture.

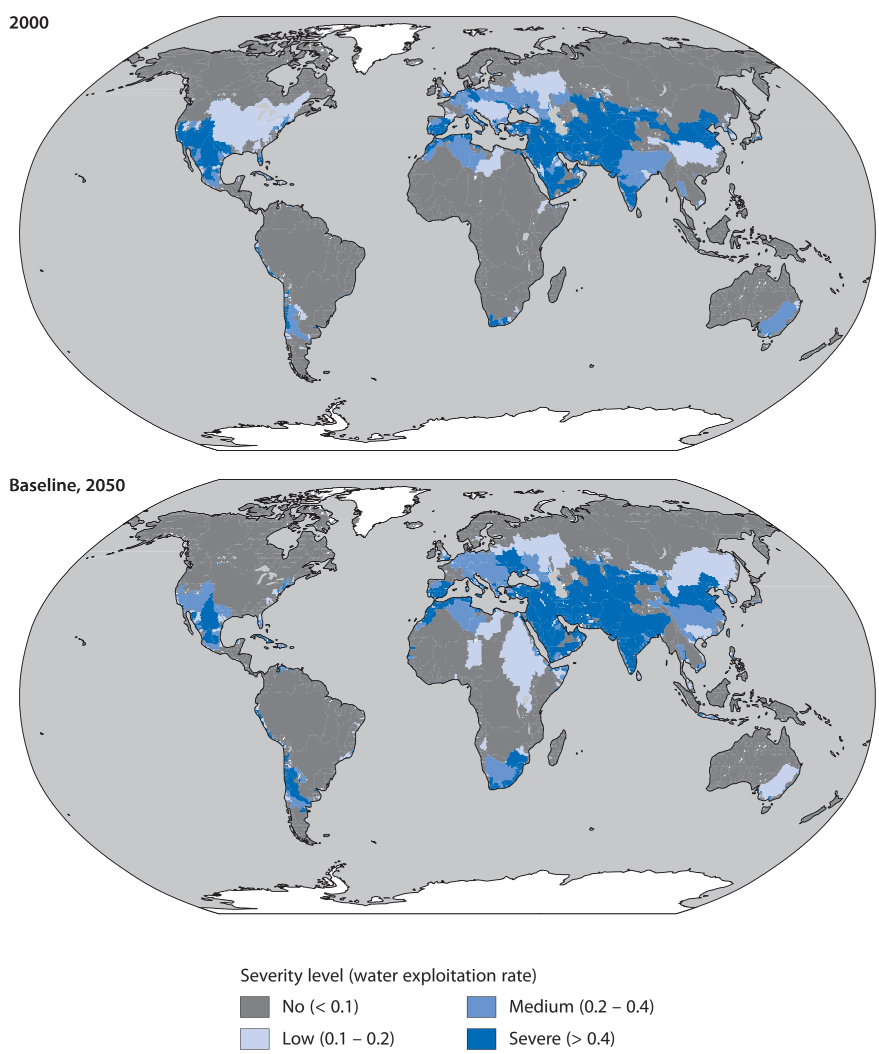
Source: The Environmental Outlook Baseline projections; output from the IMAGE suite of models (PBL)

Without new policies, the relative importance of uses which drive water demand are also projected to shift significantly by 2050. Sharp rises in water demand are expected in South Asia and China, with much higher shares for manufacturing, electricity and domestic supply in 2050. In all parts of the world, the growing demand for these uses will compete with demand for irrigation water. As a result, the share of water available for irrigation is expected to decline. If the model projections were to factor in the additional water needed to ensure enough flows to maintain ecosystem health, the competition among different water users would intensify even further.

Increasing water stress

Increased water demand will exacerbate water stress in many river basins, in particular in densely populated areas in rapidly developing economies. More river basins are projected to become under severe water stress by 2050 under the *Baseline* scenario, mainly as a result of growing water demands (Figure 1.3). The number of people living in these stressed river basins is expected to increase sharply, from 1.6 billion in 2000 to 3.9 billion by 2050, or more than 40% of the world's population. By then, around three-quarters of all people facing severe water stress will live in the BRIICS (Brazil, Russia, India, Indonesia, China and South Africa). Almost the entire population of South Asia and the Middle East, and large shares of China and North Africa's population, will be located in river basins under severe water stress. The consequences for daily life are uncertain, depending greatly on the adequacy of water management strategies put in place. On the other hand, water stress is projected to be somewhat reduced in some OECD countries, *e.g.* the US. This results from a projected decrease in demand (driven by efficiency gains, and a structural shift towards service sectors that are less water intensive) and higher precipitation caused by climate change.

Figure 1.3. **Water stress by river basin: Baseline, 2000 and 2050**



Source: The *Environmental Outlook Baseline* projections; output from the IMAGE suite of models (PBL).

Groundwater exploitation is becoming unsustainable

Groundwater is by far the largest freshwater resource on Earth (not counting water stored as ice). It represents over 90% of the world's readily available freshwater resource (UNEP, 2008; Boswinkel, 2000). In areas with limited surface water supply, such as parts of Africa, and where there is no other alternative, groundwater is a relatively clean, reliable and cost-effective resource. Groundwater also plays a significant role in maintaining surface water systems through flows into lakes and rivers.

However, the rate of groundwater exploitation is becoming unsustainable in a number of regions. As modern extraction technologies become commonplace and more accessible surface water resources are gradually overexploited, the use of groundwater to meet water demands has increased substantially. The fraction of global freshwater use currently drawn from groundwater is estimated globally at 50% of domestic water supply, 40% of water withdrawals for self-supplied industry and 20% of irrigation water supply (Zektser and Everett, 2004). Although only a relatively small fraction of the Earth's known groundwater reserves are used, the rate at which global groundwater stocks are shrinking has more than doubled between 1960 and 2000, from 130 (± 30) to 280 (± 40) km^3 of water per year (Wada *et al.*, 2010).

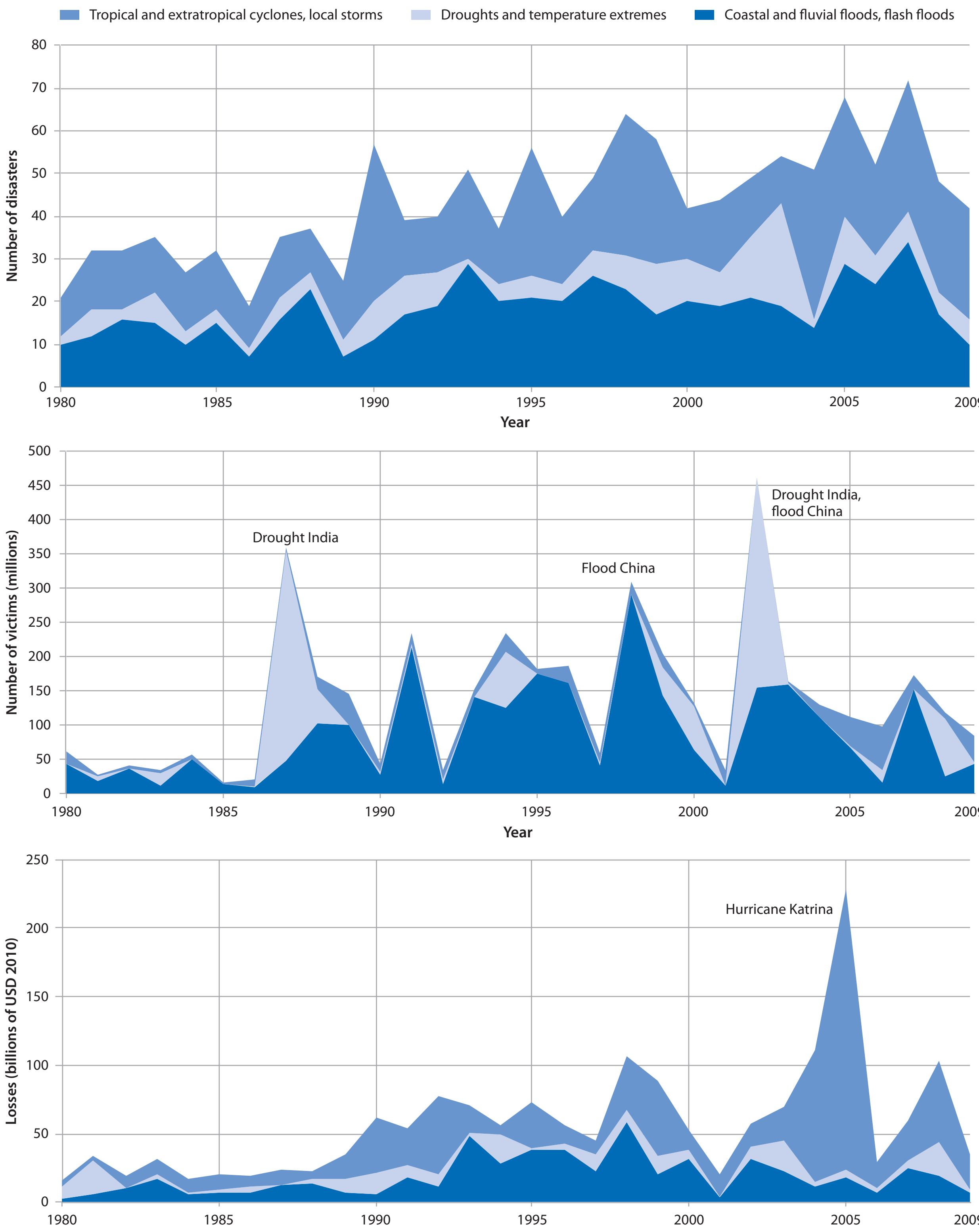
In the last half century, the boom in agricultural groundwater use has improved livelihoods and food security for billions of farmers and consumers. But groundwater depletion may be the single largest threat to irrigated agriculture, exceeding even the build-up of salts in soils. Rapid groundwater depletion is a consequence of the explosive spread of small pump irrigation throughout the developing world, often coupled with energy subsidies to agriculture that have significantly lowered the costs of extracting groundwater in a number of OECD countries and India. The volume of groundwater used by irrigators is substantially above recharge rates in some regions of Australia, Greece, Italy, Mexico and the US, undermining the economic viability of farming. In countries with significant semi-arid areas such as Australia, India, Mexico and the US, more than one-third of irrigation water is pumped from the ground (Zektser and Everett, 2004). Over-exploited aquifers, especially in semi-arid and arid regions, lead to environmental problems (poor water quality, reduced stream flows, drying up of wetlands), higher pumping costs and the loss of a resource for future generations (Shah *et al.*, 2007).

The human and economic impact of weather-related disasters is increasing

The number of weather-related disasters has increased worldwide over the last three decades, particularly floods, droughts and storms with the main drivers of this increase being a growing world population, increasing wealth and expansion of built-up areas (Figure 1.4). The number of disasters has been spread quite equally over the regions: almost 40% in the OECD, 30% in the BRIICS and 30% in the RoW. But there is a striking difference in impacts between these three groups of countries. Well over 80% of deaths were in the BRIICS countries, nearly 15% in other developing countries (RoW) and only about 5% in OECD countries. OECD countries suffered almost two-thirds of the economic losses, BRIICS one quarter and developing countries (RoW) over 10%. These figures reflect differences in adaptive capacity and the economic value of real estate and other property in the three groups of countries.

While the *Environmental Outlook Baseline* projects the world's population to increase by one-third to over 9 billion in 2050, the population is projected to increase even more rapidly in flood plains and deltas – those areas most affected by floods – by nearly 40% over the same period. Changes in exposure of people and economic assets, and in some

Figure 1.4. **Global weather-related disasters, 1980-2009**



Note: losses are in USD 2010, for comparison purposes
Source: Visser, H., *et al.* (forthcoming).

cases changes in vulnerability, have been the major drivers of the observed increase in disaster losses in the past (SREX, 2011). This trend may continue in the coming decades. Leaving aside climate change as a likely key driver of floods by 2050, the number of people and value of assets at risk will still be significantly higher than today: more than 1.6 billion (or nearly 20% of the world's population) and economic assets worth some USD 45 trillion (340% more than in 2010). By region, the increase in economic value at risk is almost 130% for the OECD, over 640% for the BRIICS and nearly 440% for developing countries (see OECD 2012 for more detail on these calculations).

Vulnerability to floods is not evenly distributed within countries and often the poorest suffer disproportionally. For example, Dhaka, Kolkata, Shanghai, Mumbai, Jakarta, Bangkok, and Ho Chi Minh City are the cities most vulnerable to flooding and are also situated in countries with low national GDPs per capita in both 2010 and 2050 (see OECD 2012).

Water quality is expected to deteriorate globally

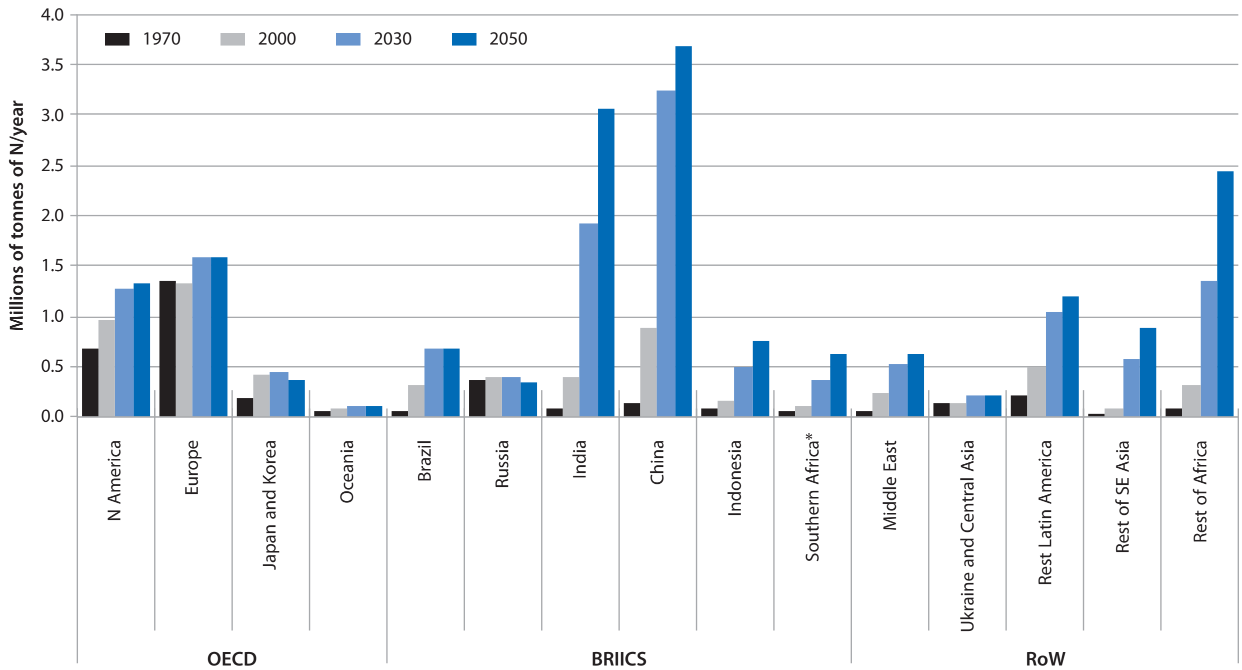
Despite significant progress in OECD countries in reducing pollution loads from municipal and industrial point sources by installing wastewater treatment plants and reducing chemical use, improvements in freshwater quality are not always easy to discern,[2] except for organic pollution. Pollution loads from diffuse agricultural and urban sources (fertilisers and pesticides, run-off from sealed surfaces and roads, and pharmaceuticals in animal and human waste) are continuing challenges in many countries (see Box 1.2). The share of nutrient water pollution from farming has risen as absolute levels of industrial and urban pollution have decreased more rapidly than those from agriculture. The pressure from agriculture on water quality in rivers, lakes, groundwater and coastal waters in most OECD countries eased between 1990 and the mid-2000s due to a decline in nutrient surpluses and pesticide use. Despite this improvement, absolute levels of nutrient and pesticide pollution remain significant in many OECD countries and regions. In nearly half of OECD countries, nutrient and pesticide concentrations in surface and groundwater in agricultural areas exceed national recommended limits for drinking water standards. Another concern is agricultural pollution of deep aquifers, where natural recovery from pollution can take several decades.

Under the *Baseline* scenario, water quality is expected to deteriorate globally due to increasing eutrophication and increasing nutrient effluents from wastewater. Eutrophication is expected to increase globally in the coming two decades, then stabilise in some regions (the OECD, Russia and Ukraine). In Japan and Korea nutrient surpluses per hectare of agricultural land have already reached high levels. In China, India, Indonesia and developing countries, eutrophication is projected to increase after 2030; in China, this is driven by nutrients from wastewater − surpluses in agriculture are projected to stabilise. In Brazil, eutrophication is expected to increase, driven by growing phosphorus surpluses from agriculture, while phosphorus from wastewater effluents and nitrogen is projected to stabilise or decrease after 2030.

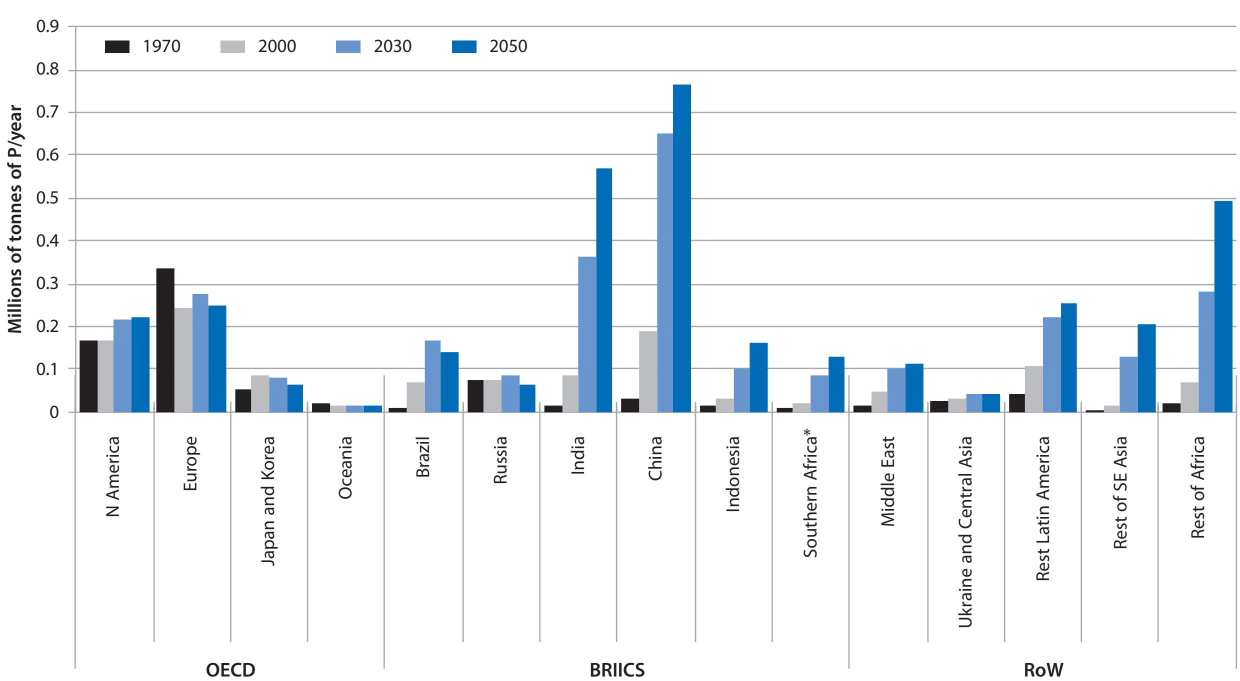
Nutrient effluents from wastewater are also projected to increase significantly. Nitrogen (N) effluents are projected to grow by 180% (from about 6 to 17 million tonnes per year between 2000 and 2050 globally); and phosphorus (P) effluents by over 150% (from 1.3 to 3.3 million tonnes per year in the same period) (Figure 1.5). This is primarily due to population growth, rapid urbanisation, an increasing number of households with improved sanitation and connections to sewage systems, and lagging nutrient removal in wastewater treatment systems. The nutrient removal in wastewater treatment systems is also expected to improve rapidly, but not fast enough to counterbalance the large projected increase in nutrient inflows.

Figure 1.5. **Nutrient effluents in wastewater, 1970-2050**

a. Nitrogen



b. Phosphorus



Source: The *Environmental Outlook Baseline* projections; output from the IMAGE suite of models (PBL).

Box 1.2. **The threat to water quality from nutrients**

Good quality water is essential for human well being, to support healthy aquatic ecosystems and for use in primary industries such as agriculture and aquaculture. Eutrophication, acidification, toxic contamination and micro-pollutants all place pressures on human health, the cost of treating drinking water, irrigation and the maintenance of aquatic ecosystems. Water that is of too poor quality to be used exacerbates the problem of water scarcity.

Nutrient surpluses in agriculture occur if more nutrients are added to the soil than are withdrawn. If there is a surplus of nitrogen, it is likely to be leached into the groundwater, run off the fields into watercourses, or be lost to the atmosphere through conversion to ammonia (volatilisation). Nitrogen enters the soil through biological fixation, atmospheric deposition, application of synthetic nitrogen fertiliser and animal manure. Nitrogen is withdrawn from the soil through crop harvesting and livestock grazing. Phosphorus (P) comes from animal manure and fertiliser. It follows the same routes as nitrogen, except that it accumulates in the soil and is not leached to the groundwater or lost to the atmosphere.

The economic costs of treating water to remove nutrients and pesticides to meet drinking water standards are significant in some OECD countries, while eutrophication of marine waters also imposes high economic costs on commercial fisheries for some countries (*e.g.* Korea and the US). Persistent micro-pollutants in water bodies also add to the costs of treating water for potable use.

Source: OECD (2012).

Surpluses of nitrogen in agriculture are projected to decrease in the *Baseline* in most OECD countries by 2050 as the efficiency of fertiliser use is likely to improve more rapidly than increases in productivity. However, the trend goes in the opposite direction in China, India and most developing countries as nitrogen surplus per hectare is likely to increase as production grows more rapidly than efficiency.

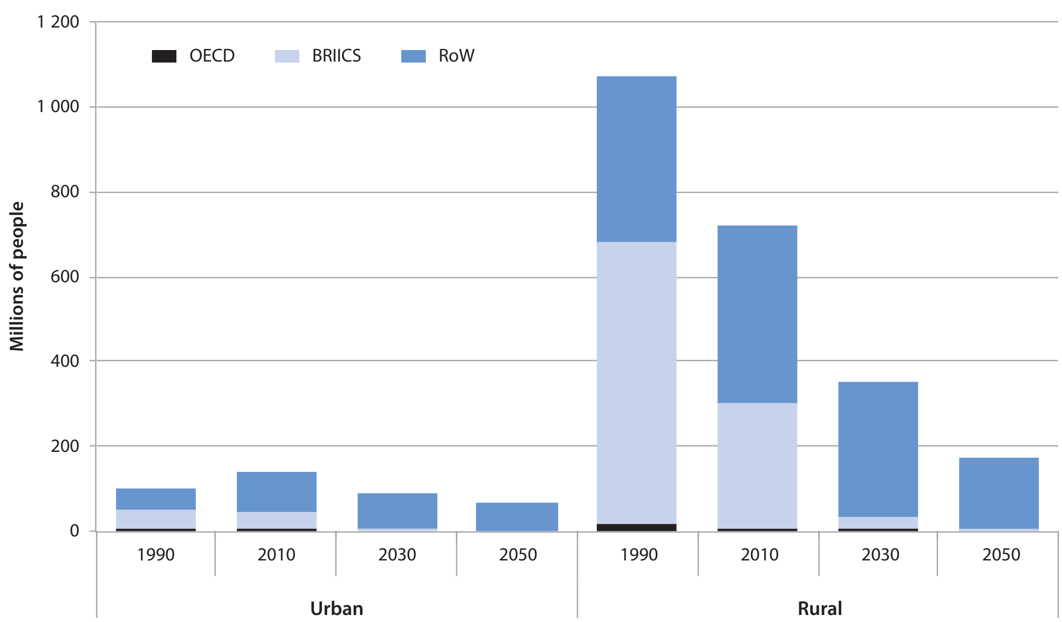
The deterioration in water quality is estimated to have already reduced biodiversity in rivers, lakes and wetlands by about one-third globally, with the largest losses in China, Europe, Japan, South Asia and Southern Africa. In the *Baseline* scenario, a further decrease in aquatic biodiversity is expected in the BRIICS and developing countries up until 2030, followed by stabilisation. However, this modelled decrease is an underestimation because the effects of future river dams, wetland reclamation and climate change have not been included. As a result of the increasing nutrient loads in surface water, the number of lakes with harmful algal blooms is projected to increase globally under the *Baseline* by some 20% in 2050 compared to 2000, mostly in Asia, Africa and Brazil. It is expected that these effects will be aggravated by climate change and increased water temperatures. Similarly, the occurrence, frequency, duration and extent of oxygen depletion and harmful algal blooms in coastal zones are projected to increase under the *Baseline* to 2050, as rivers discharge a rapidly growing amounts of nutrients into the sea, especially the Pacific.

Reaching the MDG goal for access to improved drinking water sources

The official monitoring of the Millennium Development (MDG) Goal 7 Target C "to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation" shows that worldwide between 1990 and 2008, an estimated 1.1 billion people in urban areas and 723 million people in rural areas gained access to an improved drinking water source (UN, 2011). Most of them live in the BRIICS. Nevertheless, in 2008 141 million city dwellers and 743 million rural dwellers still relied on unimproved sources of drinking water (UN, 2011). The number of city dwellers without access to an improved water source actually increased between 1990 and 2008, as urbanisation outpaced connection.

Under the *Baseline*, access to improved water supply in the BRIICS is projected to be universal before 2050 (Figure 1.6).[3] Connection rates are likely to improve because of higher income levels and continuing urbanisation, which makes water supply and sanitation (WSS) coverage easier to achieve. However, far slower progress is expected in developing countries (RoW). The United Nations estimates that by 2015, 89% of the population in developing regions are likely to have access to improved sources of drinking water, compared with 70% in 1990 (UN, 2011). The Millennium Development Goal (MDG) of halving by 2015 the 1990 level of population without improved water supply is expected to be met in most regions, but not in Sub-Saharan Africa.

Figure 1.6. **Population lacking access to improved water supply: Baseline scenario, 1990-2050**



Source: The Environmental Outlook Baseline projections; output from the IMAGE suite of models (PBL).

However, this apparent success can be misleading for three main reasons. Firstly, progress has been rapid in rural areas – a trend which is projected to continue under the *Environmental Outlook Baseline* − but the absolute number of people in rural areas without access is still a concern (Figure 1.6). Secondly, as noted above, the number of city dwellers without access to improved water supply worldwide has actually increased between 1990 and 2008, as service extension fails to keep pace with city growth. Thirdly, the MDG target indicator – the “proportion of population using an improved drinking water source” – does not necessarily reflect access to *safe* water, which was defined as a fundamental human right by the UN in 2010 (see Box 1.3).

Box 1.3. The problem with definitions: The MDG goal on water

There are a number of issues with the MDG indicators as they are currently defined and measured. For example, access to water-supply services is defined as having access via an "improved" source. In Sub-Saharan Africa, however, one third of the trips to improved water sources take more than 30 minutes, which means that people collect considerably less water than would be necessary to adopt safe hygienic practices. According to Hutton and Bartram (2008), providing water in the home would be much preferable in order to protect health and secure social benefits. Raising the indicator to such a standard would mean missing the target on the water front as well, however. Another issue raised by the JMP itself is the difficulty and high cost of measuring whether or not the water is safe to drink, even if from an "improved source". As the target date for the Millennium Development Goals is drawing nearer, a debate has been initiated on the indicators that may be appropriate to use for the sector beyond 2015. This needs to take into account the recent adoption of the human right to safe and clean drinking water and sanitation in July 2010.

The MDG goal for sanitation is a significant challenge

The official monitoring indicates that in 2008 2.6 billion people still did not have access to basic sanitation. According to the Global Annual Assessment of Sanitation and Drinking-Water (GLAAS; WHO, 2010),[4] the greatest numbers of people without improved drinking water supplies and basic sanitation are in South Asia, East Asia and sub-Saharan Africa. To date, efforts to increase connection rates have benefitted the better-off more than the poor (UN, 2011). This poses enormous health risks, especially to the poorest, who are the most vulnerable.

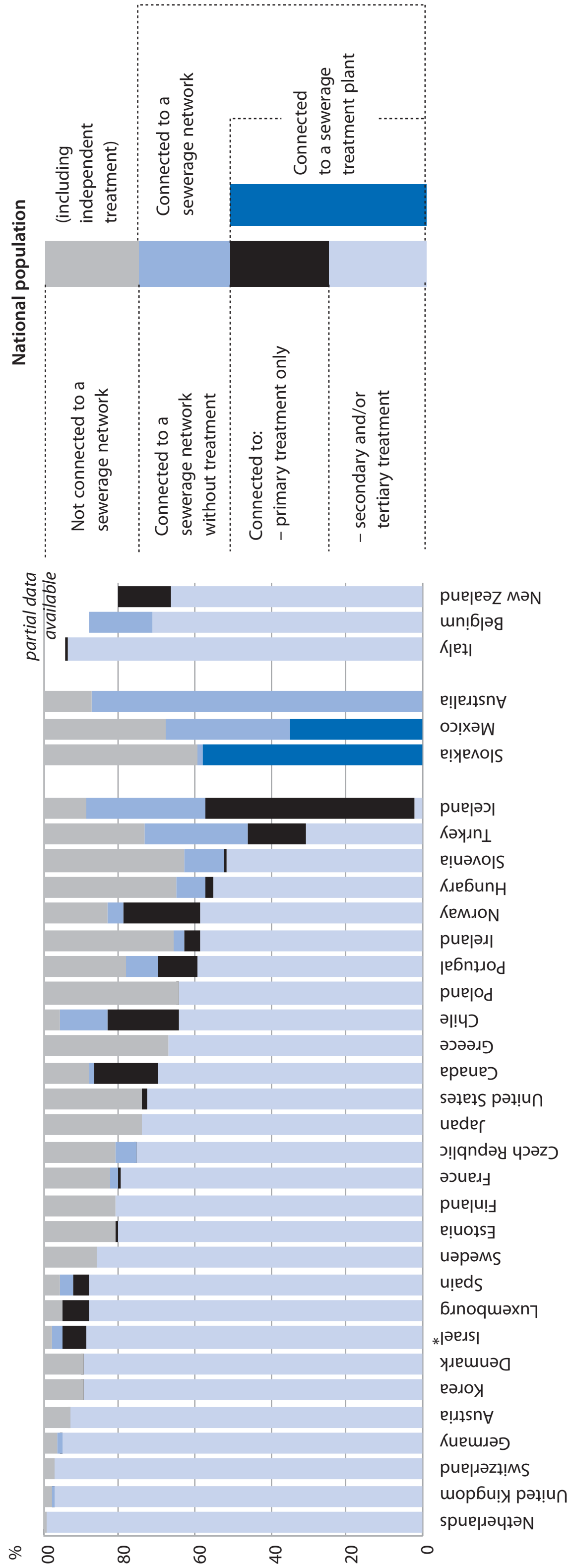
In OECD countries, the share of the population connected to a municipal wastewater treatment plant rose from nearly 50% in the early 1980s to about 70% today (Figure 1.7). For the OECD as a whole, almost half of public pollution abatement and control expenditure relates to water (sewerage and wastewater treatment). When expenditures from the private sector are factored in, this domain represents up to 1% of GDP in some countries. The share of population connected to wastewater treatment plants and the level of treatment vary significantly among OECD countries: secondary and tertiary treatment has progressed in some, while others are still completing sewerage networks or the installation of first generation treatment plants.

Under the *Baseline*, the number of people without access to basic sanitation is expected to remain at 2.5 billion in 2015 and to be almost 1.5 billion in 2050, with 60% of them living outside the OECD and BRIICS (Figure 1.8). This means that sub-Saharan Africa and a number of Asian countries are unlikely to meet the MDG target for sanitation. The vast majority of those without access to water supply and sanitation today live in rural areas. This trend is projected to continue to 2050, when the number of people in rural areas who lack access to sanitation is likely to become comparable with urban areas.

As is the case for the MDG goal on access to water, the sanitation goal suffers from a definitional issue with respect to what constitutes basic sanitation. There is a clear and significant difference between what is counted as access to basic sanitation and what is really required in terms of satisfactory collection removal and treatment of human wastes, which include urine, faeces and water contaminated by hygiene and cooking processes.

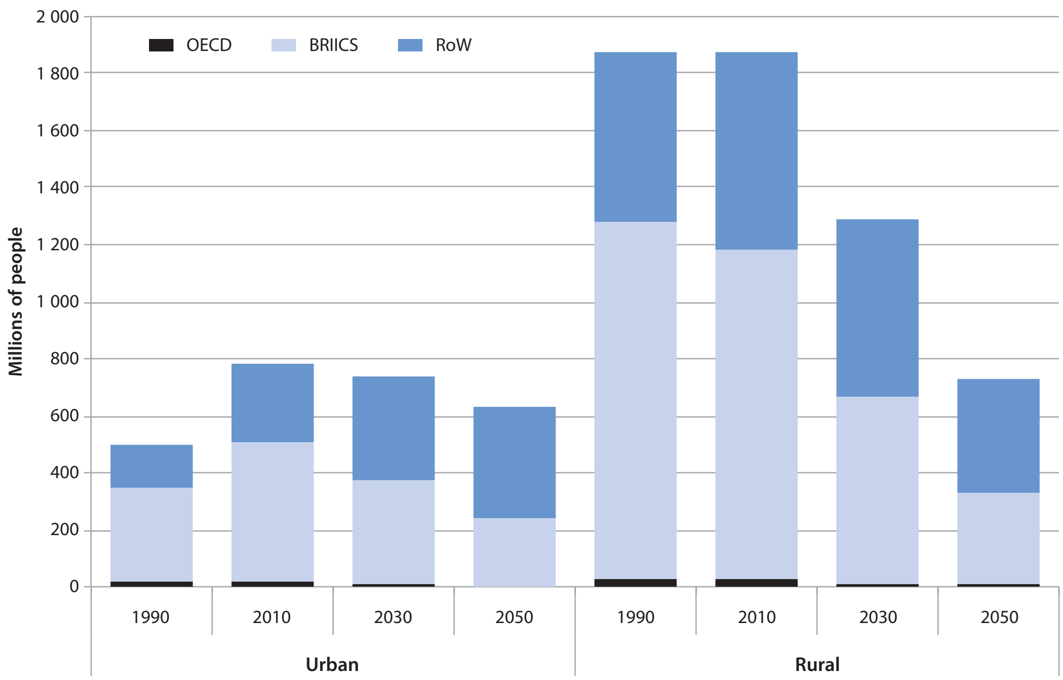
Figure 1.7. **OECD population connected to public wastewater treatment plants by country**

2009 or latest, in % of total population



Source: OECD environmental data.

Figure 1.8. **Population lacking access to improved sanitation facilities: Baseline, 1990-2050**



Source: The Environmental Outlook Baseline projections; output from the IMAGE suite of models (PBL).

These figures are daunting, and the serious consequences of failing to speed up progress cannot be overemphasised. The health consequences are well documented. Worldwide every year unsafe water, inadequate sanitation and poor hygiene claim the lives of an estimated 2.2 million children under the age of 5. Of these deaths, 1.5 million are due to diarrhoea, the second leading contributor to the global burden of disease. The death (mortality) impact of diarrhoeal disease in children under 15 is greater than the combined impact of HIV and AIDS, malaria, and tuberculosis.

Emerging issues in water policy

The *OECD Environmental Outlook to 2050* shows that more ambitious policies and new ways of looking at the water challenge are urgently needed. In the *Outlook*, a number of alternative scenarios are presented that address different aspects of water policy that could lead to improved outcomes (see Box 1.4). Drawing on the results from the *Outlook Baseline* and the alternative scenarios, this section highlights some of the most important emerging directions for water policy and its reform.

Seeing water as an essential driver of green growth

The OECD is working to reconcile the demand for continued economic growth and development with the need to ensure that natural assets continue to provide the resources and environmental services on which all human well-being relies. This underpins the concept of “green growth”, which sees sustainable water use as an essential driver, since a lack of water of appropriate quality can significantly hinder growth (OECD, 2011a). As discussed above, water management can generate huge benefits for health, agricultural

Box 1.4. **Alternative water future scenarios**

Could the situation for water be improved in the future with more ambitious policies? In addition to the "business-as-usual" projections discussed above, the *OECD Environmental Outlook* also explores three model-based policy simulations to discuss alternative futures related to water use efficiency, nutrient reduction, and improved access to safe water and sanitation.

The "Resource Efficiency" scenario

The *Resource Efficiency* scenario models how the water stress picture would change if more ambitious policies reduced water demand and enhanced water use efficiency. This policy simulation assumes lower water demand for thermal electricity generation and a greater share of electricity produced through solar and wind generation. In addition, the *Resource Efficiency* scenario assumes further efficiency improvements of 15% for irrigation in non-OECD countries, as well as 30% improvements in domestic and manufacturing uses globally. Under the *Resource Efficiency* scenario, global water demand for all uses in 2050 would be about 25% below the *Baseline* scenario (at around 4 100 km^3), but would still be higher in 2050 than in 2000, except in OECD countries. The rate of increase in global water demand from the year 2000 to 2050 would slow down from almost 55% (under the *Baseline*) to 15% (under the *Resource Efficiency* scenario).

The "Nutrient Recycling and Reduction" scenario

This *Nutrient Recycling and Reduction* scenario reflects the need for aggressive policies to further reduce nutrient discharges in order to decrease eutrophication of lakes and oceans. The scenario assesses the impact of measures to reuse nutrients in agriculture and reduce both domestic and agricultural discharges of nitrogen and phosphorus. New measures that could bring about these improvements would include an increase in fertiliser use efficiency, higher nutrient efficiencies in livestock production and using animal manure instead of synthetic N and P fertilisers in countries with a fertiliser-dominated arable system. Under this scenario, by 2050 the global nitrogen (N) and phosphorus (P) surpluses in agriculture could be almost 20% less than in the *Baseline* scenario, and the effluent of nutrients in wastewater could fall by nearly 35%. Total nutrient loads to rivers would be reduced by nearly 40% for nitrogen and 15% for phosphorus compared to *Baseline*.

The "Accelerated Access" scenario

The *Accelerated Access* scenario explores the additional annual costs and health benefits of meeting more ambitious targets than the MDGs. The targets would occur in two steps as follows:

- By 2030 the population without access to an improved water source and to basic sanitation is halved again from the 2005 base year, building on the progress already achieved under the current MDG.
- Universal access to an improved water source and to basic sanitation is achieved by 2050.

Under this scenario, by 2030 almost 100 million additional people would have access to an improved water source and around 470 million more people would have access to basic sanitation facilities than under the *Baseline*. Almost all of these people would be living outside OECD and BRIICS countries (*i.e.* in the rest of the world – RoW). By 2050, an additional 240 million would have access to an improved water source, with the RoW accounting for most of this gain. Over 1.35 billion additional people would have access to basic sanitation facilities (nearly 800 million in the RoW, and more than 560 million in the BRIICS).

Source: OECD (2012).

and industrial production. Water management can preserve ecosystems and the watershed services they provide, thereby avoiding the enormous costs that can be imposed by flooding, drought, or the collapse of watershed services.

Similarly, UNEP (2011) confirms that investments in infrastructure and operation of water-related services can provide high returns for both the economy and the environment. It highlights the need for more private and public investment in green technologies and infrastructure to boost water (and energy) efficiency and sees such investments as critical to building the green economy of the future.

The following specific policy approaches can more systematically harness water management for green growth:

- Invest in ecologically sensitive water storage and water distribution systems in water scarce regions. Reliable resources are essential for green growth. However, water storage technologies and infrastructure such as large dams can disturb ecosystem balances. Soft infrastructure (*e.g.* wetlands, flood plains, groundwater recharge), small-scale dams, rainwater harvesting, or appropriately designed infrastructure are more ecologically sensitive and cost effective.
- Put a sustainable price on water and water-related services as an effective way to signal the value of the resource and to manage demand. This will require assessing the value of water, identifying the beneficiaries, and implementing mechanisms to ensure beneficiaries contribute to cover the costs of the benefits they enjoy.
- Be prepared to allocate water across sectors and across water uses where it adds most value. This difficult policy challenge – diverting water to value-adding activities (including environmental services) may require reallocation between water users (*e.g.* from farmers to cities). Some OECD countries are gaining experience with socially fair and politically acceptable approaches for achieving this. These include water abstraction licences which reflect scarcity; market mechanisms, *e.g.* tradable water rights; and information-based instruments (smart metering). How best to allocate water is still the subject of widespread debate. More needs to be done to properly assess and scale up the use of some of these instruments, to secure environmental values while meeting social and economic needs. Experience from OECD and non-OECD countries indicates that building a strong constituency and aligning incentives are two major requisites.
- Invest in water supply and sanitation infrastructure, in particular in urban slums where unsafe water and lack of sanitation generates huge health costs and lost opportunities to the economy.
- Catalyse investment and innovation which will underpin sustained growth and give rise to new economic opportunities.

Allocating enough water for healthy ecosystems

The need to restore environmental flows and to allocate more water to watershed services is already generating interesting initiatives in several countries. In Australia, for example, the Commonwealth Government is funding the Water for the Future initiative – a long-term initiative to secure the water supply of all Australians which involves, amongst other innovations, an AUD12.9 billion investment over 10 years, the government is acquiring tradable water entitlements with the objective of returning more water to the environment. Similarly, in December 2009, the Swiss Parliament decided that all rivers and lakes should be revitalised to restore their natural functions and to enhance the benefits they provide to society.

Shifting water allocation − especially for environmental flows, but also among other users − can be challenging, as it requires difficult policy reforms that overturn expectations about "rights" to existing uses by different stakeholders. Gaining support for such reforms is a major challenge for policy makers. Experience from OECD and non-OECD countries indicates that building a strong constituency and aligning incentives are two major requisites.

Ensuring sustainable financing of the water and sanitation services

Significant and stable financial flows are still needed to build, maintain and operate water services infrastructure. This is a challenge for both OECD and non-OECD countries. For OECD countries, the main challenge lies in renewing the aging water services infrastructure that currently exists in most OECD countries. The investment requirements are significant and are significantly greater than the estimated investments required for other infrastructure sectors (such as transport and telecommunications) over the next 20 years. An OECD report has estimated the OECD and Big 5 economies will require annual expenditures in the range of USD 770 billion up to 2015 and over USD 1 trillion by 2030 (OECD 2006). Much of this spending in Europe and North America will be on maintenance, repair and replacement rather than on additions to existing networks, since water systems in many of these countries are now very old and in poor condition. This financing requirement will be even greater if countries are expecting to be able to meet increasingly stringent water quality standards.

For non-OECD countries, the challenge lies not only in building the infrastructure, but in ensuring a sufficiently stable flow of funds to be able to maintain and operate the facilities. Relying on aid flows or general taxation receipts to meet this requirement is unlikely to be sufficient over the medium to longer term.

This will require well developed and realistic strategies that tap the three ultimate sources of finance (all others are repayable): revenues from tariffs for water services, taxes channelled through public budgets, and transfers from the international community (OECD, 2010a). The private sector (the water industry and financial institutions) can also play a key role in developing and channelling innovations and enhancing efficiency. They can also harness private savings and facilitate investment when appropriate framework conditions are in place (OECD, 2009b; 2010d; 2011d).

The issues underlying the financing challenge for water supply and sanitation, and the policies and tools for meeting that challenge, are discussed in Chapter 2.

Fostering greater coherence among water, energy, environment and food policies

Water policies intersect with a wide array of sectors at different geographical scales, from local to international; coherent water governance is therefore pivotal. Analysis of water governance arrangements in OECD countries has highlighted that, along with a lack of finance for water resource management for most countries, the fragmentation of roles and responsibilities at central and sub-national levels and the lack of capacity (infrastructure and knowledge) in local administrations are both limitations and drivers for future water policy reforms.

The nexus among water, energy, environment and agriculture is close, complex, and challenging. Policy coherence among water policies and other sectoral policies – particularly energy and agriculture – is thus a key component of a co-ordinated approach to water resource management (see Chapter 4). Water is an essential element in energy production (*e.g.* for biofuels, hydropower, and cooling techniques for thermal and nuclear power plants). Energy is a critical input for transferring water and tapping alternative sources of water (*e.g.* desalinisation). In an increasing number of locations, there is competition between food and energy commodities for limited water resources. Under current trends, water for the environment and for food production will conflict in several regions (see Rosegrant *et al.*, 2002).

Tensions may arise from real or perceived trade-offs, for instance between food security (and the willingness to secure domestic production) and water productivity (and the allocation of water to activities which add more value). Inefficiencies may result from harmful subsidies (*e.g.* subsidising energy for groundwater abstraction by farmers).

Resolving such tensions requires a global perspective. For instance, freer trade in agricultural commodities and the reform of farm support policies in OECD countries can alleviate some of the tensions between food security and water productivity. The linkages between the policy areas also have to be considered early on. For instance, when countries set biofuel production targets, there is a need to factor in potential consequences for water withdrawal in the future.[5]

Policy co-ordination requires institutions to support discussion among different communities. This is more difficult where responsibility is fragmented among various ministries, and where decision making needs to be co-ordinated at different territorial levels (national, regional, state, municipal, river basin, etc.). Institutions' capacity needs to be strengthened through better information and data exchange, sector integration and joint planning.

More coherent policy approaches are beginning to take shape in a growing number of OECD countries. This is particularly evident around climate change, with many countries starting to co-ordinate previously separate policy domains such as energy, water, flood and drought control, and agri-environment. For example, the restoration of agricultural land in floodplains by planting trees has helped to reduce flood impacts, improve water quality, restore biodiversity and sequester greenhouse gases (OECD, 2010b). While some progress has been made, there is clearly much more to be done to achieve greater policy coherence.

Developing alternative sources of water

Tapping alternative water sources – rain and storm water, used water, and desalinated sea or brackish water – or encouraging successive uses of water can help to alleviate scarcity and can be a low-cost response to the water challenge. Additional benefits include saving energy and cutting investment, operation and maintenance costs. However, there are also risks attached to these technologies.

Countries are already accumulating experience with these approaches. For example Israel is using wastewater to recharge groundwater or for irrigation. Pollutant discharges have been reduced by 20% (total nitrogen), 40% (organic matter) and 70% (total phosphorus) since 2000, largely due to the construction of new wastewater treatment plants and increasing reuse of effluent in agriculture. Windhoek in Namibia and Singapore are paving the way in recycling wastewater for urban water supply. Rainwater harvesting is increasingly considered as a complement to piped water supply (*e.g.* it is mandatory in Calcutta).

A wide array of technologies, equipment and systems is available for different uses: wastewater reuse for groundwater recharge, irrigation, gardening, or non-potable domestic uses; rainwater harvesting to increase the yields of rain fed agriculture, or to supply water for non-potable domestic uses, etc. Markets for technologies related to water reuse are booming, contributing to green growth.

Governments and local authorities would benefit from considering installing these alternative water sources and their support infrastructure. Wastewater reuse for irrigation is being adopted in different contexts. Reuse for domestic uses is gaining traction as well, sometimes combined with small-scale, distributed systems. This combination is particularly appropriate in new urban areas where there is no existing central infrastructure; in city centres with decaying water infrastructure or with infrastructure facing diseconomies of scale or capacity constraints; in urban renewal projects; in unstable contexts, where flexibility, resilience and adaptation are valuable (*i.e.* because of climate change impacts); and in projects where property developers operate the buildings they invest in (to recoup investment costs).

The technologies involved are often simple, and future research and development will make alternative water sources (such as sea water desalination) even more competitive. To realise the full benefits of alternative water systems and to mitigate the risks they generate (such as pollution of agricultural land, or health risks), the following steps will be important:

- Involve and inform the public through effective communication and sound evidence; people are usually sceptical about reusing water.
- Provide regulations that allow for alternative options for supplying water to be explored. In particular, water quality standards need to be adjusted to specific uses and potential reuse. Typically, urban wastewater can only be reused if it is not heavily polluted. Such regulations need to factor in several dimensions, including life-cycle costs and benefits, and the risks and uncertainties attached to the various water sources and technologies.
- Ensure that water sector regulators monitor the quality of a variety of water sources.
- Ensure that the price of water reflecst its scarcity in order to stimulate markets for alternative water sources.
- Plan the development of several water sources and infrastructure (*e.g.* central and distributed systems) thoroughly, as tapping alternative water sources can challenge the business model of existing operators (either public or private).

Filling information gaps

Reforms and new policies are most successful when: *(i)* they rely on robust data and information (on water availability, water use, the costs and benefits of water-related services); *(ii)* they are backed by realistic and enforceable action and investment plans; and *(iii)* they are designed by a community of stakeholders with a clear understanding of their own needs and priorities.

There is a crucial need to develop water information systems (WIS) to support more efficient and effective delivery of sustainable water resource management and policies (OECD, 2010c). In particular, the rapid development in water policy reforms has created an information imbalance in many countries, with implementation of water policy initiatives often supported by little data and information.

There are also uncertainties when analysing the kinds of trends and model-based projections presented in this chapter because of data gaps and uncertainties surrounding future scientific developments or policy outcomes. Examples of uncertainties include the impact of climate change (patterns of precipitation and temperature change) on water resources at a disaggregated level; the development and diffusion of new technologies in the water sector (*e.g.* desalinisation, leakage control, etc.), in agriculture (*e.g.* new crop varieties, improved agricultural practices, irrigation efficiency, etc.), and in the energy sector (*e.g.* cooling towers, waterless biofuels, water efficiency in energy production operations); the impact of policy measures on economic behaviour (*e.g.* water pricing elasticity); and the responses of water ecosystems to policy and management interventions (*e.g.* as outlined in preparation of river basin management plans in Europe or in the design of "payment for environmental services" schemes).

In addition to these genuine sources of uncertainty, many international and national water information systems are maintained without sufficiently addressing the policy relevance of the data and information that is regularly being collected. Data concerning the economic and institutional aspects of water systems are much less developed than physical data and are only partially covered in the regular updates of most national and international WIS.

To address these issues, there is a need to:

- Assess existing WIS at local, regional, national and international levels to determine how current water information and data are collected (or not collected) and used (or not used) by policy makers, and the costs and benefits of collecting, analysing and communicating this information.
- Implement a System of Environmental and Economic Accounts for Water[6] (SEEAW) that is flexible enough to respond to varying water basin, country and international policy needs.
- Improve the understanding of hydrological systems to better guide WIS data collection efforts, for example improving knowledge of the connections between groundwater and surface water, and determining environmental flows in the context of climate change.
- Encourage innovations in water data collection, such as using new technologies or voluntary initiatives to collect data; or public agencies may regulate, finance or charge for data collection, maintenance and analysis.
- Strengthen economic and financial information including improving the understanding and measurement of the value of water.

Designing reforms that are realistic and politically acceptable

The OECD has gained extensive experience in water policy reforms, learning from successful reforms in member countries, and accompanying water policy reforms in countries of Eastern Europe, the Caucasus and Central Asia (EECCA) (OECD 2011c). Valuable lessons have been learned from this experience in making water reform happen.

A general lesson is that reform is a process that takes time, it is continuous and planning is key. Specific recommendations include:

Build a broad constituency

- Solutions to the water challenges cannot be expected to come from water policies alone, as discussed above. Water authorities need to work with other constituencies, including the agriculture and energy sectors, while taking the environment into account; they also need to work at different levels of government (local, basin, municipal, state and federal levels).
- For river basins which cross international boundaries, international co-operation can help – not only to share information and best practices – but also to share costs and benefits. For example, there has been long-standing co-operation between Canada and the United States through the Canada-US Boundary Waters Treaty and the Canada-US Great Lakes Water Quality Agreement. The United Nation's Economic Commission for Europe operates the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, providing an important framework for international co-operation.

Explore a mix of policy options and build capacity

- There is a range of policy approaches available to address water challenges, ranging from command and control instruments to market-based approaches to information and voluntary instruments. An optimal policy mix combines a variety of these approaches (for example, Israel's water policy combines improved technologies with water pricing and metering).
- Institutions and capabilities have to be adjusted to ensure there is the expertise to make complex technical and non-technical choices and to undertake comprehensive options assessments (including economic, social and environmental impact assessments).

Factor in financial sustainability from the start

- The financial dimension should be factored in early in the process (to avoid designing a plan that is not financially affordable); cost reduction potentials have to be systematically considered; and financial realism needs to be brought to Water Resource Management (WRM) plans.
- There are only three ultimate sources of finance for water-related investment and services, the 3Ts: tariffs, taxes, transfers from the international community (*e.g.* EU funds). All other sources of finance, which have a role to play, have to be paid back.
- Strategic financial planning can help in defining and prioritising water policies within the practical constraints of available financial resources.[7]
- Financial incentives from other sectors should be aligned with water policy objectives (*e.g.* subsidies for energy or agriculture).

Manage the political process

- Hard facts on the economic dimension of water policies can facilitate water policy reforms, demystify taboos and advance debates. This requires information on water demand and availability, and on the economic dimension and distributional impacts of the reform of water policies.
- Sharing international experience on water policy reforms can substantiate such a process.

Notes

1. The projections do not take into account extraction from and supplementation of deep groundwater reservoirs. The focus is on the interactions between precipitation, vegetation, soil moisture and surface and sub-surface flows to rivers and lakes. See OECD (2012) for more information.
2. This is because of poor data and because quality has not improved despite these changes. Over time, improvements in monitoring of physico-chemical pollutants and biological indicators can partly help to address this.
3. See OECD (2012) for the assumptions underlying this analysis.
4. The Global Annual Assessment of Sanitation and Drinking-Water (GLAAS) is a UN-Water initiative implemented by the World Health Organization (WHO). The objective of UN-Water GLAAS is to provide policy makers at all levels with a reliable, easily accessible, comprehensive and global analysis of the evidence to make informed decisions in sanitation and drinking water.
5. Van Lienden *et al*. (2010) calculate that by 2030, water use for first generation biofuels such as sugar cane, maize and soy beans may have increased more than tenfold compared to today, enhancing the competition for freshwater resources in many countries. A breakthrough in producing second generation biofuels that do not require expansion of croplands (*e.g.* using residues from agriculture or forestry) will greatly reduce these impacts on environment and water resources. See further discussions on bioenergy in Chapters 3 and 4.
6. To support implementation of environmental-economic accounts, the System of Environmental-Economic Accounts for Water (SEEA-Water), a SEEA sub-system, provides compilers and analysts with agreed concepts, definitions, classifications, tables, and accounts for water and water-related emission accounts (see *http://unstats.un.org/unsd/envaccounting/seeaw/*).
7. See OECD (2011d) for more information on how strategic financial planning can help in practice.

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Chapter 2

Meeting the water financing challenge

Financing has been a recurring theme in international debate on water and has been a key feature of reform efforts in many countries. Increasing access to water supply and sanitation, ensuring the environmental sustainability of water ecosystems, reducing the impacts of floods and drought, and ensuring water is used to maximise welfare across an economy all require financial support. Yet, despite some progress, securing sustainable finance for this wide range of services is an ongoing struggle for most countries, particularly in the current global economic crisis. This chapter examines the policy challenges surrounding the financing of water supply and sanitation and presents a policy toolkit that can underpin policy dialogues to stimulate much needed reform. The chapter also addresses the growing problem of financing the broader water resources management functions of government.

Introduction

Financing has been a recurring theme in international debate on water and has been a key feature of reform efforts in many countries. Increasing access to water supply and sanitation, ensuring the environmental sustainability of water ecosystems, reducing the impacts of floods and drought, and ensuring water is used to maximise welfare across an economy all require financial support. Yet, despite some progress, securing sustainable finance for this wide range of services is an ongoing struggle for most countries, particularly in the current global economic crisis. A number of countries have made significant efforts to reform their water financing mechanisms, introducing tariffs, user charges, pollution charges, cost recovery instruments, water markets and so on. However, much more remains to be done.

Sustainable financing lies at the heart of many of the solutions to improved water management. Aligning incentives through the use of tariffs and water prices is a key feature. Ensuring that the water sector has a sound regulatory and financial base can help to increase the attractiveness of the sector for private sources of funding. The financing challenge also throws light on a number of important questions relating to the need for sound governance arrangements to underpin the financial sustainability of the sector: good governance and financial sustainability are inextricably linked.

This chapter reviews the financing challenge and lays out a framework for action for governments. It focuses on two broad areas: financing water supply and sanitation; and financing the broader water resources management functions of governments. The chapter draws on recent OECD work on water supply and sanitation (OECD 2010b, 2011a, 2011b), and on forthcoming work on water resources management. The chapter focuses on identifying the benefits from investing in water and sanitation,

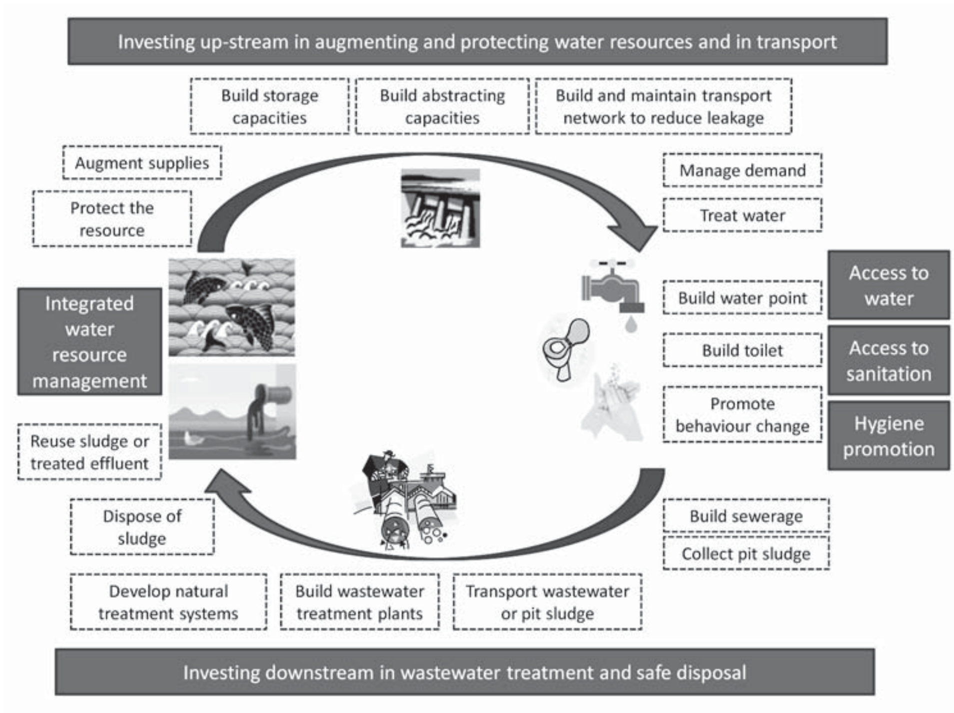
What are the benefits from investing in water and sanitation?

Water and sanitation services (WSS) generate substantial benefits for human health, the economy as a whole and the environment. Access to clean drinking water and sanitation reduces health risks and frees-up time for education and other productive activities, as well as increases the productivity of the labour force. Safe wastewater disposal helps to improve the quality of surface waters with benefits for the environment (*e.g.* functioning of ecosystems; biodiversity), as well as for economic sectors that depend on water as a resource (*e.g.* fishing, agriculture, tourism). Such benefits usually outstrip the costs of service provision and provide a strong basis for investing in the sector.

For such benefits to be generated sustainably, investments in a whole range of services along the WSS value chain need to be carried out, ranging from protecting the raw material (freshwater resources) to building storage capacity or water transport networks, all the way to investments into collection, safe disposal, treatment or re-use of wastewater (see Figure 2.1). Once built, the infrastructure needs to be adequately maintained and operated so as to provide sustainable, affordable and reliable access to water and sanitation services. New and recurrent investments in water and sanitation services are therefore critical in order to expand access to the services and maintain their ability to deliver benefits overtime.

Adequate investments are needed both downstream and upstream from providing access in order to ensure sustainable services. Investing in water resource management up-stream is critical, so that sufficient water resources of adequate quality are available

Figure 2.1. **The value chain of sustainable water and sanitation services**



Source: OECD (2011b).

over time with limited negative impact on other alternative uses of water. Downstream from providing access, adequate investment in wastewater collection, safe storage or treatment and disposal is necessary so as to ensure that the impact of wastewater being released in the environment is adequately controlled and good quality of the water resources is maintained. Recycling and reuse of treated wastewater can also reduce the amounts of water consumed and generate by-products that can be used for agriculture or energy production.

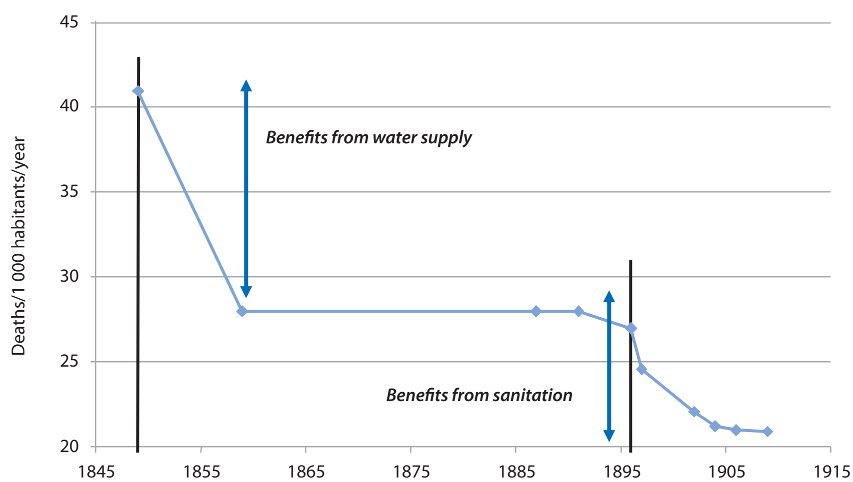
WSS typically require significant capital investments up-front in long-lived assets, which can generate benefits over several decades if adequately maintained. The bulk of investments are underground (particularly piped networks), which means that monitoring asset condition is not an easy task. Relatively simple equipment, such as hand pumps, can also fall into disrepair if sustainable systems for ensuring ongoing repairs and maintenance are not in place. To maintain incentives for efficient service delivery, it is therefore critical to invest in adequate "sector software", alongside the hardware. At sector level, this could include improving overall sector governance, conducting tariff reforms or introducing incentives for performance improvements.

Estimating the benefits from investing in water supply and sanitation

The benefits from the provision of basic water supply and sanitation services are massive and far outstrip costs. However, obtaining a robust estimate of the overall magnitude has proved to be quite challenging. This is because of the very diffuse nature of the benefits that arise from investing in WSS services, coupled with the fact that a number of the benefits are not readily expressed in comparable monetary terms. The benefits arise as a result of reduced mortality and illness leading to improved productivity and reduced health costs. Productivity improvements also accrue as a result of time savings from reduced water collection time.

In most OECD countries, these benefits have been reaped since the late 19th century all the way through the late 20th century when basic water and sanitation infrastructure was extended to reach large parts of the population. For example, in Marseille (France), water supply was a significant constraint on the city's growth during the early nineteenth century. A catastrophic drought in 1834 meant that water availability dropped from 75 litres per capita per day to 1 litre per capita per day and triggered a cholera epidemic. This in turn led to the construction of a canal to bring water, which allowed augmenting water supply to 370 litres a day after its completion in 1848. Increased water availability helped bring down mortality significantly, although it remained at much higher levels than in other French cities at the time (28 deaths/1 000 inhabitants as opposed to 9/1 000 in Paris at the same time). Higher water supply also meant more dirty water lying about: it is not until ambitious sewerage works were completed and households got connected to the sewers that mortality rates dropped significantly. Although attributing causality is always a perilous exercise, Figure 2.2 shows a clear correlation between a reduction in mortality and the timing of water and sanitation investments.

Figure 2.2. **Impacts of water and sanitation investments on mortality in Marseille (France)**



Source: Académie de l'Eau.

In France, overall, the total length of water supply networks grew from about 25 000 km in 1940 to over 800 000 km in 2004 (Smets, 2008). Only 27% of the French population had toilets inside their home in 1954 against 98% today and three quarters of the treatment plants in operation by 2009 was built after the 1990s (although the older ones tended to be larger plants). In the United States, the introduction of water chlorination and filtration in 13 major United States cities during the early 20th century led to significant reductions in mortality with a calculated social rate of return of 23 to 1 and a cost per person-year saved by clean water of about USD 500 in 2003 terms.[1]

In developing countries, WHO has estimated that almost ten per cent of the global burden of disease could be prevented through water, sanitation and hygiene interventions. Children are most affected, with 20% of disability adjusted life-years (DALYs)[2] in children under 14 attributable to inadequate water, sanitation and hygiene and 30% of deaths of children under 5.

Health benefits from improved access to sanitation and hygiene appear to be most significant, followed by improved access to clean water. With respect to water, there is reasonable evidence to support the finding that the quantity of water provided is paramount (particularly in order to adopt basic hygienic practices) if health benefits are to be achieved and may be more critical than the quality of such water, which is also important.

In developing countries, WHO estimated that achieving the MDGs for water and sanitation could generate an estimated USD 84 billion per year in benefits, with a benefit to cost ratio of 7 to 1.[3] As shown on Table 2.1, three quarters of the benefits would stem from time gains, *i.e.* time that is gained by not having to walk long distances to fetch water or to queue at the source.[4] Most other benefits are linked to a reduction of water-borne diseases such as reduced incidence of diarrhoea, malaria or dengue fever, which are estimated either in terms of reduced health care costs or productivity savings.

Table 2.1. **Overall benefits from meeting the MDGs in water and sanitation**

Type of benefits	Breakdown	Monetised benefits (in USD)
Time savings from improved water and sanitation services	• 20 billion working days a year	USD 63 billion a year
Productivity savings	• 320 million productive days gained in the 15-59 age group • 272 million school attendance days a year • 1.5 billion healthy days for children under 5	USD 9.9 billion a year
Health-care savings		• USD 7 billion a year for health agencies • USD 340 million for individuals
Value of deaths averted, based on discounted future earnings		USD 3.6 billion a year
Total benefits		**USD 84 billion a year**

Source: Prüss-Ürstün *et al.*, 2008, based on an evaluation by Hutton and Haller (2004).

In addition, WSS generate a number of non-economic benefits that are difficult to quantify but that are of high value to the concerned individuals in terms of dignity, social status, cleanliness and overall well-being. More broadly, adequate water and sanitation services appear to be a key driver for economic growth (including investments by firms that are reliant on sustainable water and sanitation services for their production processes and their workers).

Wastewater collection and treatment can generate health and environmental benefits, with ripple effects on other economic sectors, such as agriculture, fisheries, tourism or industry. The benefits of wastewater collection and the resulting protection from contamination are obvious to most individuals. By contrast, the benefits from wastewater treatment are less obvious to individuals (as is often the case with public goods) and more difficult to assess in monetary terms. The consensus on the need for increased urban wastewater treatment as well as safe disposal of its residues has therefore developed more slowly, probably also due to the relatively high costs of such interventions. In the United States, the 1972 Clean Water Act built an important legal basis for expanding wastewater treatment facilities. In Europe, the European Union Urban Waste Water Treatment Directive adopted in 1991 represented the policy response to the growing problem of untreated sewage disposed into the aquatic environment.

All benefits from wastewater treatment are linked to an improvement in water quality through the removal of different polluting substances, generating withdrawal benefits (*e.g.* for municipal water supply as well as irrigated agriculture, livestock watering and industrial processes) and in-stream benefits (benefits that arise from the water left "in the stream" such as swimming, boating, fishing).

Wastewater treatment can have a beneficial impact on the environment and economic activities that are dependent on it. For example, in the Black Sea, the degradation of water quality due to enrichment in nutrients led to an important increase in algal mass affecting aquatic life. The mass of dead fish was estimated at around 5 million tons between 1973 and 1990, corresponding to a loss of approximately USD 2 billion. Water quality is also an essential factor for certain tourism activities and sewage treatment leads to enhanced tourism attraction. In most countries, non-compliance with certain norms for bathing water leads to the closure of beaches and lakes for recreational purposes and therefore influences strongly the local tourism economy. In Normandy (France), for example, it has been estimated that closing 40% of the coastal beaches would lead to a sudden drop of 14% of all visits, corresponding to a loss of 350 million Euros per year and the potential loss of 2 000 local jobs.

Benefits for property have also been shown to be significant. People living in the surroundings of water bodies benefit from increased stream-side property values when wastewater treatment measures ensure a certain quality of water bodies. Several studies show that in proximity of areas that benefited from improved water quality, property values were found to be 11 to 18 per cent higher than properties next to water bodies with low quality.

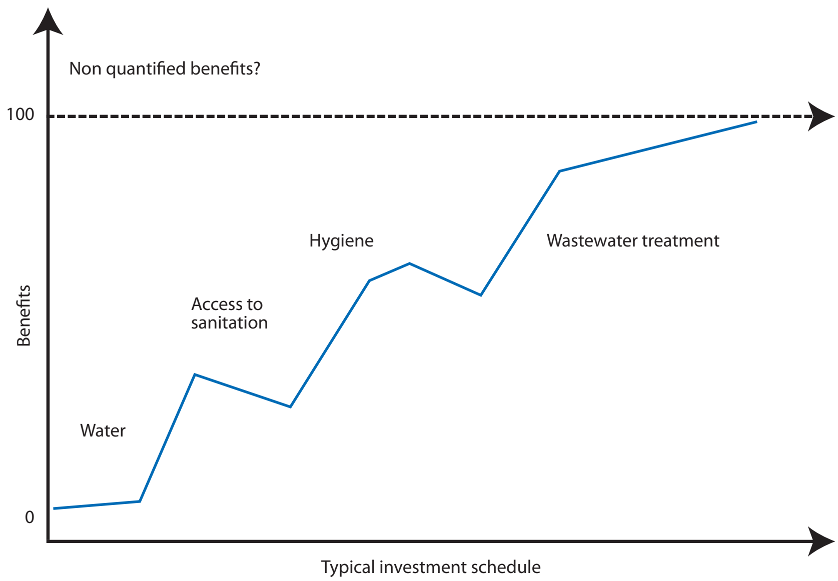
Finally, wastewater treated to adequate levels can be re-used. Both faeces and urine can be used as potent fertilizers for agriculture, as well as for producing biogas for energy production. For example, biogas plants can be built to use animal and human waste to produce a colourless clean gas similar to liquefied petroleum gas (LPG), which can be used for cooking and lighting with virtually smoke-free combustion. A study by Winrock International evaluated an integrated household-level biogas, latrine and hygiene education programme in Sub-Saharan Africa and found that the programme's economic rate of return was 178%, with a 7.5% financial rate of return (Renwick *et al*., 2007).

Economy-wide assessments of benefits of water quality improvements

Aggregated economy-wide assessments of benefits of water quality improvements are very few and far between. The US Environmental Protection Agency estimated the net benefits of water pollution legislation in the last 30 years in the United States at about USD 11 billion annually, or about USD 109 per household. In South East Asia, the Water and Sanitation Program estimated that, due to poor sanitation, Cambodia, Indonesia, the Philippines and Vietnam lose an aggregated USD 2 billion a year in direct financial costs (equivalent to 0.44% of their GDP) and USD 9 billion a year in economic losses (equivalent to 2% of their combined GDP). The financial losses include change in household and government spending as well as impacts likely to result in real income losses for households (*e.g.* health-related time loss with impact on household income) or enterprises (*e.g.* fisheries). The economic costs include the financial costs as well as longer-term financial impacts (*e.g.* less and fewer educated children, loss of working people due to premature death, loss of usable land, tourism losses) (Hutton *et al*., 2008).

The combined magnitude of the benefits from WSS can vary substantially depending on the level of sector development. Figure 2.3 represents the streams of benefits coming from a typical investment schedule.

Figure 2.3. **The water and sanitation benefits curve**



Source: OECD (2011b).

In most countries where the "access gap" is still large, providing access to water services is seen as a priority as it can indeed deliver substantial benefits, particularly if combined with hygiene education. If access to water is provided without corresponding investments in sanitation, however, this can generate temporary disbenefits, as abundant water supply can create pools of stagnant waters mixing with excreta and other types of waste (such as grey waters).

Connecting people to sewers without wastewater treatment can sometimes generate disbenefits in the cases where it transforms diffuse pollution into point-source pollution (a sea outfall for example). Wastewater treatment would eliminate all residual risks. However, benefits would start tailing off once a high degree of wastewater treatment is reached (although this would clearly depend on maintain existing installations, so that they can continue to deliver benefits). Going further, there may be some additional benefits (such as from an improved living environment or benefits for future generations) which may be harder to quantify but that could nevertheless justify investments in WSS beyond the level at which quantifiable benefits overtake costs.

There are few aggregated estimates of benefits and few rules of thumb that could be applied universally, given that benefits from water and sanitation investments tend to vary substantially according to local factors, such as the level of development of the infrastructure, the prevalence of water-related diseases, environmental status, etc. Given that carrying out a full evaluation of benefits is potentially expensive and time consuming, one alternative from a methodological point of view is to compare interventions based on cost-effectiveness criteria, *i.e.* to evaluate how much different interventions cost in order to achieve similar objectives (and therefore generate the same amount of benefits).

In developing countries, for example, it was found that investing in WASH (water, sanitation and hygiene) is very cost-effective. The Disease Control Priority project (an ongoing effort to assess disease control priorities and produce evidence-based analysis and resource materials to inform health policymaking in developing countries) found that hygiene and sanitation promotion activities cost respectively USD 3 and USD 11 per DALY averted. By comparison, the cost-effectiveness of promoting oral rehydration therapy, the main other measure to prevent diarrhoea mortality, was estimated at USD 23 per DALY, which means that hygiene and sanitation promotion compares favourably to such measure.

In another example, Haller *et al.* (2007) conducted a cost-effectiveness analysis that indicated that the provision of in-house piped water supply and sewer connection is the intervention that maximises health gains but is also the most expensive intervention. They concluded that for many developing countries, in-house piped water supply may not be affordable in the short to medium-term, and governments and households may need to settle in the short-term for second-best solutions, although health and non-health benefits would not be as large. They suggested that disinfection at point of use, which has as better cost-benefit ratio could be used as an efficient short-term policy strategy to further reduce diarrhoea incidence, while time elapses during the extension of coverage and upgrading of piped water and sewage services.

How much investment is needed?

In **OECD countries**, access to safe water supply and sanitation has largely been ensured following substantial investment over many decades (OECD, 2009a). Despite a high initial asset base, developed countries confront huge costs of modernising and upgrading their systems, so as to comply with increasingly stringent health and environmental regulations, maintain service quality over time, ensure the security of water supplies in response to climate change, pollution and growing populations, and in some cases, overcome the neglect and underfinancing of earlier years.

According to OECD (2006a), the global capital costs of maintaining and developing WSS infrastructure in OECD countries plus the BRICs could amount to 0.35 to 1.2% of their GDP. This corresponds to total projected annual needs of around USD 780 billion by 2015 and USD 1 037 billion by 2025, up from a current estimated expenditure on water infrastructure of USD 576 billion annually. According to OECD (2007), this is far higher than comparable estimates for roads (USD 160 billion per year by 2020) or electricity transmission and distribution (around USD 80 billion per year by 2025).

Lloyd Owen (2009) sought to derive more comprehensive estimates by forecasting spending needs both for investments and operations and maintenance, across a large number of countries, across developed and developing ones. Lloyd-Owen (2009) estimated that meeting future challenges (such as rehabilitating existing assets or meeting the MDGs) would call for around USD 2 880 billion in investments over the next two decades (or about USD 144 billion per year) in the 67 countries covered by the analysis, with associated operating costs which could be twice as high as capital investment costs, as shown on Table 3.1. This report also identified a substantial financing gap as it estimated that only USD 631 to 1 381 billion could be generated from existing sources of revenues (including tariffs), leaving a gap of between USD 1 049 to 2 297 billion over the period.

In **EECCA countries** (Eastern Europe, Caucasus and Central Asia), the need for maintaining and upgrading existing infrastructure is combined with sometimes significant needs to expand coverage and address the challenges of poor governance, institutional inefficiency and the deterioration of the asset base. Much of the existing infrastructure is old and over-sized for present needs, and is ill-suited to economic and demographic realities. A number of these countries cannot afford to maintain even existing services in their present form, and face a situation where they have to choose between maintaining affordable tariffs and skimping on quality by lowering the standards of service. OECD (2009a) refers to the examples of Armenia, Moldova or Georgia where the current levels of financing are clearly insufficient even to maintain assets at their present low operational levels or to provide adequate levels of service, with the corresponding long-term cost impacts. In the Commonwealth of Independent States, JMP (2010) found that the rate of access to piped water in the home has declined by 2% between 1990 and 2008 (from 71% to 69%), which points to clear under-investment in the sector. In addition, OECD (2006b) pointed out that JMP figures paint an over-optimistic picture of the situation with respect to access to water and sanitation services in the region.

In many EECCA countries, a sharp deterioration in service levels implies that "having a water tap does not necessarily mean having sustainable access to safe drinking water". Cross-contamination between water and sewerage networks, due to high levels of leakage, for example, can have serious effects on public health. To meet the MDGs in EECCA countries, it was estimated in 2006 that EUR 7 billion would be necessary annually for operation, maintenance and capital investments, which was roughly double available financing at the time.

In **developing countries**, a significant percentage of the population still does not have access to water and sanitation services, whilst many others suffer from unsatisfactory services. The international community is committed to achieving the Millennium Development Goals (MDGs) that aim to halve the proportion of people without access to safe drinking water and basic sanitation by 2015. Despite strong calls for action at international level, the Joint Monitoring Program, led by WHO and UNICEF, found that 2.6 billion people still do not use improved sanitation (out of which 1.1. billion still defecate in the open), whilst 884 million people do not use improved sources of drinking water (JMP, 2010).

There is a broad range of estimates for the costs to reach the MDGs, depending on the assumptions used on the types of investment made. According to the GLAAS report, the global cost estimates for meeting the drinking water and sanitation MDG target range from USD 6.7 billion to USD 75 billion per year, *i.e.* USD 33.5 billion to USD 375 billion by 2015 (UN-Water, 2010). There is a ten-fold variation in the cost estimates, largely due to the fact that estimates are based on different assumptions with respect to baseline years, population growth, cost of technology and levels of service.

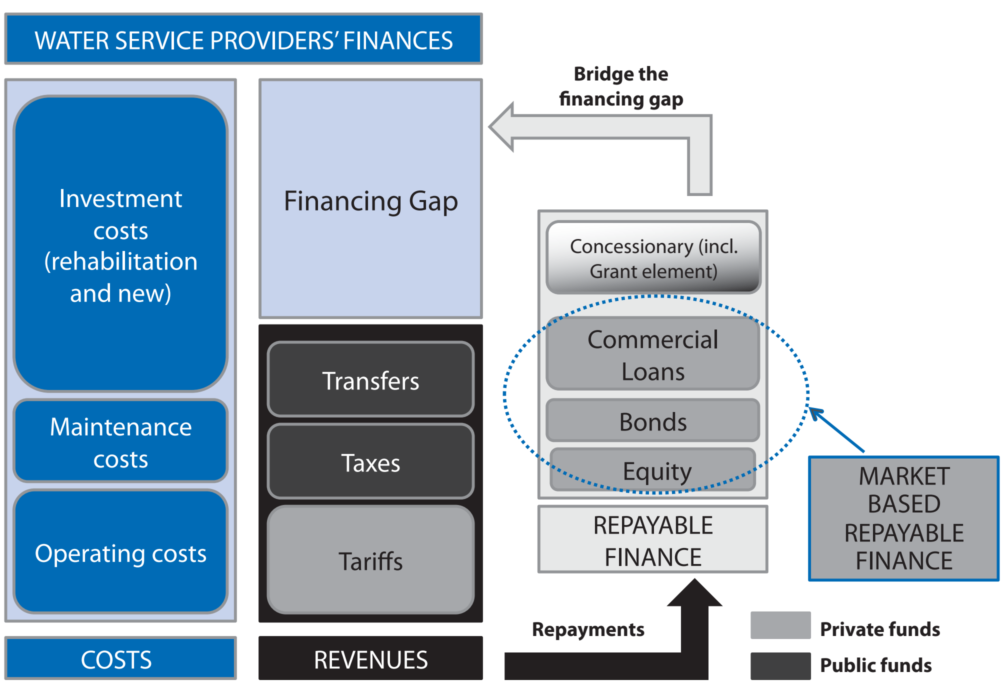
Some of the cost estimates include only the cost of new capital infrastructure and do not consider the costs of maintaining or rehabilitating existing infrastructure, which can be a very significant. For example, Hutton and Bartram (2008) estimated spending required to meet the MDG target at USD 42 billion for water and USD 142 billion for sanitation, a combined annual equivalent of USD 18 billion. The cost of maintaining existing services totals an additional USD 322 billion for water supply and USD 216 billion for sanitation, a combined annual equivalent of USD 54 billion. In addition, administrative costs, incurred outside the point of delivery of interventions, of between 10% and 30% were estimated necessary for effective implementation. A report by Hutton and Bartram (2008) highlights that 75% of annual needs to attain the MDG target for water and sanitation relate to the maintenance and the replacement of existing infrastructure, while 20% relates to the extension of sanitation services and 6% of water services. While the need for capital investment for new systems is often emphasised, there are significant costs associated with human resources and operation and maintenance to ensure that the existing systems are kept functional. According to Fonseca and Cardone (2005), most estimates do not appear to include the costs of support services or institutional capacity to ensure that systems are planned, installed and maintained adequately.

Closing the financing gap

The key conclusion from the above analysis is that current financing allocations will not be sufficient to meet the MDGs or, if more ambitious targets are put in place, such as to guarantee the human right to safe and clean drinking water and sanitation. Despite the clear benefits for human and economic development, insufficient resources are currently allocated to meet the Millennium Development Goal (MDG) targets for sanitation and drinking water (in some countries).

Closing the financing gap will require countries to mobilise financing from a variety of sources, which may include reducing costs (via efficiency gains or the choice of cheaper service options), increasing the basic sources of finance that can fill the financing gap, *i.e.* tariffs, taxes and transfers (commonly referred to as the "3Ts") and mobilising repayable finance, including from the market or from public sources, in order to bridge the financing gap. These potential sources are shown on Figure 2.4.

Figure 2.4. **Sources of Finance for WSS**



Source: OECD (2010b).

Closing the financing gap will require countries to make efforts both on the "demand side" and the "supply side" of the sustainable finance equation (OECD, 2009a). On the demand side, the costs of providing WSS services can be reduced through improved operating efficiencies, which can be a crucial way of generating financial resources (as well as saving on physical resources, particularly in areas of water scarcity) and demand management. In addition, improved investment planning can generate substantial savings and support the definition of more realistic investment programs, including by selecting cheaper and more locally-appropriate investment options or adapting service levels to local conditions and development strategies.

On the supply side, additional revenue sources can be mobilised from the 3Ts or from repayable sources through making the case for investment in WSS, improving the allocation of resources or reducing risks to attract private investments. Planning for the right balance between all these sources of revenues calls for strategic financial planning, so as to evaluate the potential for mobilising financing from each source of revenues (as well as reducing costs). The rest of this section reviews the demand and supply sides of the sustainable finance equation.

Improving the efficiency of operations

Inefficiencies are responsible for important losses of funds within the sector. Operational inefficiencies include poor revenue collection, distribution losses (referred to as leakage or non-revenue water, NRW), labour inefficiencies and petty corruption.[5] For example, reducing NRW can significantly reduce operating costs, because it generates savings in terms of lower amounts of water used, reduced treatment and transport costs (as moving the water around can use a substantial amount of energy). Accumulated inefficiencies and deferred maintenance can result in higher costs over time. The Africa Infrastructure Country Diagnostic (Banerjee and Morella, 2011) estimated that, in Sub-Saharan Africa, inefficiencies of various kinds generated a cost to the sector of an average 0.5 percent of GDP (or USD 2.9 billion a year), and could rise up to 1.2 percent of GDP for low income fragile states (although they include in such inefficiencies the fact that tariffs are charged below cost-recovery levels).

There are three main ways to reduce such inefficiencies: by raising user charges closer to cost-recovery levels (to provide more efficient price signals and help capture lost revenue); by reducing utilities' operating inefficiencies (to prevent waste of significant resources, support healthier utilities, and improve service quality); and by improving budget-execution rates. It is estimated that if such inefficiencies were eliminated, the funding gap to meet the MDGs could be almost eliminated in middle-income countries, even though it would still remain substantial in other countries (the majority) in Sub-Saharan Africa (Banerjee and Morella 2011).

In Greater Cairo (Egypt), a Strategic Financial Planning exercise conducted with the support of the European Union Water Initiative (Mediterranean Component) and the OECD found that a series of efficiency measures, including reducing domestic consumption, reducing water losses and improving pumping efficiency would allow lowering overall system costs by 19% but that this would only make a minor contribution to reducing the financing gap faced by the city to maintain existing assets and meet future needs. If no measures are taken, the financing gap is expected to increase by 45% between 2006 and 2026 due to very low user charges, a serious backlog of investment accumulated over the past decades and a strongly projected demographic growth over the next 20 years.

The scope for realising efficiency gains is particularly high in developing countries and EECCA countries. Whereas leakage rates are typically in the range of 10 to 20% in OECD countries, they frequently exceed 40% and sometimes reach up to 70% in developing country utilities. In Armenia, for example, OECD/EAP Task Force (2007) identified that water losses could go up to 70% in certain cities due to extensive leakage in the worn-out public networks and buildings' internal piping, excessive pressure in the water supply network or defective meters. The high rate of leakage in many systems is one, highly visible, aspect of the more general problem of inefficient operations.

There are many potential ways to stimulate increases in efficiency. Incentives for improved efficiency can be introduced with a number of tools, including price regulation, assignment of risks and rewards, competitive tendering, penalties and benchmarking. As a first step, benchmarking tools, such as IBNet, can be used to compare the performance between various utilities and identify areas of potential inefficiencies. In England and Wales, the water and sewerage companies provide the economic regulator, Ofwat, with indicators of service performance covering water supply, sewerage services, customer service and environmental impact. Ofwat publishes the indicators annually in a public report. These simple performance scorecards have helped measure the efficiency of service provision and pressure the "worst in the class" (Kingdom and Jagannathan, 2001).

Opting for different levels of service to reduce initial capital costs

Choice of hardware and technologies can make a big difference to costs. In OECD countries, the regulatory regime in place can influence the selection of investment options, linked to the set of incentives that they introduce. Whilst a rate-of-return regulatory regime may give an incentive to select higher cost options to earn a higher return (what is sometimes referred to as "gold plating"), incentive-based regulatory regimes (such as price cap regimes) introduce incentives to invest at least cost. In England and Wales, for example, this has allowed substantial investments to take place in the context of minimal tariff increases for customers. Optimising existing WSS infrastructure can generate substantial savings, for example, by scaling down capacity to the present and forecasted demand, or replacing inefficient pumps with a short asset life by new more efficient ones with a long asset life.

At world level, the per capita costs of different options for meeting the water MDG have been estimated by Hutton and Bartram (2008): the report shows that the per capita cost of household connection is over three times higher than a stand post in Africa and Latin America. According to their estimates, the total global costs of attaining the water and sanitation MDGs could therefore go down from a high technology to a low technology option, from USD 327 billion to USD 135 billion, equivalent to an annual saving of USD 19 billion worldwide. Cutting down on investment costs may also be achieved by lowering service standards to levels that a country can afford: for example, many developing countries have adopted Western standards without tailoring them to their own circumstances, resulting in unnecessarily investment costs.

Finance to close the gap: A combination of the 3Ts

As is now well-recognised, the 3Ts (defined as tariffs, taxes and transfers from overseas development assistance or philanthropic donations) are the ultimate sources of finance for water and sanitation services (OECD 2009a). The 3Ts can also be used to leverage, and eventually repay or compensate, other funding sources, principally loans, bonds and equity.

To date, most countries have used public transfers (either from their own government or from external sources) to fund the development of WSS, particularly for capital expenditure. As countries develop and WSS become more mature, there tends to be a shift towards more use of commercial finance, reimbursed by growing cash flows from user charges (*i.e.* tariffs). For example, as set out in OECD (2010a), whereas tariffs represent 90% of direct financial flows to the sector in France, they only account for about 40% in Korea, 30% in Mozambique or as little as 10% in Egypt.

Increasing revenues: Tariffs

Although the conventional economic wisdom calls for charging WSS tariffs at full cost recovery level, very few countries, either developed or developing, recover all costs via tariffs. This is true even when only financial costs are included and even more difficult when attempting to recover environmental and social costs. According to OECD (2009b), "sustainable cost recovery" (as originally defined by the Camdessus report) should be based on the simultaneous application of three principles:

- An appropriate mix of the 3Ts to finance recurrent and capital costs, and to leverage other forms of financing;
- Predictability of public subsidies to facilitate investment (planning),
- Tariff policies affordable to all, including the poorest, while ensuring the financial sustainability of service providers

Tariff setting is usually driven by a combination of factors, many of which go beyond the immediate needs of the service. Politicians can insist on keeping tariffs low (*i.e.* below cost-covering levels) as water is an essential good, for which charging can be politically and socially sensitive. The "willingness-to-charge" may therefore be lower than the willingness-to-pay due to political motivations. From an economic perspective, setting tariffs needs to reconcile a series of potentially conflictive objectives, including economic efficiency, cost-recovery (or financial sustainability) and social concerns (or affordability). As discussed in OECD (2011b), a number of tariff structures can be adopted to reconcile those principles.

In OECD countries, operating costs are by and large covered but the scope for covering capital costs varies substantially. In OECD countries, OECD (2009d) found that prices can vary by a factor of 10 or more, ranging from 0.49 USD/m³ in Mexico to 6.7 USD/m³ in Denmark (such high price being underlined by an attempt to incorporate environmental costs into pricing). The report also sought to estimate cost-recovery ratios, based on IBNet data and other sources. Such analysis indicated that, in OECD countries, operation and maintenance costs of domestic and industrial WSS services are generally covered through tariffs. However, there does not appear to be a large margin for operators to also face the need to renew and replace ageing infrastructure, although very few countries provided data on this item. Generating revenues to cover the full economic or sustainability costs (including the environmental impact of abstracting water) seems to be a remote target only. An analysis of specific cases (such as Finland, Switzerland or Belgium) suggested that efforts have been made to increase cost-recovery in many OECD countries, and in particular to cover the costs of wastewater management where larger investments are needed.

Overall, WSS tariffs represent only a small share of average household incomes in OECD countries (ranging from 0.2% in Korea to 1.2% in Poland). These average figures hide some areas of "water poverty", however, with WSS bills representing up to 4.2% or 7.9% of household income for the poorest decile in Mexico and Poland respectively.

Cost-covering tariffs are much less prevalent in developing countries. OECD (2010a) indicated that prices for water supply and sanitation services in developing countries have been increasing over the last decade, however from usually low levels. Some countries in Asia, Latin America and the Middle-East have tariffs above 1 USD/m³. However, in most cases, tariffs provide little incentives to use water efficiently (including by curbing down leakages) and do not cover costs. Whilst operating costs are not always covered, capital expenditure for large investments is almost always financed via public funds, either from government taxes or international transfers.

In some regions, such as in Sub-Saharan Africa, households' contributions to sector financing are substantial, however, in the form of direct investments in self-supply. For example, the Africa Infrastructure Country Diagnostic, a continent-wide effort led by the World Bank to track expenditure in seven infrastructure sectors, found that households were actually the largest source of finance in the sector, ahead of domestic governments and international donors: "in Sub-Saharan Africa, households are important financiers of capital investment (0.3 percent of the Sub-Saharan African GDP) and account for USD2.2 billion, most of it dedicated to the construction of on-site sanitation facilities, such as latrines. The level of contributions from OECD donors is similar to that of domestic public resources and is equivalent to 0.2 percent of the Sub-Saharan African GDP" (Banerjee and Morella 2011).

In many developing countries, generating additional revenues via tariff reforms (including changes to tariff levels and tariff structures) requires taking account of affordability constraints for the most vulnerable population. The apparent trade-off between financial sustainability and affordability can be addressed via careful tariff design. Affordability can be assessed at two levels: for society as a whole, and for the most vulnerable groups (what can be referred to as "micro-affordability"). A number of countries (in the OECD and elsewhere) have adopted increasing block tariffs (IBTs), with a first "subsistence" block provided at zero or very low prices. The assumption behind their adoption was that they would enable poor households to have access to a basic level of water services for free or at low cost, while at the same time contributing to cost recovery by providing a cross-subsidy from larger water users and providing an incentive to conserve water. But the actual experience with their implementation has shown that IBTs are regressive in countries with incomplete networks, where the poor are generally not connected and therefore do not benefit from the consumption subsidy by definition. Part of this results from the flawed design of IBTs in a number of countries (*e.g.* the lack of attention given to their impact on large poor households). Adjustments in their design can improve their capacity to target the intended population, but cannot completely overcome the shortcomings. In reality, poorer households are often larger households, so that they may end up consuming more than smaller, higher income ones. In areas where access is still low, it has been shown that the targeting performance of consumption-based subsidies is lower than that of connection subsidies (Komives *et al.*, 2005).

Alternative solutions to tackle affordability, apart from modifying tariff structures, include providing income support (to compensate poor households for increases in the prices of services of public interest that are judged to be unacceptably burdensome) and facilitating payment (to help poor consumers manager their budgets by paying water bills at short intervals for example).

In the context of the financial crisis, raising tariff revenues is likely to remain difficult. The financial crisis is likely to affect the ability for water companies to raise tariffs in two main ways: through a hardening of affordability constraints and a possible increased political reluctance to increase tariffs to sustainable cost recovery levels. The affordability constraint will be particularly felt in developing and transition countries. Although developing countries initially appeared to be shielded from the sudden stop in private capital flows that characterised the financial crisis from October 2008, they were later affected as the financial crisis spread to the real economy. In developed countries, household incomes are also stretched and consideration will need to be given for people on low income or with special needs who face increases in the cost of their utility bills and other costs in general.

Increasing revenues: Taxes

In both OECD and developing countries, allocations from public budgets still represent an important share of revenue for the WSS sector and are likely to play a significant role for the foreseeable future. According to OECD (2009a), the allocation of public funds to WSS can be justified for a number of reasons, including to promote the consumption of merit goods (whose value consumers may not fully realise, such as household sanitation and hygiene) or to compensate for market failures, by rewarding WSS providers for supplying public goods (public health) and external benefits (such as avoidance of groundwater pollution). Public funds may also be used to allow service providers to provide services at a tariff below cost for vulnerable consumer groups.

In order to be efficient and effective, subsidies should be transparent, targeted and ideally taper off over time. The most widespread form of subsidy among OECD and developing countries alike is capital expenditure. In OECD countries, for example, most of the heavy initial investment that was made in the late 19th and early 20th century (for water supply and sanitation) and since the 1960s (for wastewater treatment) were financed through public funds. Such capital expenditure subsidies can be provided in the form of grants, subsidised loans or guarantees, while utilities are expected to cover their O&M costs from tariffs. When utilities are owned by municipalities, local government budgets are often not sufficient and benefit from transfers from the central government. It is the case for example in South Africa, where municipalities often struggle to obtain adequate financing from tariffs. The central government therefore transfers municipal infrastructure grants, to address the capital investment backlogs inherited from the Apartheid era and the "equitable share", which is a need-based allocation transferred to local governments for operating expenses.

It is crucial that such transfers are provided in a way that ensures an effective contribution to the long-term sustainable financing of the WSS sector. Experience gained in the OECD and in countries of Central and Eastern Europe shows that two important criteria should be taken into account when organising these transfers: intergovernmental transfers should generate stable revenues that can be integrated in medium-term financial strategies of local governments and those transfers should be limited in time, until the achievement of pre-specified targets (EAP Task Force, 2006).

While public funds are limited by budgetary constraints and multiple demands from different sectors, there is scope for increasing public budget spending. In particular, several developing countries currently allocate only a small portion of government spending to the water and sanitation sector. Results from a recent survey of expenditure on water and sanitation, reported in the GLAAS report (UN-Water, 2010) state that countries reported public expenditures (from internal and external sources) between 0.04% and 2.8% of GDP for drinking water and between 0.01% and 0.46% of GDP for sanitation. Amongst the countries that had responded, Burkina Faso was the country that spent most on water and sanitation combined as a percentage of its GDP (with an estimated 3% of GDP), whilst countries with the lowest expenditure on the sector as a percentage of their GDP included South Soudan, Côte d'Ivoire but also the Philippines. These figures highlight that overall spending in developing countries remain insufficient, although they mostly account for public spending and do not include private sources of finance. It is also recognised that data on national government spending on water and sanitation is not always very robust.

In OECD countries, in the context of the economic crisis, however, tax transfers are only likely to surge where stimulus packages target the water sector. The financial crisis is likely to have a two-pronged effect on government transfers to the water sector, as set out in OECD (2010a). A potentially negative impact is that, during times of crisis, there are many competing demands for limited public funds. Substantial public borrowing is likely to exacerbate the pressure on non-sovereign borrowers, through a "crowding-out" effect, making it even harder for them to borrow at acceptable rates. On the other hand, several governments have responded to the crisis by unveiling substantial stimulus packages, which could benefit the water sector. Following the lead of the United States and China, many of these stimulus packages include measures to "green the economy" (such as the "Green New Deal" announced in Korea) which, in some cases, include investments in water and wastewater.

In addition, governments in developed and developing countries alike are less likely to be able to borrow at acceptable rates. As a result, they may be tempted to make "temporary" cuts in water and wastewater investments so as to reallocate those resources to other sectors, with potentially long-term damaging impacts. The economic and financial crisis will also strengthen the case for making the best use of public resources (taxes and ODA alike) in order to leverage other forms of finance, including repayable finance.

*Increasing transfers (*i.e. *Official Development Assistance and philanthropic donations)*

Official Development Assistance may be able to play a role in closing the financing gap in transition and developing countries. The share of ODA to water and sanitation varies across recipient countries. In some countries ODA subsidises most investments, while in others it plays a more marginal role. ODA has an important role to play both as a source of finance and of capacity development for the provision and financing of water services. It can also have a catalysing effect by reducing bottlenecks (particularly capacity constraints), ensuring access to the poor, and harmonising and aligning assistance with national strategies.

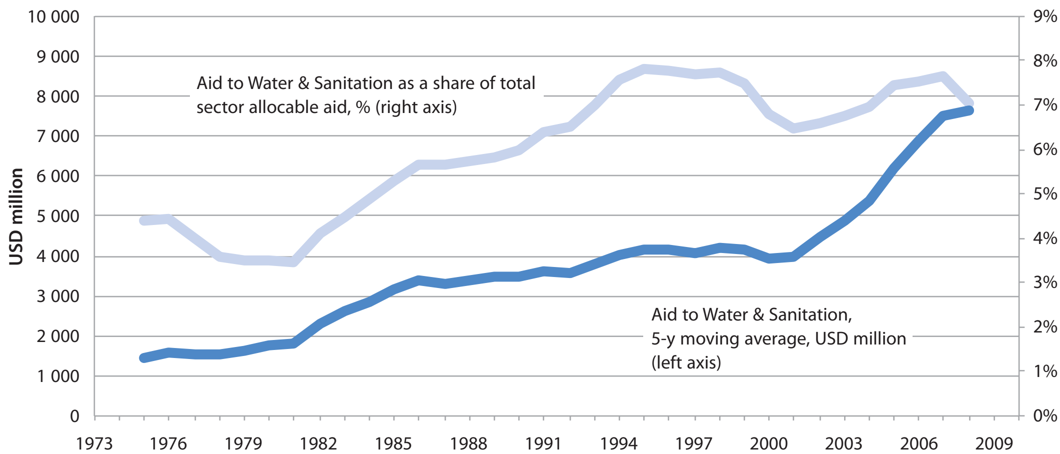
While the bulk of ODA is extended in the form of grants, loans constitute a large share of ODA to certain sectors. About half of ODA to water supply and sanitation in 2009-10 was in the form of loans. In the context of an analysis that distinguishes between the basic sources of revenue (tariffs, taxes and transfers) and other financial means, the different roles of ODA grants and loans need to be borne in mind. *ODA grants* consist of "transfers" and are considered as basic sources of revenue. *ODA loans* lower the cost of capital and are useful in helping water utilities "bridge" the financing gap that is created by the need for large upfront infrastructure investment and are therefore rather to be accounted for in the category "repayable sources of funding".

After a temporary decline in the 1990s, aid to water and sanitation has risen sharply since 2001. In 2009-10, total annual average aid commitments to water and sanitation amounted to USD 8.3 billion. Bilateral aid to water increased at an average annual rate of 7% over the period 2001-10 and multilateral aid also rose by 3% annually.

According to OECD-DAC (2012), the share of aid to water and sanitation in DAC members' and multilateral agencies' aid programmes represented 7% of their sector-allocable aid in 2009-2010, as shown in Figure 2.5.

Figure 2.5. **Volume and share of aid to water and sanitation**

1973-2009, commitments, 5-year moving averages, constant 2009 prices



Source: OECD-DAC (2012).

International transfers will increasingly be needed to fill the gap but will be affected by the dire situation of public finance. In the context of the financial and economic crisis, it is likely that international transfers from IFIs, bilateral donors and charitable organisations will increasingly be needed to fill the financing gap in the water sector or to leverage other sources of finance, including market-based repayable finance. On the lending front, some IFIs have seen a growing demand for their services and products, especially as the competition from commercial banks has reduced. It should be noted, however, that such IFIs have to finance their loans through the capital markets and that their own borrowing costs have increased in line with the market.

A critical question is whether international donors (and philanthropic organisations) are going to be able to significantly increase their commitments in years to come. Previous economic crisis have usually seen official development assistance fall. Given the global significance of the crisis, however, OECD governments have committed to maintaining aid flows despite pressures on their own budgets. This has also been reflecting in IFIs expanding their lending facilities as a response to the crisis. For example, the World Bank has set up specific facilities to address what they identified as the sectors most at risk, with a special focus on infrastructure.

Bridging the financing gap: Tapping repayable sources of funding

Whilst revenues from the 3Ts can *close* the financing gap for WSS, the role of repayable finance is only to *bridge* the financing gap, since it requires subsequent compensation in the form of interest or dividends. WSS providers usually look to mobilise repayable finance in order to finance capital expenditure for repairs, renewals or expansion of water and sanitation systems whilst ongoing operating costs and ordinary maintenance are routinely financed from a mix of the 3Ts (OECD, 2010b).

Market-based repayable finance refers to a sub-set of repayable finance, where financing is provided through the market by private actors. Sources of market-based repayable finance include: debt finance (loans from commercial banks, bonds issued through capital markets, project finance) and equity finance (from capital markets or private equity funds). Debt financing has been the backbone of most infrastructure investment in developed countries. Depending on the development of local bond markets and the size of the debtor, it has come either in the form of bonds or loans. In developing countries, water companies can use bank loans to finance capital investments (although these are usually concessional loans from development institutions). The use of other forms of finance, such as bond finance, project finance or equity finance has so far remained limited in developing countries but they are gradually emerging as ways to complement other forms of finance. The ability of the WSS sector to tap sources of repayable finance depends critically on effective governance (Box 2.1).

Box 2.1. **The importance of the finance-governance nexus**

The prospects of securing market-based repayable financing for the WSS sector is critically linked to the effectiveness of the governance regime in place for the sector in specific countries, regions and municipalities. The sector is often perceived by potential providers of market-based repayable finance (such as banks, institutional investors, private equity funds, equity investors, project sponsors, etc.) as a "high risk / low return" sector, even though its fundamental economics (with relatively stable and almost "recession-proof" demand for the services and long-life buried assets) would rather place it in the "low risk/ low and steady return" category for a number of reasons. This high-risk reputation is frequently linked to political and institutional difficulties in increasing water and sanitation tariffs to cover costs, due to perceived affordability constraints or political resistance to increasing tariffs. As a result, many water utilities are in dire financial situations, with under-capitalised balance sheets that impede their capacity to raise debts. In the absence of any repayment capacity or history of past lending, most commercial banks are unlikely to lend to the sector which they do not perceive as being "credit-worthy". Having effective institutions can dramatically improve the attractiveness of the sector for investors.

An additional mismatch occurs as a result of the often highly fragmented nature of the institutions delivering water services. Local financial markets may not be able to provide long-term loans with low interest rates to water operators, which overwhelmingly tend to be mid-size of small utilities, which can be referred to as an inappropriate "market fit". There is often a discrepancy between long-term investments needed in the water sector to match the life of the assets and the short-term lending capabilities on local markets in both developed and developing countries. In many countries, decentralisation of water and sanitation services has transferred large investment needs to local government and utilities. However, the availability of funds at local level is restricted: local government's credit worthiness tend to be low, making it challenging to raise funds on international markets, and the small scale of service of many utilities may result in too high transaction costs to make market-based financing viable.

Source: OECD.

Bank finance through short and medium-term commercial loans are common for financing working capital requirements in developed and developing countries alike. Short and medium term lending facilities may also need to be used to finance investments in countries where obtaining long-term bank financing to match the long asset life of water sector investments is difficult, as commercial banks are not able or willing to lend over such long periods. In developing countries, commercial banks are usually not familiar with the water sector, which is perceived as a high risk sector due to difficulties with increasing tariffs, inefficient management and corruption. Water utilities' revenues may not be sufficient to reimburse loans. Furthermore, they may not be sufficient to cover market-based financing costs, and this limits their ability to borrow. Finally, certain types of service providers, such as local or small-scale service providers may not have access to traditional bank financing at all, although they may have the option in some cases of relying on microfinance institutions for access to credit.

The re-evaluation of risk that has taken place during the financial crisis has led to a dramatic increase in the cost of commercial debt and in a reduction in the availability of overall debt financing, especially for long-term debts, resulting in a severe contraction in bank lending. The onset of the financial crisis has also affected sovereign states' ability to borrow and consequently reduced the value of sovereign guarantees in some cases. Microfinance institutions have suffered as well and may be less willing to diversify in water and sanitation away from their more traditional markets, *i.e.* income-generating activities. However, microfinance institutions in many developing countries are not offering such micro-loan/finance facilities for WSS. National development banks – if and where they exist – tend to focus more on large WSS projects than on small ones. As a result, bigger, richer and creditworthy cities usually can obtain bank finance, while most small towns and rural areas are neglected.

Bond financing is common in developed markets as it often offers cheaper access to debt finance than loans and the water sector is considered to have a low risk profile that makes it well suited to the debt market. The types of bonds issued can include corporate bonds, sovereign bonds or municipal bonds, depending on the structure and ownership of the water sector. For example, in the United Kingdom, the water market is dominated by large private water and sewerage companies which issue corporate bonds. In the United States, water companies are smaller municipally owned companies and municipal bonds have provided a major source of finance for water and sanitation investments in the United States since 1837. The financial crisis has affected such source of finance on the United States market, however, as the credibility of credit rating agencies has been questioned and several monoline insurers (which used to enhance the rating of municipal borrowers in exchange for an insurance premium) have disappeared. As a result, highly rated municipal bonds have somewhat lost their attractiveness for cautious investors, making it difficult for United States municipalities to raise the budgeted funds.

In the majority of less developed markets, municipal bonds were not available even before the onset of the crisis due to poor creditworthiness and transparency of those entities. There are a few exceptions, with incipient municipal bond markets in India, the Philippines or South Africa which have been used partly to finance water and sanitation investments.

Project finance consists of financing long-term infrastructure through a special purpose entity that can be financed with project debt and equity. A project finance "deal" would typically involve a number of equity investors, known as "sponsors" and a syndicate of banks that provide loans to the operation. Following the financial crisis, the feasibility of project finance deals based on high debt levels granted to off-balance sheet special vehicles has been severely affected, particularly in countries considered to be risky. New project finance structures are likely to require co-operation with sovereign-backed banks and will often require bridging loans at less favourable conditions.

Equity financing can be a good way of financing long-term investments as it is a source of finance with no specific deadline for repayment. Equity holders are usually interested in holding their stake over the long term in order to benefit from future dividends and any potential increase in the value of their equity. Equity can be used as collateral to leverage other forms of private finance, rather than as a way to finance long-term capital investments directly. When equity investors are private, however, that would usually be reflected in a higher cost of equity versus the cost of debt finance. Shares are either listed on a stock exchange (which can be referred to as the "listed equity model") or held privately, by the founders and managers of the company or institutional investors. A number of water companies have listed shares on the stock exchange, including some public companies (such as SABESP in Brazil) and private ones (such as Lydec in Morocco or Manila Water in the Philippines). However, a key constraint weighing on the ability to raise capital on the stock exchange is linked to the varying degree of development of local capital markets.

In the context of the financial crisis, equity financing has been more difficult to attract as the equity risk premium (*i.e.* the return expected by equity investors compared to risk-free investments) has gone up in both developed and developing countries. On the whole, availability of market-based repayable finance has been negatively affected by the financial crisis and the potential to rely on certain financial innovations seriously dented. This trend has to be placed in the broader context of the overall availability of finance to the sector, however, so as to assess the likely impact on investments going forward.

Innovative financing mechanisms can play a major role to attract market-based repayable finance to the sector. Financial innovation could significantly help with leveraging market-based repayable finance into the water sector, both in OECD and developing countries. Below are a few examples of what these innovations might entail; OECD (2010a) contains more detailed analysis of these innovations and examples of where they have been applied.

- ***Blending grants and repayable financing*** consists of combining concessional financing (either grants or loans with a grant element) with repayable finance in order to support a single project or a comprehensive lending program. In the water sector, this has been done at the level of specific projects, like in Maputo (Mozambique) for the financing of the urban water and sanitation program or via the establishment of financing vehicles, which aim to combine diverse sources of finance (such as in FINDETER in Colombia, a public-private financing entity which rediscounts commercial bank loans for local infrastructure development, including water and sanitation).
- ***Microfinance*** has been identified as a key way to overcome affordability constraints for providing access to services, particularly for households and small-scale water providers in developing countries. The use of microfinance has so far been limited in the water sector, partly due to a lack of awareness and limited understanding on the part of microfinance and water sector professionals of their respective sectors. However, a recent review by Mehta (2008) made the case for the strong potential of microfinance in the sector, particularly for loans to households and to community projects (such as slum redevelopment projects). ODA can play a role in developing the use of microfinance for WSS by providing seed financing to revolving funds or microfinance institutions, smart subsidies for product development or guarantees.
- Although a whole array of ***guarantees and insurance products*** are available from donors, IFIs and private institutions, they have not been used on a regular basis or

at a large scale in the water sector. This partly reflects the changing structure of the market for water services: whilst international private operators have largely been driven away by adverse conditions, guarantees provided by international institutions for relatively large "transactions" are less appropriate than previously.

- Forming ***grouped financing vehicles*** can be a helpful way to provide access to finance to a large number of relatively small borrowers, particularly with the combined use of guarantees to improve credit rating. Such groupings are particularly well-suited to decentralised water sectors, in which small and medium-sized service providers are struggling to access financing on their own merit.
- ***Direct lending to sub-sovereigns****,* without the need for a central government guarantee has been practised with success for some time by some IFIs and donors, such as the EBRD or the AFD. However, many other donors and IFIs have not been able to lend at the sub-sovereign level, either because their internal rules do not allow them to do so or because they are not willing to take on a risk that they cannot manage adequately. Such constraints should be critically examined. Donors should evaluate how they can relax such guarantee requirements at the sub-sovereign level, so as to pave the way for commercial lending to those borrowers. These types of agreements can help introduce financial discipline and support the implementation of reforms at the level of borrowers, as long as donors and IFIs can also provide adequate resources to support reform processes at the local level.
- ***Raising equity*** can help strengthen the balance sheets of water companies, which are often under-capitalised. Interesting models have been developed in the water sector to mobilise equity via financial markets (such as the Hyflux Water Trust in Singapore), thereby diversifying away from mobilising funds from private water companies (whose ability to bring in equity capital is limited in any case) and using such equity injections to leverage other forms of finance for capital investments. Mobilising equity through capital markets can strengthen financial discipline and improve transparency, including for companies that are primarily government-owned (including a number of State Water Companies in Brazil, which are publicly listed).
- ***Credit ratings*** can help improve transparency and facilitate access to financial markets for borrowers. Significant progress has been made for awarding credit ratings to municipal governments and water companies, although the use of such ratings has remained limited, particularly in markets that are too small to develop a national rating scale.
- Finally, ***project preparation facilities*** can also help with the definition and preparation of bankable water projects. A limited number of such facilities have been set up at the international level. Project preparation facilities, on the whole, have enabled the preparation of bankable projects in an accelerated manner and improved the effectiveness of donors' contribution by pooling funds together for support to project preparation. They have been particularly useful in well-defined geographical areas where they have been set up to accompany well-defined policies, such as in Eastern Europe or the Mediterranean. In Sub-Saharan Africa, they can be particularly useful to assist countries with limited project preparation capacities to develop projects that can only attract repayable finance if they are combined with innovative approaches to financing, such as blending grants and loans or using guarantees to reduce the risk perception.

The role of the private sector to help mobilise financing

The private sector is involved in many different ways in the water sector. Private actors alongside the different segments of water service provision may include:[6] formal private water and sanitation service operators; informal private water and sanitation service operators; private financial institutions (such as banks or investment funds); and private companies. During the 1990s and early 2000s, the introduction of private sector participation (PSP) in the management of water and sanitation services in developing countries was somewhat wrongly construed as a way to bring additional financial resources to the sector and therefore to fill the financing gap. Indeed, the introduction of private sector participation (PSP) was often based on the misconception that private operators would bring financing with them in the context of concession contracts or other similar contracts with investment obligations. The early termination of a number of high-profile concessions (such as in Buenos Aires) following financial crises, in which the private operator was exposed to foreign exchange risk on its debt to finance investment programs, challenged these earlier expectations. It also helped highlight the fact that private operators themselves have to source external capital and arrange financing.

More generally, recent experience has allowed a better understanding of the ways in which private operators can either directly or indirectly mobilise financing for the sector, which they can do:

- ***By improving overall sector efficiency, thereby reducing costs (and financial needs) and improving the sector's creditworthiness and ability to attract financing***. By reducing costs private sector participation can contribute to fill (*i.e.* reduce) the financing gap. Improved services can contribute to creating a "virtuous circle": customers are more willing to pay their bills when service improves, more efficient operation increases cash flow from operations, more funds are available for investment, which in turn increases the customer base and the utility's revenues. As creditworthiness improves, a utility can more easily access funding and invest in service expansion;
- ***By financing investment costs, particularly when the public sector's ability to borrow is limited***. Private operators are sometimes brought in because they are deemed more able to mobilise financing, especially from private financial institutions. While the facilitation of access to repayable market finance is a crucial role that PSP can play, especially given the need for such funding to cope with huge upfront capital investment costs, it does not per se contribute to fill the financing gap, but rather helps to bridge it, Private financing ultimately needs to be repaid (plus interest) through a combination of the 3Ts.
- ***By managing and enabling the capital programmes of public authorities.*** The private sector manages an extensive investment programme on the behalf of the public authority and co-ordinates the work with the ongoing operation and maintenance of the service. This has made a significant contribution to increasing public sector investment into the sector in cases such as Algiers.

Private sector participation over the last 20 years has proved to be a useful tool for improving sector performance and efficiency, as shown by a number of recent studies. For example, Marin (2009) looked back at 15 years of experience with public-private partnerships (PPPs) for urban utilities in developing countries and evaluated their impact on four dimensions of performance: access (coverage expansion), quality of service, operational efficiency and tariff levels. Marin's research found that many private operators succeeded in reducing water losses, notably in Western Africa, Brazil, Colombia, Morocco and Eastern Manila in the Philippines. In some cases, private operators reduced non-revenue water (NRW) to less than 15 percent, a rate similar to the best-performing utilities in developed countries. Such efficiency gains have contributed to improving the financial position of water utilities (by cutting costs, increasing revenues and therefore reducing the need for external subsidies) and to reducing (*i.e.* filling) the financing gap.

The ability of private sector participation to facilitate access to repayable market finance largely depends on the type of contractual arrangements they have entered into with the public sector. Private companies can operate under a broad variety of contractual arrangements with the public sector, which reflect the ways in which risks have been allocated between the parties. The allocation of responsibilities for investment (and for financing such investment) can vary substantially according to the contractual arrangement in place.

An overview of the range of contractual arrangements is presented in Table 2.2. It is only in the case of concession contracts, BOTs, divestitures or some joint ventures that private operators are requested to mobilise substantial funding for capital investments directly, which they can usually recoup via tariff revenues or fees. In the case of other contractual arrangements, responsibility for mobilising investments rests with the public sector and the private operator is brought in largely for its capacity to drive efficiency

Table 2.2. **Typology of contractual arrangements between Government (G) and the private sector (P)**

	Service contract	Management contract	Affermage/ Lease	Concession	BOT	Joint venture	Divestiture
Asset ownership	G	G	G	G	P/G	G/P	P
Capital investment	G	G	G	P	P	G/P	P
Commercial risk	G	G	Shared	P	P	G/P	P
Operations/ Maintenance[a]	G/P	P	P	P	P	G/P	P
Contract duration	1-2 yrs	3-5 yrs	8-15 yrs	25-30 yrs	20-30 yrs	Infinite	Infinite
Source of retribution of operator	Municipality	Municipality: fee is fixed or based on performance.	Operator collects user fees. Lease: fee paid by municipality Affermage: revenue shared	Users	Municipality	Users	Users
Occurrence 1991-2009 (World Bank PPI Database)	Not part of scope	Together: 111 of 715 projects		278 of 715 projects	294 of 715 projects	Not a separate category	32 of 715 projects
Examples	Mexico City Chennai	Johannesburg Amman	Cartagena Côte d'Ivoire Senegal	Gabon Jakarta Manilla	China India Malaysia Mexico Morocco	Cartagena Netherlands Chongqing Sino French Water Supply	England Chile

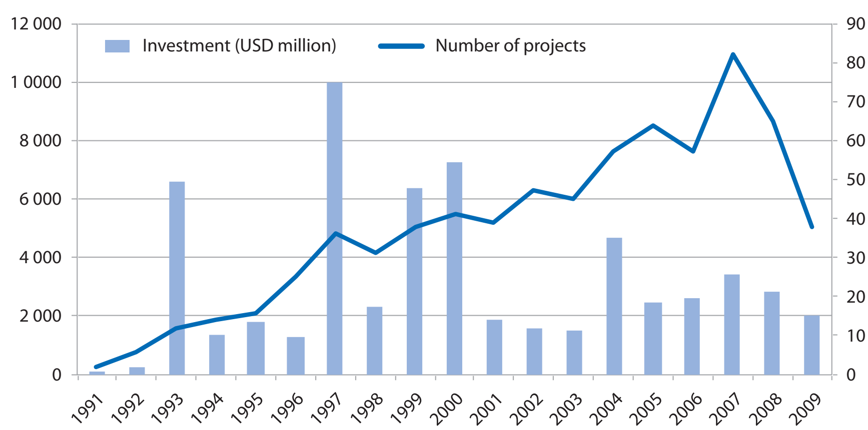
Note: a. Maintenance may lead to considerable amounts of investments on the part of the responsible partner.

Source: OECD (2009a) updated based on World Bank PPI database.

gains or to mobilise financing indirectly. The private operator has also more control over management in the case of "higher-powered" forms of private sector participation (such as concessions, BOTs or divestiture), which is usually associated with a greater ability to deliver efficiency gains.

Overall, Marin (2009) notes that private financing of urban water utilities (*i.e.* new capital brought in by private operators) in developing countries has been limited when compared with other infrastructure sectors, as it represented only 5.4% of the total investment commitments in private infrastructure between 1990 and 2000. Based on figures from the PPI (Public-Private Infrastructure database),[7] he finds that investment commitments by private operators (made in the year of financial closure) have gone down sharply in the aftermath of the Asian financial crisis, from a peak of USD 10 billion in 1997 to a low of about USD 1.5 billion in 2003, and have not recovered since, as shown on Figure 2.6.

Figure 2.6. **Evolution of investment in public private partnerships projects in developing countries, 1991-2009**



Source: World Bank Private Participation in Infrastructure (PPI) Database, *http://ppi.worldbank.org*.

More and more countries are adopting PPP models and risk sharing arrangements in which investment largely remains in the hands of the public sector while the private operator focuses on improving service and operational efficiency (OECD, 2009c and Marin, 2009).[8] In practice, funding for investment under these mixed-financing PPP projects comes from a combination of direct cash flows from revenues, with a variable mix of government and private sources that tend to make the traditional dichotomy between leases-affermages and concessions increasingly obsolete. This is demonstrated by the development of alternative approaches to combine private sector participation (so as to benefit from efficiency gains) and a mix of public and private financing that have been developed over the past decade:

- Concessions that rely largely on revenue cash flow for investment, with cross-subsidies from electricity sales (Gabon), tariff surcharges (Côte d'Ivoire), or both (Morocco).
- Affermages, as originally applied in Western Africa, bolstered by enhanced incentives for operational efficiency, a program of subsidised connections to expand coverage for the poor, and a gradual move to full cost recovery through tariffs (Senegal, Niger, and now Cameroon).

- Mixed-ownership companies, as used in Latin America (Colombia, La Havana in Cuba, and Saltillo in Mexico) and several countries of Eastern Europe (the Czech Republic and Hungary).
- Concessions with public grants for investments to spearhead access expansion or rehabilitation while minimising the impact on tariffs. This is typified by the PPPs in Colombia designed under that country's Programa de Modernización de Empresas (PME); a similar approach has been adopted in Guayaquil in Ecuador and in a few concessions in Argentina (Cordoba and Salta).

In sum, the private sector can contribute to filling the financial gap in several distinct ways. However, as noted in Box 2.1, the ability of the private sector to contribute requires appropriate institutional and regulatory environments as well as sustainable cost-recovery. In order to provide guidance to countries on the allocation of roles, risks and responsibilities between public and private partners, as well as on the institutional, regulatory and policy framework necessary to improve the investment conditions in the water sector, the OECD has developed a tool – the *Checklist for Public Action* (OECD 2009c) – and supported its use in a number of countries, including Egypt, Lebanon, Mexico, Russia and Tunisia.

Beyond water and sanitation: Financing water resources management

The financing challenge goes beyond ensuring the financial sustainability of the water services sector. As was highlighted in Figure 2.1, the WSS sector sits within a broader water value chain and is critically linked both upstream and downstream to the water resource base. Government management of that water resource base is central to the environmental and financial sustainability of the WSS sector, as well as to the sustainability of the water resource base and the value of its contribution to maximising the welfare for societies.

However, managing the water resource base comes at a cost, and the financing of water resources management is an increasingly important item on the agenda of many countries (see, for example, Rees *et al.*, 2008). Looking across the range of functions that water resources management entails, it is clear that countries face important social choices related to financing water resources management. Water resources management (WRM) is understood as a set of activities (or functions) aimed primarily at:

- Ensuring that society has timely and reliable access to water resources of enough quality in the right location;
- Protecting society from water-related risks (floods and droughts); and
- Ensuring the protection of aquatic ecosystems and the environmental sustainability of water use.

This set of activities can be grouped in two broad categories: the governance of water (or the "soft" measures); and the development and management of infrastructure, including "ecological services" (or the "hard" measures). Those two groups of functions are closely related, and the balance between an emphasis on governance and infrastructure solutions, and the financial resources devoted to each of them, requires careful co-ordination and planning, and will also need to evolve with time.

The cost of turning a variable resource into a reliably available one (whether through traditional infrastructure or emerging options such as desalination), the cost of achieving environmental targets (such as the ones included in the EU Water Framework Directive), and the cost of reducing the risk of water-related disasters are all increasing. Paying for those costs is becoming increasingly difficult in the current financial climate and there is a need for increasing the economic rationality in the planning and operation of water infrastructure. At the same time, it is not clear that those functions are always adequately supported – both in terms of amounts of financial resources devoted to the activities and governance processes by which decisions are made about priorities and management.

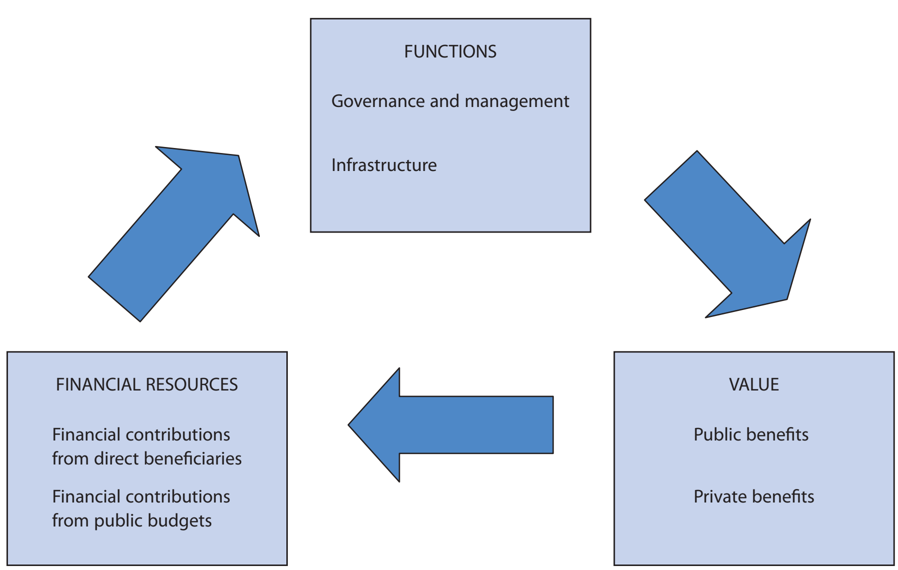
Substantial financial resources are required to pay for governance and management interventions, as well as for infrastructure interventions. For example, in 2004-08, China spent around EUR 10 billion per year in water resources works (40%), flood control (37%), hydropower development (7%), soil and water conservation (6%) and capacity development and other items (9%). In the Netherlands, for the period 2007-27, the additional costs of measures for EU WFD implementation have been estimated at EUR 2.9 billion and the investments in the complete package of measures total around EUR 7.1`billion, with management and governance costs representing around 11% of total costs (PBL, 2008).

A framework for financing water resources management

When thinking about WRM financing, it is useful to frame the problem as "achieving financial sustainability of water management". Societies manage their water resources by setting up water governance mechanisms that generate certain decisions, and implementing those decisions by using "soft" management instruments as well as building and operating "hard" infrastructure. Those broad functions result in concrete interventions that generate value for water stakeholders, whether they are direct benefits for clearly identified private agents or more diffuse (but no less real) benefits for groups of private agents or society at large (Figure 2.7).

The value generated by the water management functions provides one of the rationales for government action in the face of market or regulatory failure and should be the source of financial resources to pay for those functions to be carried out. If the water management

Figure 2.7. **Achieving financial sustainability by harnessing the value generated by water management**



functions do not generate enough value to pay for their costs, once all opportunities for reducing those costs have been exploited, then they should be phased out. If the value generated cannot be harnessed to pay for the water management functions, the functions will not be carried out and further value will not be generated. The key challenge in applying such a framework is the difficulty in valuing many of the public-good type benefits from WRM, such as ecological services, existence values, and so on. Similarly, there are significant technical and administrative obstacles to collecting user charges on diffuse beneficiaries. Nevertheless, the value framework is a useful conceptual framework for identifying policy actions around the financing of WRM.

A conceptual framework to help policy makers, water managers, and water stakeholders more generally think about water financing can be structured around five steps:

- Identifying the benefits and beneficiaries of WRM;
- Identifying the costs of WRM;
- Identifying cost savings through improved efficiency and co-ordination;
- Developing principles for financing WRM; and
- Implementing the policy framework.

The benefits and beneficiaries of water resources management

Water resources management provides a large range of benefits of very different nature, starting with direct benefits received by water users. This first category of benefits encompasses the direct benefits received by water users such as farmers, energy generation and industrial facilities, as well as households. For economic sectors, direct benefits often take the form of increased economic production, but reduction in risks is also an important benefit. Another type of direct benefit is that of biodiversity conservation and ecosystem protection. In Sweden, six out of 16 national environmental objectives are related to water (IVL, 2010), while in the European Union, achieving good ecological status of water bodies is the ultimate objective of the Water Framework Directive.

The benefits provided by water infrastructure projects have long been recognised. Dikes, levees and floodgates help to protect population centres from flood risks. Reservoirs and canals make possible to supply water to urban areas and agricultural lands. Wastewater treatment plants help to protect water quality in rivers and lakes. There are many examples of benefits estimates for water investment projects. In fact, cost benefit analysis was first applied to water projects in the US, mandated by the 1936 Federal Navigation Act and 1939 Flood Control Act. Over time, estimates of benefits have been expanded to less traditional areas of the water agenda, such as river rehabilitation (see Box 2.2 on Israel). In any case, the benefits of water infrastructure are very site specific – they depend on the direct service provided (*i.e.* water supply, flood protection, water quality protection), the size of the population or economic activity affected, and the alternative options available to ensure equivalent services.

WRM also generates indirect benefits. One example of those indirect benefits is the reduced costs of other productive inputs (such as agricultural commodities) and transport services faced by industrial producers. Another example is the reduced costs of consumer products (whether agricultural or industrial) bought by households. The macroeconomic impacts via those second-round impacts may well be the main indirect benefits provided by sound water resources management.

Box 2.2. **Benefits of river rehabilitation in Israel**

Israel's rivers have long been plagued by a range of problems. Most of the springs and flows were captured for water supply for drainage and agriculture. Sewage and solid waste were disposed to river channels. Rivers have become the "backyards" of most localities, serving as sites for the disposal of sewage and solid waste. But over the past two decades, river rehabilitation and recovery of the river's environmental and social function have taken an increasingly important place on the public agenda. The heightened consciousness of the importance of river rehabilitation has been catalysed by the recognition that alongside their function regulating flow, rivers have ecological, social and cultural value. The different benefits identified in Israel with river rehabilitation include:

- Ecological aspects: Conservation of nature, landscape and biodiversity. Prevention of water, soil and environmental pollution.
- Leisure aspects: Benefits derived from the existence of the river as a recreation and leisure site actively used by the public. Benefits derived from the development of intensive urban parks in the case of rivers which pass trough urban fibers. Preservation of open spaces and creation of green lungs. Development of recreation and tourist sites.
- Economic aspects: Benefits derived from the increased value of property adjacent to the rehabilitated river. Benefits derived from the protection of open spaces and infrastructure from floods. Benefits derived from the creation of employment and income sources.

Within the framework of the 2005 National Plan for River Rehabilitation uniform indicators were developed to present the benefits derived from the rehabilitation of the different rivers. The total benefits from river rehabilitation for 14 rivers were calculated to be 5 billion shekels (USD 1.3 billion). The benefits varied greatly by river, from 39 million shekel for the Southern Jordan to 1.5 billion shekel for the Yarkon. As a result, rehabilitation plans have been initiated and implemented by the National River Administration, the Yarkon and Kishon Authorities, in cooperation with drainage authorities.

Source: SVIVA (2010).

Much less is known about the benefits of water governance measures. The value of better information, improved planning, or more effective processes for negotiating and enforcing solutions is generally difficult to quantify. Rather than trying to value the benefit provided by individual governance measures, it may be worth looking at the benefits that stronger water governance allows to reap. In a sense, water governance enables water stakeholders to enlarge the space of viable solutions that may result in the adoption of less costly solutions (from a society-wide perspective) than would otherwise be the case.

In many cases, the water resource management options that deliver the higher benefits per dollar spent are likely to be in the realm of water governance. They include monitoring and forecasting, dam operations protocols, drought management protocols, or enforcement of existing regulations. These measures do not need massive financial resources; what they require is sustainable revenues to cover regular costs (personnel, training, equipment). More costly infrastructure options can still be justified – such as building and operating desalination plants to secure water supply for cities and high value uses.

Identification of benefits and beneficiaries is an important step in defining how to finance water resources management. In principle, the benefits of individual water resources management activities do not accrue to society in general, they accrue to particular groups in society or even individual agents. Table 2.3 provides some examples of benefits and the corresponding beneficiaries. Adopting a beneficiary perspective is useful because it helps to identify the potential sources of revenue to pay for water resources management. In some cases, careful analysis may reveal more beneficiaries of a particular intervention than initially thought.

Table 2.3. **Examples of benefits and beneficiaries of water resources management**

Benefits	Beneficiaries
Avoided costs of supplying water from more expensive sources	Water utilities and households Industrial facilities Farmers
Avoided human and economic losses from floods	Households Industrial facilities Cities
Avoided catastrophic losses from drought (loss of perennial crops)	Farmers
Reduced costs of generating electricity thanks to hydropower	Power companies Electricity consumers
Savings in transportation costs from expansion of water-based transport	Water transport companies Producers and consumers of transported goods
Increased opportunities for recreation and revenue from recreation-based tourism	Households Tourism industry
Avoided costs of water treatment thanks to protected water quality	Water utilities and households
Avoided habitat degradation and biodiversity loss thanks to reduced water pollution and increased baseline flows	General population
Reduced incidence of water-borne diseases	Households Health system
Increased value of property thanks to improvements in water and riparian ecosystems	Households

Source: OECD.

Multi-purpose infrastructure highlights the need for adopting a beneficiary perspective. Multi-purpose dams generate a range of benefits – such as flood control, hydropower generation, securing water supply for agricultural and urban use, or recreation. They also highlight two important and related challenges. First, it would seem important to have reliable estimates of potential benefits and to operate multi-purpose infrastructure in a way that maximises the benefits generated by the infrastructure. This is not always the case – for instance in India dams are often operated to maximise water supply for farmers while hydropower production is in most cases a higher value use (Malik, 2010). Second, it is important to have the benefits estimates accepted by the beneficiaries, because this will provide a strong basis for allocating costs among beneficiaries. If the costs of flood control are readily assumed by the government under a public good rationale (as it is the case in Spain), there is a strong incentive for other stakeholders to push the authorities to inflate the estimates of flood control benefits as to reduce their own share of the costs. On the other hand, prices for water could take into account the different "reliability" levels – which are usually lower for farmers.

Countries may want to improve their understanding of the benefits of water resources management. Currently, we know very little about the quantitative benefits of water resources management, although the issue of the benefits of water and sanitation services has been more closely examined (see OECD 2011a). No equivalent study about the benefits of water resources management is yet available and may not be possible to undertake in the short term because of knowledge gaps at country level.

Costing water resources management

Information about the costs of water resources management is rather dispersed and not always easily available. In general, economic and financial information of the water sector is very hard to come by – this is one of the conclusions of the OECD Workshop on Water Information that took place in Zaragoza (Spain) in May 2010. In most countries, information on expenditures and costs needs to be brought together from very different sources. The budgets of water organisations provide a first insight in current expenditures. However, costs of water management are rarely singled out completely, with overlapping categories being frequently used. This applies in particular for the "soft" parts of WRM – *e.g.* planning, public participation, monitoring – when they are at all considered. Overall, major effort needs to be undertaken to achieve "financial transparency" in water resources management.

Improvements in the availability of information are taking place, largely driven by policy processes. The foremost example is the Water Framework Directive in the European Union. But even in EU countries the costs and financing sources of the WFD programmes of measures, which should provide recent and comprehensive information on financing needs, tend not to be publicly available as they are not always included in the river basin management plans. It might still be too early, and political processes are not yet consolidated. It is unclear whether coherent cost estimates will be provided for all river basin management plans (RBMPs). A review of draft RBMPs reveals that the costs of water management, monitoring and research are not systematically calculated and presented: indeed, some RBMPs focus only on the investment costs of infrastructure projects, neglecting the ongoing operation and maintenance costs as well as the governance costs.

From a sustainable financing perspective, it is important to take into account all cost elements as well as their structure. The broad categories of costs that need to be taken into account are:

- *Infrastructure costs*. Infrastructure (or "hard") costs tend to dominate discussions about water financing as they usually represent the largest share of water management costs. Infrastructure costs include items such as water storage and distribution, flood protection, or wastewater treatment.
- *Governance costs.* The governance (or "soft") costs are also very important. These include items such as *(i)* monitoring and research, *(ii)* water policy development and planning, and *(iii)* administration of water policy instruments (including enforcement and compliance).
- *Operation and maintenance costs*. Within infrastructure, there is a tendency to focus on the capital costs of building new infrastructure and pay less attention to operation and maintenance costs. In many countries this has led to a cycle of "build-neglect-rebuild". While the most extreme examples can be found in irrigation infrastructure in developing countries and in WSS in Eastern Europe, Caucasus and Central Asia (EECCA), this problem also applies to OECD countries (such as in some irrigation districts in Spain or drinking water supply in some United States cities).

- *Integration/multipurpose costs*. Water management involves many different sub-sectors. Assessing water management costs by sub-sector and aggregating those costs may not be sufficient as integrated water management demands additional costs, both in terms of governance (planning, co-ordination, governance structures) and in terms of infrastructure (multipurpose dams, for example).

Water management costs are likely to evolve over time. For industrialised countries, water governance and management costs are likely to increase, as more effort needs to be paid to integrative tasks. For instance, achieving the EU WFD objectives of good status will require more extensive monitoring, drafting of catchment area plans, and enhanced international cooperation for managing transboundary rivers. At the same time, "infrastructure costs" are also likely to evolve, with some items increasing and others decreasing. In general, the share of operation, maintenance and renewal costs are likely to increase (in relation to the share of new infrastructure). Box 2.3 provides an example of the evolution of costs in South Africa.

Box 2.3. **Evolution of water management costs in South Africa**

South Africa has a large stock of water storage and distribution infrastructure that requires significant, although relatively stable, expenditures in operations and maintenance. New investment programmes are carried out, but their lumpy nature implies that the year-on-year evolution varies greatly. Perhaps the most significant trend is the increase in water governance expenditures necessary to match the increasing complexity of water management. At the same time, there has been progress in reducing costs via optimised infrastructure operations and expenditure co-ordination at regional level.

Public expenditures in water management (billion rand)

	2000/01	2004/05	2008/09
Governance	0.63	0.92	1.42
Water supply infrastructure (on-going)	0.9	1	1.05
Water supply infrastructure (capital)	0.2	0.19	1.95

Source : Adapted from Pegram and Schreider (2010).

Seeking cost savings in WRM

There is broad range of options to reduce costs, while achieving the same policy objectives. Clearly, not all of them are applicable in all countries or water sub-sectors. They include the following ones:

- *Increasing the operational efficiency of water infrastructure*. Water infrastructure is not always well utilised and managed. This is particularly true of wastewater infrastructure, but it is also applicable to dam operations and other infrastructure. Brazil has introduced innovative incentive-based approaches to achieve cost reductions that rely on paying for proven results rather than for physical works – the River Basin Clean-Up Programme (PRODES) has provided incentives for increasing the operational efficiency of wastewater treatment infrastructure, while the Water Producer Programme pays for ecosystem services based on an evaluation of performance on erosion reduction and forested areas – not on works undertaken.

- *Selecting cost effective measures.* In many cases, the current mix of measures put in place is not cost effective. For instance, up to now, state subsidies for actions to mitigate euthropication in Sweden have been issued regardless of local conditions – with low cost effectiveness – and the government is funding research to improve its cost effectiveness, including the possible use of a permit fee system for nutrients that could save about SEK 60 million in the Southern Baltic river basin alone. Cost-effectiveness analysis (CEA) is very rarely applied in the water sector. For instance, even though it is encouraged by the EU WFD, CEA has rarely been applied at the stage of programme design, and most EU member states are rather falling back on expert judgement or (local and/or national) working groups.
- *Managing water demand.* Avoiding the need for making water available in the first place is often among the most cost-effective options. Market-based instruments (water pricing, water trading) as well as other instruments can achieve significant cost savings by reducing the demand for water and its associated costs. Examples include the use of a water extraction levy in Israel, water reallocation in the US, or even the relocation of water-intensive economic activities (such as in South Africa). In Australia demand management makes use of regulations, incentives (such as providing subsidies for water efficient appliances) and training to irrigators in best practice irrigation management practices and technologies.
- *Expanding the menu of options to include alternative, lower cost solutions.* There are high costs of replacing and expanding existing systems under a traditional capital intensive engineering approach. More efficient lower cost alternatives such as sustainable urban drainage options, constructed wetlands for wastewater treatment, managed realignment for flood risk management, and aquifer recharge for water storage are worth exploring.
- *Improving the efficiency of governance arrangements.* While they may not provide the same scope for savings as infrastructure related interventions, given the trend towards increasing water governance costs, it is worth looking into opportunities for savings also in this domain. In Brazil, the National Water Agency (ANA) has launched an "Integration Pact" framework involving ANA, the States and the river basin committees that will allow to reduce the administration and compliance costs derived from the federal nature of WRM in Brazil by enabling joint implementation of WRM instruments through the establishment of goals, activities and deadlines for each party. The Czech Republic has identified that some limited cost reductions could be achieved by integrating the management of all watercourses in the river boards. In France, public authorities in have traditionally encouraged inter-municipal cooperation in order to reduce the cost of providing water-related services.
- *Applying an integrated approach to infrastructure development and management.* The classic example is the use of multipurpose dams. However, at least an equally important opportunity resides in ensuring that investments in different water sub-sectors (such as water storage and water distribution, or wastewater collection and wastewater treatment) are carried out in a co-ordinated manner, so that a certain infrastructure stock doesn't remain idle because the complementary infrastructure is delayed – sometimes for years. Another opportunity is the consideration of ecosystem services, when they are cost effective and reliable enough, as part of the menu of options. For instance, Australia is experiencing with innovative approaches, and following the identification of suitable aquifer targets for a potential managed

aquifer recharge system to secure the supply of water for the town of Broken Hill, the Government has committed up to AUD 16 million to fully test this new approach.

- *Reformulating water policy objectives***.** Sometimes, when the costs of achieving policy objectives prove too high, the only option is to reformulate those objectives. Examples include: reducing the expected reliability of water resources for some sectors, adjusting quality objectives to different uses, allowing "target trading", and relaxing implementation schedules. For instance, France is taking advantage of the possibility contemplated in the EU WFD of asking for delays or exemptions in the achievement of the good ecological status objectives when the costs are disproportionate to the benefits (using cost benefit analysis to justify those requests). France is also taking advantage of the possibility of reformulating objectives from good status to good potential in the case of artificial water bodies.
- *Reforming policies in other sectors.* Policies in agriculture, energy, urban development or trade are often responsible for ever growing pressures on water resources. Changes in those policies, including their financing components, can in many cases facilitate strong reductions of water management costs.

In general, achieving financial savings has relatively large governance requirements and thus requires investing in stronger governance. This makes achieving cost savings more difficult in countries with less developed water governance systems. Water governance and water infrastructure expenditures are to a large extent complementary. There is a need to ensure that a level of governance capacity is in place that is effective but not burdensome. Governance options to increase the likelihood of adoption of cost effective measures include: reduction in transaction costs (through improved information systems), setting up regulatory frameworks that require cost effectiveness analysis, and setting up infrastructure operation frameworks that reward efficient operations.

Who pays for what and how?

The question of how to pay for WRM needs to be addressed by looking at two inter-linked issues: who should pay for water management, and what payment mechanisms can be used. In relation to who should pay for water, there are a number of well-established principles that can be employed. Many countries have explicitly included the polluter pays principle or the user pays principle (sometimes also formulated as a cost recovery principle or beneficiary pays principle) in their legislation or their policy documents. For example, the EU countries have adopted the polluter pays principle while India has implemented the user pays principle. Some countries make reference to additional principles. For example, the Netherlands include references to solidarity and legality, while France has adopted the principle "water pays for water" with the meaning that the water sector shall not receive subsidies from the government budgets but that cross-subsidies within the water sector are possible. The cost-recovery and user-pays principles are well established in several countries for services linked to water supply and sewage collection and treatment, but they are much less often applied in other areas of WRM and possibilities of increasing its use should be further evaluated.

In terms of the payment mechanisms that countries can use to implement these principles, many countries adopt cost recovery mechanisms that can be employed to ensure that water users and beneficiaries contribute to finance the different water management functions. Among cost recovery instruments, the most common ones include: charges for the provision of administrative services (such as the issuing of water licenses); charges for the provision of water services (such as raw water for municipal or irrigation use); charges for non-consumptive uses of water (for cooling or hydropower generation); water pollution charges; charges for access to watercourses for transport or recreational uses; land taxes to pay for flood protection services; and levies to pay for other aspects of water management (such as research and development).

The key feature of cost recovery mechanisms is that they are targeted at the beneficiaries of WRM and should, at least in principle, reflect the private benefits that accrue. How to cover the costs of providing WRM functions that serve the public more generally is more problematic and this is generally met through allocations from public budgets (*i.e.* from general taxation). Some countries make specific budgetary allocations for water resources management as a whole. South Africa's policy framework details the "payment mechanisms" that can be employed to cover for different water management functions (such as water research). China's policy framework includes rules for allocating a portion of public budgets (at different levels, from national to local) to water funds. Differences in the main principles advocated by specific countries and their implementation translate chiefly in differences in the share of infrastructure costs (investment, operation and maintenance) paid by public subsidies and by end-users of specific services (see Table 2.3).

Table 2.3. **Estimated financing of water infrastructure costs in selected countries (%)**

	Investment for water sector development		Operational costs	
Country	Government	Water users and municipalities	Government	Water users and municipalities
Spain	70	30	50	50
France	50	50	0	100
Canada	75	25	50-70	30-50
Japan	100	0	0	100
USA	70	30	50	50

Source: Dukhovny *et al.* (2009).

Effective cost recovery rates vary widely among countries, but there is a trend towards relying more on contributions from users and beneficiaries to fund water management. Developed countries rely more on user contributions than developing countries. Some countries, such as France and the Netherlands, fund almost all water management (in excess of 90%) from user contributions. In some cases, like Australia, the rapid evolution of water management needs has prompted an increase in the amount of public resources devoted to public management. Cost recovery rates tend to vary for each water management sub-sector – for example, in Spain the rates are likely to be around 50% for water abstraction, 95% for distribution in urban systems and 85% for wastewater treatment

There are limited but increasing examples of innovative instruments that allow to raise revenues for difficult to fund functions, such as environmental restoration. For instance, in the United States regulation obliges hydropower producers to invest in salmon restoration and they can do so by buying in-stream water rights (using a specialised intermediary such as the Oregon Water Trust). There are also examples of voluntary financial contributions from water users (see box). In Germany, energy consumers ultimately pay for the cost of modernising the stock of hydropower plants as to contribute to achieving water policy objectives (specifically, achieving good ecological status as demanded by the EU WFD). The mechanism used is the structure of feed-in tariffs specified in the German Renewable Energy Law: when hydropower facilities comply with certain criteria (such as ensuring biological continuity of the river, or being built in a location where there are barrages or weirs) they are paid a higher-feed in tariff from electricity distributors, who in turn reflect it in the energy bill that consumers pay. The additional remuneration is paid to hydropower producers for 20 years and varies according to facility size and output – smaller plants are paid higher remunerations per kWh than bigger plants to ensure their profitability, and plants producing more than 5 MW are only paid for the increased part of production after modernisation.

The balance between allocations from public budgets and contributions from users varies from country to country. What is important is that the sum of financial resources is enough to achieve the water policy goals. The use of public budgets tends to be accepted when the interventions are aimed at ensuring water supply to the population and for works generating public benefits (such as flood control or environmental protection). In the case of economic uses, public budget support has sometimes been justified on the grounds of supporting poorer regions or in strategic considerations about the role of water in the economic development of a country (as it has been for example in Spain). A larger share of user contributions may be preferable in order to ensure sufficient and predictable funding over time, helping to insulate the sector from the risk of shifting government priorities or across the board budget cuts.

There are some, but limited, examples of instruments designed to pay for water governance, although they tend to cover only a minor part of water governance costs. The classical example is water licensing fees – when the fee is set to pay only for the administrative cost of issuing a license to abstract water. Other examples include the pollution control tax in Spain (to pay for enforcement by river basin agencies) or the research charge in South Africa.

There are very different patterns of use of instruments across countries, with opportunities for mobilising additional funds from a wider and better use of cost recovery instruments. Some countries, such as China, France, Spain or South Africa, have many instruments in place, while other countries, such as Sweden or Uganda, have relatively few. Instruments to recover water management costs from users and beneficiaries combine charges and taxes. In many cases taxes are earmarked. Taxes can be applied at different levels: national level, provincial level, river basin level or local level. Even the use of basic and traditional instruments, such as abstraction charges varies widely. Many countries do not have abstraction charges in place, and among those that have them, the rates vary widely (see also OECD, 2010a). Low rates may be perfectly justified – a country may think that there are better forms to finance water management, or that a low rate is enough for the purpose intended (whether financing or demand management). Yet, there seems to be in many cases scope for raising more revenues from these traditional instruments. At the same time, more efforts can be devoted to exploring and developing opportunities for payments by beneficiaries of specific ecosystem services to help fund the measures to deliver them.

A sound understanding of who pays for what in WRM should also provide a clear role for commercial finance. Given the "lumpy" nature of investments in water resource management infrastructure and the long-term nature of the benefits that it provides, commercial finance may usefully provide "bridging" finance. For instance, Chinese cities such as Guandong and Guanxi take on bank loans for flood control projects and repay them using proceedings from land sales or flood control security fees. In the Czech Republic, the government has taken loans from the EIB to finance investments in flood management, and water administrators take loans to finance investments in profit-making infrastructure (such as hydropower) and the drinking water sector makes also frequent use of loans.

Another key aspect is the allocation of clear water financing responsibilities to the different levels of government and providing guidance on how to co-ordinate them. As table 2.4 illustrates, even within a relatively small geographical area (in this case the city of Shanghai), there are many types of water interventions, for which different levels of government may be responsible.

Table 2.4. **Multi-level governance and water financing in Shanghai**

	Large scale river basin projects	City-level backbone projects	Regional projects	Farmland water conservancy projects (suburbs)
Central government	Additional support			
City-level government	Main funder	Main funder (construction)	Additional support	Additional support
District/county-level government	Additional support	Additional support (operation and maintenance)	Main funder	Additional support
Town-level government				Main funder

Source: DRC (2010).

Thinking strategically about financing WRM

As is the case with the financing of water supply and sanitation services, there are significant benefits to taking a strategic planning approach to the question of financing WRM. This can strengthen the link between water resource management policies and financing in a number of ways. First, it helps plan financing needs in the medium term (integrating O&M costs when new infrastructure is built). Second, it facilitates the exploration of alternative options, to bridge potential financing gaps. Third, when developed in the context of a policy dialogue, it contributes to more transparent and information-based decision making and stronger ownership from users, thus facilitating implementation.

Adequate data is an essential prerequisite. Unfortunately, little is known about the costs and benefits of water resources management, and about the contribution of different user groups to its financing. This is due in large part to the highly fragmented nature of water governance in most OECD countries. Information and data gaps hinder the deployment of cost effective measures.

As in many other policy areas, an explicit and well formulated policy framework is no guarantee of effective implementation. Among the many aspects related to implementation, it is worth highlighting the following four:

- *Tracking cost recovery levels*. Virtually all policy frameworks will include the contribution of water users (and beneficiaries of water management more generally) to financing water management – at least in some degree, for some water management interventions and some users. It is thus important to track progress to any cost recovery targets that may have been defined. It is not that common for countries to have uncontested figures on cost recovery levels. An important step is to clearly define what is exactly meant by cost recovery, as there is no universal definition and even within the EU Water Framework Directive process different countries interpret cost recovery in different ways.
- *Improving management of cost recovery instruments*. As mentioned above, there are many available instruments that can be employed to raise revenues from users and beneficiaries to pay for water management. A challenge common to many countries is to define a system of cost recovery instruments that is understood and accepted by the water stakeholders, easy to administer and flexible to accommodate evolving circumstances. Some countries have very few cost recovery instruments in place (such as Sweden), while others have a large array (such as Spain). What is important

is that the system is manageable – the South African experience suggests that the system put in place in the last decade is probably too sophisticated and cumbersome to run effectively. Particular attention needs to be paid to the "commercial aspects" of billing and collecting payments – Korea provides an example where recent improvements in those areas have provided additional financial resources without changing the rates of the water charges.

- *Improving management of public expenditures***.** In most countries governments pay for a large part of the total water management bill, mobilising resources raised through general taxation. It is thus crucial to make the most of those resources. In many countries, particularly but not only in the developing world, the public financial resources devoted to water management have suffered from lack of transparency and corruption (Transparency International, 2008). Equally important is to ensure that public financial resources are allocated to the "highest value use". In many cases, this will require a hard look at the way those resources are currently allocated within the water sector in its broadest sense, and how to make easier (or even possible) to transfer resources from one broad item (such as water supply development) to another (such as environmental protection).
- *Raising commercial finance***.** As highlighted above, the most crucial element in the definition of a "financing model" is who pays for water management – users and beneficiaries, tax-payers, or some external donors. However, since water infrastructure is expensive to build and provides benefits over long periods of time, it may make sense to "borrow money" in the market to build the infrastructure and "repay" it overtime. Such "borrowing" can take place through a range of commercial finance mechanisms – such as taking out loans, issuing bonds or selling equity. It may sound obvious, but it is important to keep in mind that such commercial finance will have to be repaid with the proceedings from the revenue sources (whether user contributions or public subsidies). Commercial finance is extensively discussed in the 2010 OECD report on innovative financing mechanisms for the water sector – while the focus is on drinking water supply and sanitation, the analysis is relevant to water resources management as well.

The policy framework for water financing also needs to look beyond the water sector and ensure coherence with non-water sector financing. The EU Water Framework Directive has stressed the importance of analysing the financing linked to sector policies (*e.g.* agriculture, energy or climate change) that directly support projects and actions that impact on the water system. For example, in Spain 25% of agricultural (CAP) subsidies remain coupled to production, encouraging inefficient use of water (Aldaya *et al.* 2010). Because of the inter-sectoral nature of integrated water management, its financing will rely on financial sources from both the water sector and other economic sectors (in particular for promoting good practices in these sectors and limit their pressures on aquatic ecosystems). The mechanisms and processes developed for ensuring coherence between water and sector policies, and thus financing WRM, should be further investigated and analysed.

Moving forward on the water financing challenge

The need for strategic financial planning

The extent to which each source can generate additional funds will be highly location-specific and depend on the overall environment and on the willingness of governments to set realistic objectives and to adopt reforms so as to improve the efficiency and creditworthiness of existing service providers. Goals that are set politically and are not matched by real revenue streams result in major financing gaps and unexecuted plans, with the consequence that the poor suffer most through absent or deficient services. For example, Ethiopia has adopted a Universal Access Programme, which foresees improving access to improved drinking water sources from 22% in 2006 to 98% in 2012, but it is unclear how this policy would be financed. In some cases, donors share responsibility for lack of realism, for instance when they require the use of best available wastewater treatment technologies that may not be affordable if scaled up beyond the project level. Strategic financial planning must be carried out in the context of broader sector planning that address roles and responsibilities of government agencies, policy priorities and related legislative and regulatory reforms in order to ensure that a package of measures that can realistically be financed is being put forward.

In order to deal with those challenges, governments have to set realistic objectives for the development of the WSS sector, checked against available resources, and agreed in a multi-stakeholder policy dialogue (a process termed "strategic financial planning, or SFP")". According to OECD (2009b), SFP has several objectives: "it provides a structure for a policy dialogue to take place, involving all relevant stakeholders including Ministries of Finance, with the aim of producing a consensus on a feasible future WSS. It illustrates the impact of different objectives and targets in a long term perspective, linking sector policies, programmes and projects. It also serves the important aim of facilitating external financing, providing clear and transparent data on financing requirements". Such process can be carried out either at national level or at municipal or regional levels.

The OECD has supported the application of such approaches, using a strategic financial planning tool called FEASIBLE, in a number of countries, particularly in the EECCA countries such as Armenia, Bulgaria, Moldova, Georgia, Kazakhstan, the Kyrgyz Republic and six Russian provinces as well as in Egypt, Lesotho and Turkey. OECD (2011c) summarises the key lessons from carrying out SFP in the EECCA countries, particularly in terms of conducting the process and deriving implications for reform. Box 2.4 provides an example of the results of a strategic financial planning exercise undertaken in Moldova.

Countries where most benefits are to be reaped, *i.e.* where the access gap is the largest, are also the ones where the financing gap is the most glaring and will be most difficult to fill/bridge. For example, an evaluation of the financing gap to meet the MDGs and potential ways to bridge was recently conducted in the context of the Africa Infrastructure Country Diagnostic (AICD), a multi-donor initiative led by the World Bank. This evaluation showed that whereas middle-income countries in SSA may be able to reduce the financing gap to almost nothing thanks to performance improvements, the financing gap was likely to remain at a very substantial level in fragile states (see Box 2.5).

Where the financing gap remains substantial, public funding (in the form of domestic government funding or ODA) could potentially play a critical role in terms of leveraging other forms of finance. This would be where reforms to improve the effectiveness of service delivery and lowering of capital costs would be most needed.

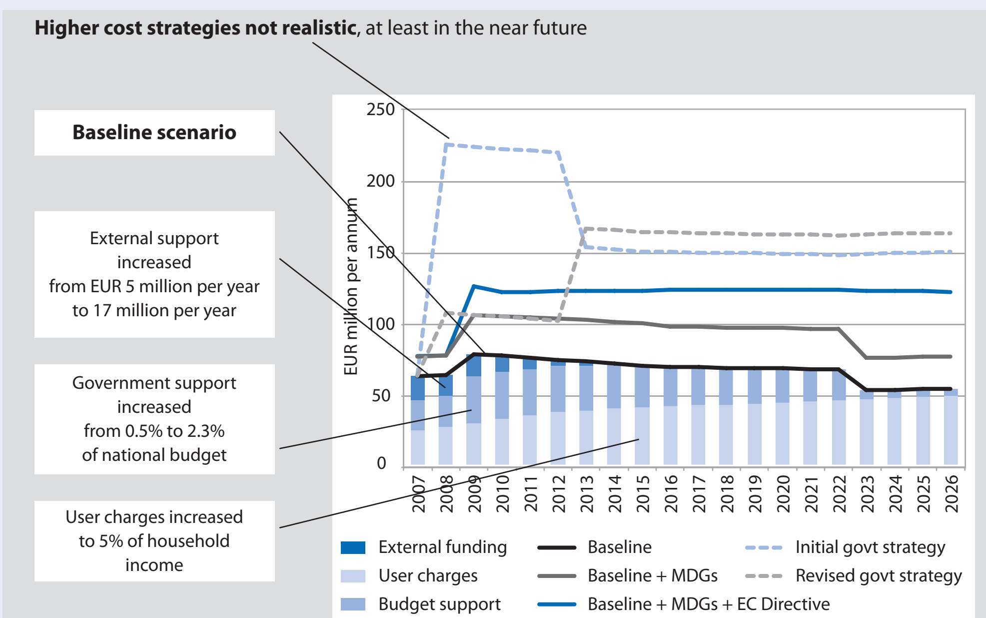
In the context of the financial and economic crisis and constrained public budgets, however, there is a substantial risk that investments in water and sanitation services might be delayed, due to a lack of available financing. Such delays would lead to deferred benefits and potentially higher investment costs in future, which would therefore translate in false economies.

To avoid such counter-productive reductions in funding, it would be critical to increase policy makers and funders' awareness of the substantial benefits from investing in water and sanitation services. This would also require identifying areas for priority investment,

Box 2.4. Strategic financial planning: The case of Moldova

Using the FEASIBLE planning tool, the OECD assisted the Government of Moldova with defining policy goals that they could afford (OECD 2009a and OECD 2011c for more details). Moldova faced a situation where it still had to extend access in unserved rural areas whilst upgrading its existing installations and investing in wastewater treatment to meet European directives. The Government defined alternative investment strategies, ranging from a "baseline scenario" (which essentially assumed the maintenance and rehabilitation of existing WSS infrastructure, with no extension of service to previously not connected populations) to higher cost strategies including full compliance with EU directives. As shown in the figure below, the analysis found that even if tariffs were increased substantially up to an average of 5% of household income (with social protection measures to support the poorest who would pay more than this average), user charges would only generate about 50% of cash flow needs for the foreseeable future, going up to 95% by 2028. The analysis therefore recommended prioritising investments, starting with investments to reduce water related morbidity and halt the deterioration of existing infrastructure, then improve the efficiency and reliability of existing systems. It was deemed necessary to achieve those goals first before considering extending existing systems (to meet the MDGs) or reduce pollution. This incremental approach is much more realistic and sustainable than a sudden increase in coverage that most economies cannot maintain in practice.

The Case of Moldova



Source: OECD(2009b).

Box 2.5. Evaluating the financing gap in Sub-Saharan Africa: The Africa Infrastructure Country Diagnostic

A recent comprehensive review on the state of infrastructure in Sub-Saharan Africa was carried out by the Africa Infrastructure Country Diagnostic project, a multi-donor initiative led by the World Bank. For the water and sanitation sector, the study evaluated the financing gap to reach the MDG target and how such gap could be filled from existing or future sources.

Estimating current spending. The report found that existing spending on water supply and sanitation in Sub-Saharan Arica is USD 7.9 billion. The report found that household contribution to on-site sanitation facilities was higher than public spending either from public budget or ODA sources (0.3% of GDP spent by households on building latrines every year as opposed to 0.2% allocated by governments and 0.2% coming from ODA respectively). As such, they found that households contributed to almost half of total capital investments in the sector. Contributions from private sector operators were found to be negligible, with local capital markets contributing next to nothing to the WSS sector in Sub-Saharan Africa and little prospect for doing more.

The cost of reaching the MDGs. The report estimated that the price tag for reaching the MDGs for both water and sanitation in Sub-Saharan Africa would reach USD 22.6 billion per year, or 3.5% of these countries GDP. For improved water alone, it would be USD 17 billion a year (roughly 2.7% of SSA's GDP). Given the substantial access gap remaining in SSA, AICD estimated that capital investment needs for new infrastructure and rehabilitation of existing ones would account for over two thirds of total investment needs in some countries.

Where will the money come from? The report then sought to estimate how the financing gap could be reduced, from a variety of sources, including the elimination of inefficiencies. The table below shows the results of this evaluation.

Funding gap (USD million per year)

	Total needs	Spending traced to needs	Gain from eliminating inefficiencies	Sources of inefficiency			(Funding gap) or surplus
				Under-execution of budget	Operating inefficiencies	Under-pricing	
Sub-Saharan Africa	-22 640	7 890	2 877	168	1 259	1 450	-11 873
Low-income, fragile	-4 531	441	471	6	106	358	-3 620
Low-income, nonfragile	-7 810	1 840	685	39	265	381	-5 285
Middle-income	-3 987	2 637	1 037	8	492	537	-312
Resource-rich	-6 364	1 753	522	137	172	214	-4 089

Source: Ghosh Banerjee and Morella (2010).

For example, the report estimated that losses associated with tariffs set below cost-recovery levels amounted to USD 2.7 billion a year in Sub-Saharan Africa and impeded service expansion. Improving cost recovery of water utilities could reduce the gap by USD 1.4 billion a year, and addressing operating inefficiencies would bring an additional USD 1.2 billion a year.

However, the report concluded that even if major sources of inefficiencies were eliminated, the remaining funding gap would still be large, particularly in low-income countries. The report estimated that there was limited scope for increasing existing sources of finance, particularly domestic public finance and self-financing by households, which were both likely to be affected by the ongoing economic and financial crisis. They concluded that two realistic options to meet the targets would be to either defer the attainment of the infrastructure targets or to try and achieve them by using lower-cost technologies.

The AICD report shows a wide range of fiscal efforts on water supply and sanitation throughout Africa. If the average is close to 0.9% of GDP, several countries find possible to reach more than 2% of GDP spend on the sector. This leaves room for potential improvement in the other countries.

Source: Ghosh Banerjee and Morella (2010). See also *www.infrastructureafrica.org/aicd/* for information on the AICD project.

depending on where the highest benefits are likely to stem from and where the most cost-effective interventions can be identified.

Ultimately, the water and sanitation sector must include a full range of financing approaches, making the most of potential efficiency gains, adjusting targets and combining funding from both public and private sources, in order to meet its investment needs and successfully maintain and expand service. To achieve this, policy makers and water service providers need to engage in a process of strategic financial planning so as to identify what needs to be financed, how much additional resources can be generated from existing sources and how the performance of utilities can be improved to generate such efficiency gains and mobilise external financing. The set of tools presented in the next Part of this report can help in achieving such goals.

A "Toolbox" to support financial planning

To provide support to governments and water and sanitation service providers, the OECD (in conjunction with a number of other international organisations) has developed a series of tools, including financial tools, benchmarking tools and guidelines with a view to improve the performance of utilities. The audience for these tools varies, and may include policy and decision-makers, municipal government staff, water utility managers, staff of international organisations, etc. Details on the toolbox are provided in OECD (2011c) and a brief summary of each tool is provided below.

Strategic Financing Planning, based on the FEASIBLE tool. As discussed above, strategic financial planning (SFP) is a methodology designed to help many developing and transition countries that need to engage in a reform process for the water and sanitation sector with the definition of achievable targets and financially sound planning, taking into account limited public funding. FEASIBLE is a computer-based tool that can assist with the process.

The Financial Planning Tool for Water Utilities (FPTWU) was created to assist water utilities, originally in EECCA countries, with achieving medium and long-term operational and financial sustainability through solid investment planning as well as forecasting tariffs and subsidies. It is a computerised model that allows users to summarise key technical, financial, operational parameters of a water company, calculate a set of performance indicators for utility monitoring and analyse the financial gap to meet these performance indicators on the basis of cash in and cash out. The resulting gap that needs to be filled is presented graphically and the model allows defining a program of measures in order to close the financing gap, including through tariff adjustments and/or public subsidies for capital improvements.

The Multi-Year Investment Planning Tool for Municipalities is targeted at municipalities to help them prioritise their investments in the economic and social sectors under their responsibility. To do so, the tool gathers data on historical budget trends, planned expenditures, available resources and cost of debt. Based on investment prioritisation criteria, it then set priorities for the next 4 to 6 years.

The Guidelines for Performance-based contracts provide guidance on preparing, negotiating and implementing performance-based contracts. They include the choice of performance indicators, tariff structures and mechanisms for monitoring and enforcing the contract. This tool was developed primarily for countries in Eastern Europe, Caucasus and Central Asia (EECCA) but could potentially be applicable in other regions.

The Water Utility Performance Indicators (IBNet) is a benchmarking tool developed by the World Bank that promotes international benchmarking of water utilities and provides guidance on data collection and monitoring.

The Checklist for Public Action for Private Sector Participation in Water Infrastructure seeks to assist policy makers in assessing and managing the implication of PSP in the water sector. It identifies key policies needed for performing cooperation and provides a set of tools and practices to address those issues, based on countries experiences.

Taking a holistic approach

A strategic financial planning approach is also a useful means of addressing the broader issue of financing water resources management. However, this is much more challenging than is the case for water supply and sanitation. The diffuse nature of the water resources management functions, covering both infrastructure and governance aspects require a much more flexible approach to be taken. There is also a significant mix of public and private benefit that will vary significantly across functions and countries, meaning that there is also a need to take a flexible approach to the financing vehicles that are used. User charges, cost recovery, and polluter pays mechanisms all have a significant role to play and will need to be blended with funding from public budgets and, where feasible, commercial finance.

However, taking a holistic approach to financing WRM is dependent on the availability of good data and information. This is an area where further efforts are required by OECD countries. In addition, the importance of good governance comes to the fore. Clearly identifying roles and responsibilities, and matching them with the financial means and mechanisms to support them, is essential if such a strategic and holistic approach is going to work. The challenge of multi-level governance is addressed in the next chapter of this report.

Notes

1. See OECD (2011a) for more detailed facts and figures.
2. The sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability.
3. MDG 7c calls for reducing by half the proportion of people without sustainable access to safe drinking water and basic sanitation (see: *www.undp.org/mdg/goal7.shtml*).
4. The value of those time gains is estimated on the assumption that any time "gained" in such a way could be productively used on income-generating activities. This may not be possible in some developing economies, but such time would nevertheless be gained for other activities generating more intangible benefits, such as furthering education for children and adults alike.
5. According to IBNET, non-revenue water represents water that has been produced and is "lost" before it reaches the customer (either through leaks, through theft, or through legal usage for which no payment is made). IWA distinguish between non-revenue water (%) and unaccounted for water, with the latter not including legal usage that is not paid for. The indicators are usually measured in m^3/connection/day. The difference is usually small, and the IBNET Toolkit therefore only uses non revenue water as an indicator.

6. Note that households can be also considered as private actors, either when they invest in building and maintaining water and sanitation facilities on the private domain to enable them to benefit from connection to full public services or when such services are self-supplied (as with the case of on-site sanitation systems for example).

7. See: *http://ppi.worldbank.org/*. It should be noted, though, that a weakness of the PPI database is that it does not provide a comprehensive picture of private investment in water infrastructure since it fails to cover some of the deals that involve mainly domestic players as well as some of the re-financing that occurs over the life-span of PSP contracts. As a result PPI numbers may fail to capture an important new source of private investment and distort the overall picture.

8. Different PSP contracts entail different impact on operational efficiency and therefore on access to finance. This can be explained by the various risk-sharing and responsibility-sharing arrangements across different contracts, *e.g.* concessionaires are responsible for both operations and investments, while lease contracts give direct incentives to increase operation efficiency through the revenue structure.

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Chapter 3

Meeting the water governance challenge

Managing and securing access to water for all requires not only a question of financing, but equally a matter of good governance. While many of the solutions to meeting the water challenge (such as water pricing, water markets, financial planning) do exist and are relatively well-known, the rate of take-up of these solutions by governments in OECD and non-OECD countries has been uneven. Some countries have undertaken very innovative and sophisticated reforms while others seem to be hamstring by significant obstacles to reform. A major challenge lays in the implementation of these solutions, tailoring them to local contexts, overcoming obstacles to reform, and bringing together the main actors from different sectors to join forces and share the risks and tasks. This chapter highlights the key governance challenges confronting water policy reform, focusing on the issues arising from the multi-level governance structure that generally characterises water resources management.

Introduction

Managing and securing access to water for all is not only a question of financing, but is also a matter of good governance. While many of the solutions to meeting the water challenge (such as water pricing, water markets, financial planning) do exist and are relatively well-known, the rate of take-up of these solutions by governments in OECD and non-OECD countries has been uneven. While some countries have undertaken very innovative and sophisticated reforms, change in many other countries seem to be hamstrung by significant obstacles to reform. A major challenge lays in the implementation of solutions for water, tailoring them to local contexts, overcoming obstacles to reform, and bringing together the main actors from different sectors to join forces and share the risks and tasks. Drawing on a recent OECD report on governance of water in OECD countries, this chapter highlights the key governance challenges confronting water policy reform, focusing on the issues arising from the multi-level governance structure that generally characterises water resources management.

Water is essentially a local issue and involves a plethora of stakeholders at basin, municipal, regional, national and international levels. In the absence of effective public governance to manage interdependencies across policy areas and between levels of government, policy makers inevitably face obstacles to effectively designing and implementing water reforms. Key challenges are institutional and territorial fragmentation and badly managed multi-level governance, as well as limited capacity at the local level, unclear allocation of roles and responsibilities and questionable resource allocation. Insufficient means for measuring performance have also contributed to weak accountability and transparency. These obstacles are often rooted in misaligned objectives and poor management of interactions between stakeholders.

The trend towards the decentralisation of water policies in the past decades has resulted in a dynamic and complex relationship between public actors at all levels of government. To varying degrees, OECD countries have allocated increasingly complex and resource-intensive functions to lower levels of government. Despite these greater responsibilities, sub-national actors do not always have the authority over the financial allocation required to meet these needs, or the capacity to generate local public revenues. Meanwhile, the central government may not find it easy to develop and assess water resources and service strategies without obtaining information from sub-national governments and building, developing and reinforcing capacity at local level.

Improving water governance has thus become a key topic in the political agenda worldwide. It is a prerequisite for sustainable and innovative water policies that can "do better with less". Effective public governance is critical for regulation and the mix of economic instruments (including pricing, subsidies, or compensation mechanisms) that offer incentives to different groups of users to engage in water-sustainable practices and to agree on water reforms. It is also crucial to reconcile the long-term financial needs of the sector with the revenue streams available (3Ts – taxes, transfers and tariffs), taking into account the need for efficiency of fund use and the importance of strategic financial planning. Finally, integrated public governance is also necessary to overcome the typical disjuncture between water policies and planning on the one hand, and engineering and infrastructure investments on the other hand, both of which affect water quantity and quality.

There is no one-size-fits-all answer, magic blueprint or panacea to respond to governance challenges in the water sector, but rather a plea for home-grown and place-based policies integrating territorial specificities and concerns. The institutions in charge of water management are at different developmental stages in different countries, but common challenges – including in the most developed countries – can be diagnosed ex ante to provide adequate policy responses. To do so, there is a pressing need to take stock of recent experiences, identify good practices and develop pragmatic tools across different levels of government and other stakeholders in engaging shared, effective, fair and sustainable water policies.

A multi-level governance approach for addressing complexity in the water sector

Rationale for a multi-level governance perspective

To clarify the "black box" that governs water, ways of designing and implementing water policy must be addressed, including setting priorities and formulating strategies to solve the problems that have been identified. Co-ordination and consultation mechanisms must be devised to overcome the barriers to effective implementation on the ground. In particular, adopting a "systemic" approach to water policy design and implementation requires overcoming critical multi-level governance challenges. This implies better management of multi-level governance, *i.e.* the explicit or implicit sharing of policy-making authority, responsibility, development and implementation at different administrative and territorial levels, meaning: *i)* across different ministries and/or public agencies at central government level (upper horizontally); *ii)* between different layers of government at local, regional, provincial/state, national and supranational levels (vertically); and *iii)* across different actors at the sub-national level (lower horizontally).

Most governance principles for managing water resources and services are based on common pillars. They have been variously combined in different frameworks, thus emphasising certain universal aspects of governance (Lockwood *et al*., 2008):

- *legitimacy* of the organisation's authority to govern
- *transparency* in the decision-making process;
- *accountability* of actors and their responsibilities, including integrity concerns;
- *inclusiveness* of the different stakeholders;
- *fairness* in the service delivery or allocation of uses;
- *integration* of water policy making at horizontal and vertical levels;
- *capacity* of organisations and individuals managing water;
- *adaptability* to a changing environment.

Several international organisations and academic institutions have launched water governance initiatives or programmes. Some aim to rank countries according to their governance practices (for example, the Asia Water Governance Index). Others, for example, development banks, are focused on backing up investment projects; in supporting specific action, such as technical assistance (*e.g.* UNDP Water Governance Facility); or guiding policy makers in the assessment of the "enabling environment" for private sector participation (OECD, 2009a, b). Most of these initiatives call for further research on multi-level governance issues. The OECD perspective on water governance is intended to complement existing approaches, concepts, and messages. It specifically addresses the issue of coherence and co-ordination of *public* action to achieve water policy outcomes, such as sustainability, efficiency, equity, rule of law, accountability and participation.

The institutions in charge of water management are at different developmental stages in different countries, but common challenges occur – including in the most developed countries – and can be diagnosed *ex ante* to provide adequate policy responses. The multi-level approach water governance attempts to investigate the "black-box" of water policy making to understand better *who* does *what*, at *which level* of government, and *how* in terms of water policy design, regulation and implementation. It also proposes a "reading template" to diagnose common multi-level governance bottlenecks for integrated water policy across OECD countries, as well as governance instruments adopted in response for managing mutual dependencies across levels of government and building capacity at the local level.

This multi-level approach takes a close look at the processes through which public actors articulate their concerns, decisions are taken and policy makers are held accountable. It conceives water governance as the political, institutional and administrative framework forwater resources management. Both high-level decision making and actions taken at local and regional levels are studied, including the ability: *i)* to *design* public policies whose goal is the sustainable development and use of water resources, and to mobilise the social resources to support them; and *ii)* to ensure that the different actors involved in the process *implement* them successfully.

The multi-level governance approach to water policy

The OECD Multi-level Governance Framework was originally developed for addressing the interdependencies across levels of government in decentralised public services contexts (Charbit, 2011). It has been tested in other public policy areas of OECD interest, such as regional development in the framework of territorial, metropolitan and rural reviews,

Box 3.1. **Methodological note on the OECD 2010 water governance survey**

17 OECD member countries participated in the 2010 Survey on Water Governance. In all, 23 questionnaires (were processed for the following respondents (see list in Annex): Australia, Belgium, Canada, Chile, France, Greece, Israel, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Portugal, Spain, United Kingdom, and Colorado, US.

Actually, in some countries (Belgium, France, Italy, New Zealand, Portugal) more than one questionnaire was collected because in general, the Secretariat targeted both central administrations and a sub-national authority (*e.g.* river basin authority, inter-municipality, metropolitan region, etc.). This could sometimes enrich the analysis, by making possible comparisons within the same country and highlighting aspects of policy making, such as an asymmetry of information between central and sub-national actors, or between actors involved at the level of policy design and those involved in implementation. But on the other hand, a different kind of challenge arises when the answers returned are different or incompatible. In such cases, the response from the central authority was chosen.

This sample of OECD countries includes a diverse group from different continents, with varied levels of income and environmental and institutional features, as well as approaches to water policy. It permits comparisons between areas where water is scarce and plentiful, and water policy is decentralised versus centralised. For instance, water policy in Belgium (water-rich) is exclusively designed and implemented by the regions, and the central government plays a minor role. An opposite case is that of Israel (water-scarce), where water policy is highly centralised. Cross-country comparisons should take these factors into account.

The ease of performing comparisons within regions depends on the number of valid answers and questionnaires available. Some of the questionnaires were less helpful than others because a higher number of questions were left unanswered. Certain types of comparisons should be subject to particular caution, due to institutional features and the division of responsibilities and also because most quantitative data rely on perception indicators based on subjective judgments on a "1-to-3" scale (not important, important, very important).

innovation, and public investment. In-depth studies on selected governance mechanisms (such as fiscal relations across levels of government, contractual arrangements and performance indicators) have also been undertaken. This framework has largely been adapted to embrace the intrinsic characteristics of the water sector, which combines all of the seven co-ordination gaps that structure the framework. It was tested in 17 OECD countries, based on an extensive survey on water governance undertaken in 2010 (see Box 3.1 and Table 3.1).

Table 3.1. **OECD Multi-level Governance Framework: Key Co-ordination Gaps**

Administrative gap	Geographical " mismatch" between hydrological and administrative boundaries. This can be at the origin of resource and supply gaps ⇒ ***Need for instruments to reach effective size and appropriate scale***
Information gap	Asymmetries of information (quantity, quality, type) between different stakeholders involved in water policy, either voluntary or not. ⇒ ***Need for instruments for revealing and sharing inform***ation
Policy gap	Sectoral fragmentation of water-related tasks across ministries and agencies ⇒ ***Need for mechanisms to create multidimensional/systemic approaches, and to exercise political leadership and commitment***.
Capacity gap	Insufficient scientific, technical, infrastructural capacity of local actors to design and implement water policies (size and quality of infrastructure, etc.) as well as relevant strategies. ⇒ ***Need for instruments to build local capacity***
Funding gap	Unstable or insufficient revenues undermining effective implementationof water responsibilities at sub-national level, cross-sectoral policies, and investments requested. ⇒ ***Need for shared financing mechanisms***
Objective gap	Different rationales creating obstackes for adopting convergent targets, especially in case of motivational gap (referring to the problems reducing the political will to engage substantially in organising the water sector). ⇒ ***Need for instruments to align objectives***
Accountability gap	Difficulty ensuring the transparency of practices across the different constituencies, mainly due to the insufficient users' commitment' lack of concern, awareness and participation. ⇒ ***Need for institutional quality instruments*** ⇒ ***Need for instruments to strengthen the integrity framework at the local level*** ⇒ ***Need for instruments to enhance citizen involvement***

Source: Adpated from OECD Methodology presented in Charbit (2011) and Charbit and Michalun (2009).

An *administrative gap* occurs when there is a geographical mismatch between hydrological and administrative boundaries. In sectors like health and education, administrative gaps do not present a major obstacle, because the logic of service provision is not constrained by nature. In the water sector, however, the administrative boundaries of municipalities, regions and states rarely correspond to hydrological imperatives. This results in a mismatch at sub-national level that often obstructs water policies and complicates the relationships between elected representatives, local authorities, water agencies, resource managers and end users. Historically, water administrative bodies have been organised along administrative boundaries, although river catchments rarely obey administrative logic. Management failures, such as a lack of co-operation, participation and transparency, are often rooted in this mismatch. For example, it is difficult to enforce water quality regulations and water abstraction rules where two or more water management bodies are in charge of different sections of one river. The administrative gap may raise the question of the "appropriate" scale for investments, which can be achieved through better co-ordination of water policy. The fact that water does not respect urban administrative borders is a problem that integrated metropolitan water governance must respond to. Metropolitan areas, with their overlapping jurisdictions and political fragmentation, can lead to incoherent and, at worst, mutually contradictory water management practices. Water conflicts between municipalities within one metropolitan area are increasingly common, and tools are needed to assist in confronting water scarcity, climate change, and competing uses between cities in one metropolitan area.

The *policy gap* refers to the sectoral fragmentation of water-related tasks across ministries and public agencies. Silo approaches in water policy result in incoherence between sub-national policy needs and national policy initiatives and reduce the possibility of success for implementation of cross-sectoral policy at the sub-national level. If individual ministries or public agencies operate independently, rather than undertaking cross-sectoral initiatives, the opportunity for "whole government" approaches is minimised. At the same time, possibilities for maximising efficiency and effectiveness in cross-sectoral public services may be lost, and sub-national development adversely impacted. Policy initiatives designed at the central level and implemented at the sub-national level are symbolic of the co-ordination needed between ministries to reduce the impact of sectoral fragmentation on sub-national actors. The policy gap therefore refers to a lack of policy coherence at central government level, which is a condition for better cross-sector co-ordination at the sub-national level.

An *information gap* occurs when there is an asymmetry of information across ministries, between levels of government and across local actors involved in water policy. A primary concern is the lack of information to guide decision makers in the water sector. In recent years, the rapid development in water policy reforms was difficult to put into practice because little data and information were available, particularly on the economic and institutional implications. In many countries, this was exacerbated by the lack of capacity, resources and expertise to collect, analyse and interpret water data. Even when the information is available, it must be shared at all levels of government to capitalise on individual knowledge centres, thereby creating a stronger whole. An asymmetry of information may occur when national and sub-national authorities do not actively share their knowledge of what is happening on the ground and can create win-lose situations by specific use of information not in the possession of the other party.4 In practice, sub-national governments will tend to have more information about local needs and preferences, and also about the implementation and costs of local policies. Unless they generate and publish reliable data on a timely basis and communicate it to the central level, an information gap is generated. Nevertheless, the sub-national level views are only "partial" – limited to a specific area or territory. Thus the central government plays an indispensable role in managing the information so as to support a broader vision of public policy objectives. Information can also be used to identify capacity deficiencies so they can be corrected. Once again, this indicates a relationship of mutual dependence.

A *capacity gap* is generated by insufficient scientific and technical expertise and infrastructure for designing and implementing water policies. If there is a difference between the capacity needed to shoulder water responsibilities, and the local authority's organisational, technical, procedural, networking and infrastructure capacity, consequences for the implementation of national water policies are unavoidable. The local authority may not have the funding to operate and maintain services effectively. This may leads to the deterioration and potential failure of services and infrastructure, which in turn threaten the quality of water resources. Many countries willing to decentralise their water policy face a fundamental sequencing question: at what point is the sub-national level ready or sufficiently mature to assume responsibilities associated with devolved or decentralised tasks in water policy making? Will learning by doing be sufficient, or is it essential to build capacity before it is possible to properly deliver on assigned competences? There is no right or wrong answer to these questions. Capacity development needs vary with the pre-existing levels of administrative infrastructure. Established sub-national governments with well-developed institutions may need little capacity building when faced with new responsibilities. But where sub-national governments or related institutions must be created or have historically had a limited role, the difficulties will be greater. This capacity gap is not restricted to the sub-national level. It also applies to the national level in terms of managing multi-level relations, allocating responsibilities and funds, and ensuring co-ordinated, coherent policy approaches among actors at central level. In some instances, the subnational level experiments with innovative approaches in water policies, and they are subsequently "learned" and capacity built by peer levels or transferred from the sub-national level to the central level.

The *funding* (or fiscal) *gap* refers to insufficient or unstable revenues to implement water policies across ministries and levels of government. It is represented by the difference between sub-national revenues and the expenditures sub-national authorities require to meet their responsibilities in the water sector. This gap reflects a mutual dependence between levels of government. Sub-national authorities often depend on higher levels of government for funding water policies, while central government depends on the sub-national authorities to deliver them and meet both national and sub-national policy priorities. This interdependence is all the more crucial when government funding has been slashed in times of economic and financial crisis. The cost of construction and maintenance of water and sanitation infrastructure is constantly increasing and requires long-term investment. Private partners, investment banks and innovative arrangements at local level have thus been explored as complements to public action in water financing.

The *objective gap* occurs when diverging or contradictory objectives between levels of government or ministries compromise long-term targets for integrated water policy. Frequently, when priorities are not clearly formulated at the highest political level, conflicting interests in water uses, quality, energy efficiency and pricing policy prevent consensus on aligned targets. For example, at sub-national level, urban flood controls and ecological preservation or restoration of urban waters often conflict. In the past, exclusive emphasis on structural methods of flood control led to destruction of habitat as well as deterioration of water quality. When the objectives of flood control, ecological preservation and spatial planning converge, the impact on other policy areas can be minimised. Overall, the objective gap underlines governments' challenges in fostering strategic and territorialised planning of water policy. All relevant stakeholders must be engaged for the long haul, beyond political changes and electoral calendars. The timeframe for decisions is of crucial importance in strategic planning. Water policies are frequently long-term endeavours that involve planning, ex-ante evaluation, consultation, several stages of implementation and *ex post* evaluation. Short-term considerations and vested interests can result in action that is potentially counterproductive. The prospects of success are greater when the timeframe for one policy aligns with activities in another policy. In theory, time scales are relatively easy to co-ordinate. For instance, regulatory and budget cycles can be synchronised over time (*e.g.* multi-annual budgeting) so that decisions that require coherence can be taken independently of political calendars and agendas, which vary from one ministry to another. In addition, strategic planning is more difficult to design if policies, legislation and institutions on the water environment are questioned from one government to another. It essentially requires a public relations effort to manage the expectations of those who have a vested interest in previous policies, so that they can be engaged in policy changes and build flexibility towards policy coherence at the central and local level.

The *accountability gap* refers to a lack of transparency in water policy making, and institutional issues of quality and integrity. Ensuring transparency across different constituencies is key for the effective implementation of water policies. But often, shortening the decision-making process introduces risks of transparency, integrity, capture and corruption, in particular when local governments do not have the capacity to monitor investment and civil society is not totally engaged. In addition, recent decades have seen a decrease in government provision of public goods and an increase in private sector participation. The latter has changed traditional government accountability. In this context, the accountability gap can be reflected in the market entry process, award criteria, as well as contract provisions for unforeseen contingencies. The question here for governments is not whether citizen awareness must be developed but whether mobilising public interest could lead to more effective water policies.

Observations from the institutional mapping of roles and responsibilities in the water sector

Institutional mapping at central government level

Unclear, overlapping and fragmented roles and responsibilities across policy areas and between levels of government are often considered as the major obstacle to effective design and implementation of water policies. The water sector is affected by numerous external drivers and generates important externalities in various policy domains, hence the multiplicity of actors mutually dependent and the inherent risks of confusion, efficiency costs and conflicts in both water resources management and water services delivery. In this context, it is crucial to understand clearly who is responsible for what in terms of strategic planning, priority setting, allocation of uses, economic and environmental regulation, information, monitoring, evaluation, at which level of government (national, regional, local) and how such responsibilities are defined (by a specific law on water, by the Constitution, etc.).

The analysis of the allocation of roles and responsibilities at central government level in 17 OECD countries suggests the following observations (Table 3.2).

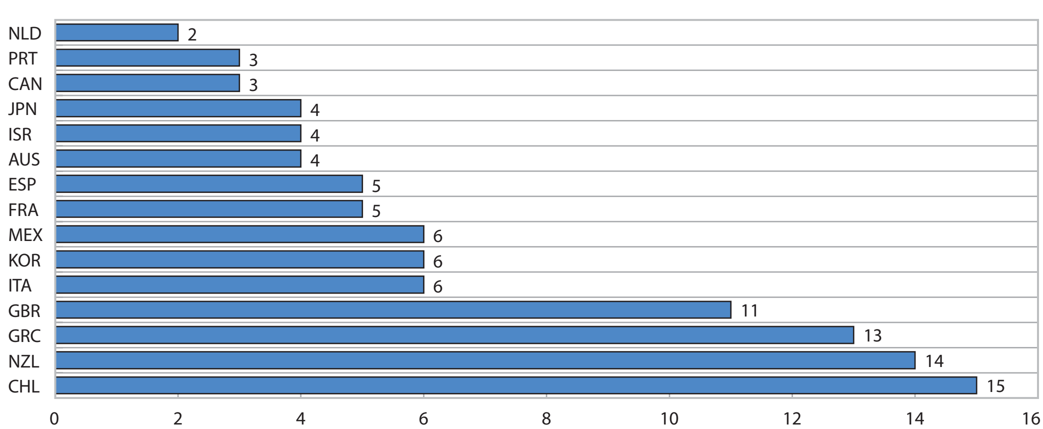
- In some OECD countries, the allocation of roles and responsibilities in water policy making is so widely distributed across national and subnational levels that it is impossible to capture a “national model” with comprehensive institutional mapping. Doing so would involve making a lot of generalisations that would obscure the diversity, fragmentation and omissions in the systems or listing dozens of exceptions and caveats that would probably result in more confusion than clarity. An example of a high level of hyper-fragmentation of water policy is the United States.
- In all OECD countries surveyed, the central government plays a certain role in water policy making. In some countries (France, Spain) the intervention of ministries and public agencies is focused on strategic planning and priority-setting, as well as policy making and implementation, while in others (Canada, United States, United Kingdom), it is more oriented towards environmental regulation. However, the role of central government in water policy is less important in federal countries that have either devoted most of the responsibilities to sub-national governments or totally decentralised their water policy making, as in the case of Belgium where competences for water policy are exclusively regional, except for selected environmental issues.
- In all OECD countries surveyed, multiple actors are involved in water policy making and regulation at central government level, thus contributing to the complexity of the sector. As Figure 3.1 shows, the number of central government actors involved in water policy making ranges from two in the case of the Netherlands to 15 for Chile.

Table 3.2. **An overview of OECD countries' water policy at the central level**

Country or region	Unitary, federal or quasi-federal country	Number of principal actors in design and implementation	Number of actors in regulation	Role of central government (dominant actor, joint role with local actors, none)	Means of defining roles	Specific water regulatory agency (yes/no)
Australia	Federal	4	4	Joint	Law	Yes
Belgium (Flanders)	Federal	7	-	None	Constitution Law Other	No
Belgium (Wallonia)	Federal	-	-	None	Constitution Law	No
Canada	Federal	9	3	Joint	Constitution Law	No
Chile	Unitary	15	10	Dominant	Law Ad hoc Other	No
France	Unitary	5	5	Joint	Law Ad hoc Other	No
Greece	Unitary	13	12	Dominant	Law	Yes
Israel	Unitary	4	4	Dominant	Law Other	Yes
Italy	Quasi-federal	6	5	Joint	Law Ad hoc	No
Japan	Unitary	4	-	Dominant	Law	No
Korea	Unitary	6	4	Dominant	Law	Yes
Mexico	Federal	6	4	Dominant	Constitution Law Ad hoc	Yes
Netherlands	Unitary	2	2	Joint	Constitution Law	Yes
New Zealand	Unitary	14	7	Joint	Law Ad hoc Other	Yes
Portugal	Unitary	3	5	Dominant	Law Ad hoc Other	Yes
Spain	Quasi-federal	5	6	Joint	Constitution Law Ad hoc Other	No
United Kingdom	Unitary	11	5	Joint	Law	Yes
United States (Colorado)	Federal	11	7	Joint	Constitution Law	No

Source: OECD Water Governance Survey, 2010.

Figure 3.1. **Number of authorities* involved in water policy making at central government level**
(17 OECD countries surveyed)



* Ministries, departements, public agencies etc.

Source: OECD Water Governance Survey (2010).

- Even when there is a clear allocation of roles and responsibilities under a specific "water law", co-ordination is still an imperative. Beyond the determination of *who* does *what*, the challenge lies in the problems of overlapping responsibilities generated by interpretation and implementation of water policy on the ground.

The water sector is a heavily regulated sector. Three categories of countries can be distinguished in terms of allocation of environmental and economic regulatory powers in the water sector at the national level (Table 3.3). In a first category of countries, these functions are carried out by ministerial departments and/or public agencies; in a second category of countries, such duties rely on specific regulatory agencies in the water sector; and a third category of countries, in the middle of the continuum, significant regulatory powers are granted to specific actors at national level. OECD countries' institutional mapping shows that these different models have sometimes been combined within a same country, as environmental regulation is often carried out by ministerial departments or agencies, while economic regulation is undertaken either at the territorial level (states, provinces, municipalities) or by specific regulatory agencies.

Table 3.3. **Allocation of regulatory powers at the national level**

Where regulatory functions are mainly carried out	Examples
Ministerial department or public agency	Mexico (COFEPRIS), New Zealand (EPA), Israel (IWA)
Specific regulatory agency in the water sector	Chile (SISS), United Kingdom (economic regulation, OFWAT), Australia (ERA), Portugal (ERSAR)
National entity with specific regulatory powers	France (ONEMA), United States (EPA), United Kingdom (EA, DWI)

Source: OECD Survey on Water Governance (2010).

Institutional mapping at sub-national government level

The analysis of the allocation of roles and responsibilities at central government level in 17 OECD countries suggests the following observations.

- In all OECD countries, sub-national governments have mandates to act on water governance and may make decisions that determine or influence water distribution systems and the sustainability of service delivery and resource management. Both municipal and regional authorities are well positioned to develop policy and programmatic solutions that best meet specific geographic, climatic, economic and cultural conditions. They are equally well placed to develop innovative policy solutions that can be scaled up into regional or national programmes, or to provide a laboratory for national pilot programmes on the urban level.
- Three categories can be distinguished with respect to the allocation of responsibilities to sub-national actors in water policy making: a first category of countries where local and regional authorities are the main actors in water resources management and service delivery; a second category where local and regional authorities play an important role in the design and implementation of water policies together with the central government; and, on the other side of the continuum, a third category of countries where sub-national governments' role in water policy making is either restricted to implementation only or non-existent (Table 3.4).

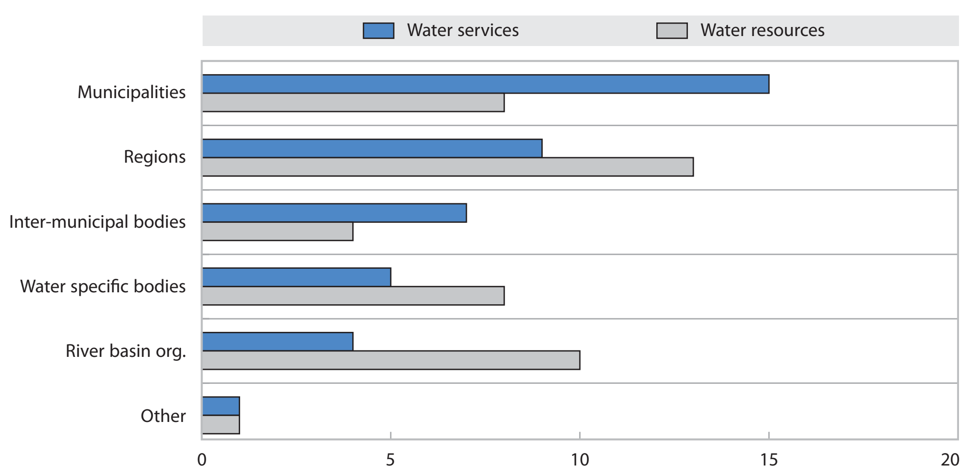
Table 3.4. Involvement of sub-national actors in water policy design and implementation

Level of involvement	Examples
Main actors	United States, Canada, Belgium, Australia
Joint role with central government	France, Spain, Italy, New Zealand, Netherlands, Mexico, Portugal, United Kingdom, Japan
Main role: implementer	Israel, Chile, Korea

Source: OECD Survey on Water Governance (2010).

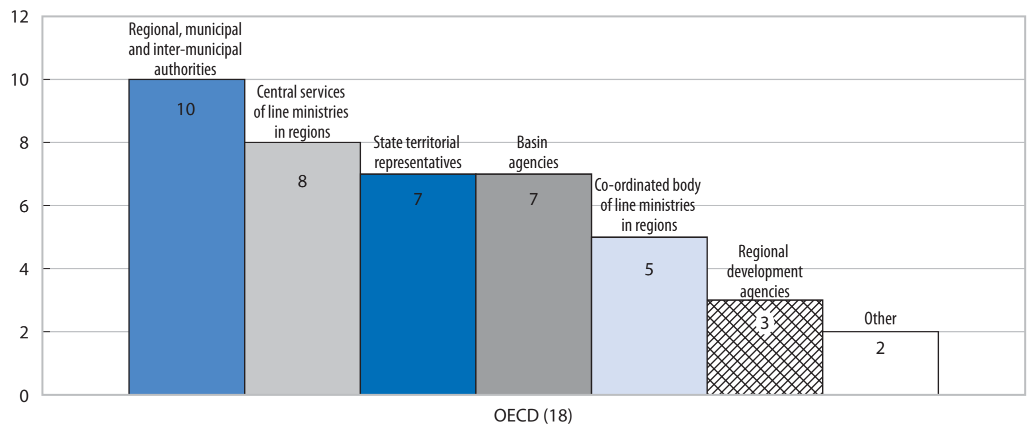
- A closer look at the prerogatives of sub-national actors involved in water policy making, in the countries where they play an important role, reveals common trends in OECD regions (Figure 3.2). As regards water resources management (and this is also true for water services for agricultural users), regions are the primary sub-national authority responsible for (co-)designing and implementing policies in two-thirds of the OECD countries surveyed. The second type of sub-national authority involved is the river basin organisation, followed by water-specific bodies such as Water Boards in the Netherlands. In the case of water supply for domestic use, in almost all OECD countries surveyed, municipalities are the primary sub-national authorities in charge of (co-)designing and/or implementing policies. They are followed by regions (and inter-municipal bodies. The trend is similar in the areas of water supply to industrial users and wastewater treatment.

Figure 3.2. **Type of sub-national actors involved in water resources management and service delivery**



- In almost two-thirds of OECD countries surveyed, regions, municipalities and inter-municipal bodies are the primary actors in charge of implementing central government policies at the sub-national level (Figure 3.3). In Australia, co-operative arrangements have led to agreements between Commonwealth, State and Territory agencies for primary responsibility in water policy. In France, municipalities and inter-municipal bodies are the primary actors for drinking water supply and sanitation, while regional and departmental bodies as well as irrigation groups are in charge of aquifer and river management.

Figure 3.3. **Who implements central government water policies at the sub-national level?**
(17 OECD countries surveyed)



- Despite the diversity of situations at the sub-national level governing the implementation of water policies designed by the central government, two categories of countries can be distinguished (Table 3.5). A first category includes countries where implementation of water policies at the sub-national level essentially relies on a single type of actors, *i.e.* representatives of central government in regions; and a second category includes countries with a combination of several sub-national authorities' responsibilities in the implementation stage. This often, if not invariably, reflects how decentralised water policies have become across OECD countries.

Table 3.5. **Implementation of central government water policies at the territorial level**

Where responsibility for implementation lies	Examples
A few types of actors, mainly state territorial representatives or deconcentrated bodies/services	Chile, Israel, Korea
A multiplicity of actors, municipalities, intermunicipal bodies, regions, RBOs, etc.	France, Mexico, Italy, United States, Canada, Australia, Spain

Source: OECD Survey on Water Governance (2010).

Main conclusions on OECD countries' institutional organisation of water policy

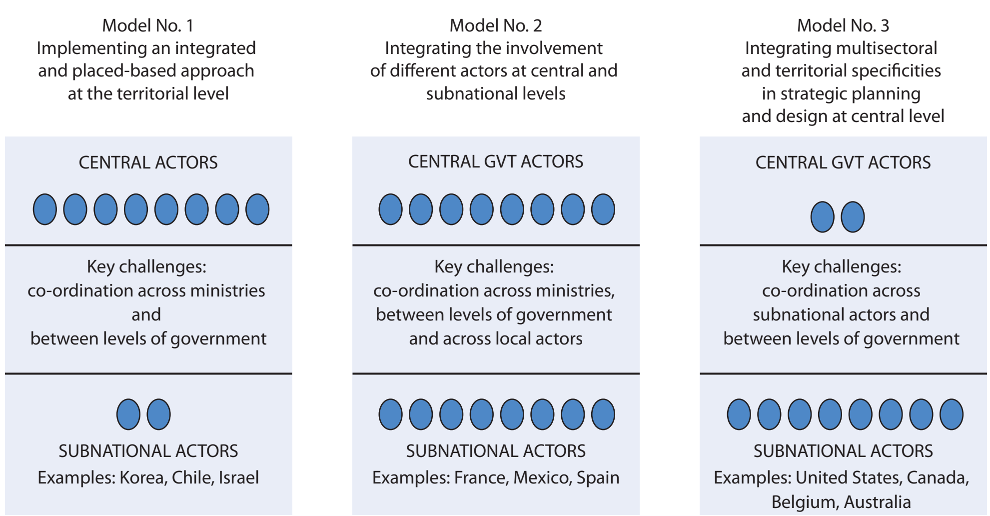
First, it is not possible to identify a master plan generally adopted for assigning competencies across ministries and levels of government in the water sector. However, common trends across OECD countries are noticeable, especially regarding sub-national actors and their responsibilities as most OECD countries have largely decentralised their water policy making;

Second, no systematic correlation can be found between a given country's institutional organisation (unitary or federal, for example) and the institutional mapping of water policy. Geographical, environmental and economic factors also have a considerable impact; There is a diversity of situations across OECD federal and unitary states in terms of the institutional organisation of water policy. On the one hand, some federal countries (United States, Canada, Belgium) have delegated many water responsibilities to lower levels of government, while in other federal states (Mexico, Australia) the central government still plays a strong role (*e.g.* strategic planning, regulation, etc.) in ongoing water policy reforms, not only in terms of design but also at implementation levels. On the other hand, though some unitary states still retain significant water responsibilities at central government level, with highly centralised water policy making (Korea, Chile, Israel), most OECD unitary states (France, New Zealand, Greece, the Netherlands) have *de facto* delegated many responsibilities to lower levels of government.

Third, river basin management has been encouraged in both federal and unitary countries, by institutional factors but also hydrological parameters and international incentives or regulations (*e.g.* EU Water Framework Directive); All the federal or quasi-federal countries surveyed (Australia, Belgium, United States, Spain, Italy, and Mexico) have created river basin organisations, but more detailed study of at these experiences reveals a diversity of situations, which reflect the varying degrees of "maturity of decentralisation" in water policy making.

Fourth, based on the comparison of the allocation of roles and responsibilities at central and sub-national level in a series of OECD countries, Figure 3.4 defines three models, raising different governance challenges related to the frequent "paradox of decentralisation" and the need to manage the relationship between "diversity" – to customise water policy according to territorial specificities – and "coherence", *i.e.* the need to adopt a holistic and integrated approach to water policy. These models are not intended as normative in the sense that one would be better than the other, but they highlight different co-ordination challenges raised by a given institutional organisation of water policy even if – within a same "category" – the degree to which governance challenges have an impact on the performance of water policy may vary from one country to another.

Figure 3.4. **Categories based on the allocation of roles and responsibilities in water policy**



These models could be further developed in the framework of water-specific policy dialogues with selected countries and regions. In addition to outlining the challenges to co-ordination, they could be enriched by adding other dimensions (*e.g.* capacity gaps, variety of tools in use, etc.), to produce a more elaborate matrix linking each model with policy objectives and desired outcomes. This would support the hypothesis that regardless of the model adopted (which is often dependent on institutional legacy and not always under government control), the same policy goals can be achieved with a combination of different governance instruments.

Challenges to co-ordinating water policies across ministries and between levels of government

The survey of water governance in OECD countries also sought to identify the key governance gaps by asking respondents to rank a series of water governance gaps through a series of proxies (see Box 3.2). Figure 3.5 and Table 3.6 show the degree to which effective co-ordination and implementation of integrated water policy may be hindered by multi-level governance gaps varies in OECD region and demonstrates that multi-level governance "gaps" in water policy design, regulation and implementation affect all OECD countries, but to varying degrees.

Box 3.2. **Identifying governance gaps in water**

The assessment of OECD countries' challenges proposed in this section is based on the OECD Multi-level Governance Framework and data collection from the 2010 OECD Survey on water governance. In the 17 countries surveyed, respondents from central administrations, river basin organisations and regulatory agencies were asked to rank a series of water governance challenges from 1 (not important) to 3 (very important), according to a set of indicators attempting to illustrate each of the multi-level governance gaps. Though several elements contribute to the 7 broad governance challenges previously described, one proxy indicator per gap has been selected to facilitate the analysis. The table below summarises the main proxy indicators that were selected for the different gaps in order to design categories of water governance challenges in OECD countries.

Proxies for measuring multi-level governance gaps in water policy

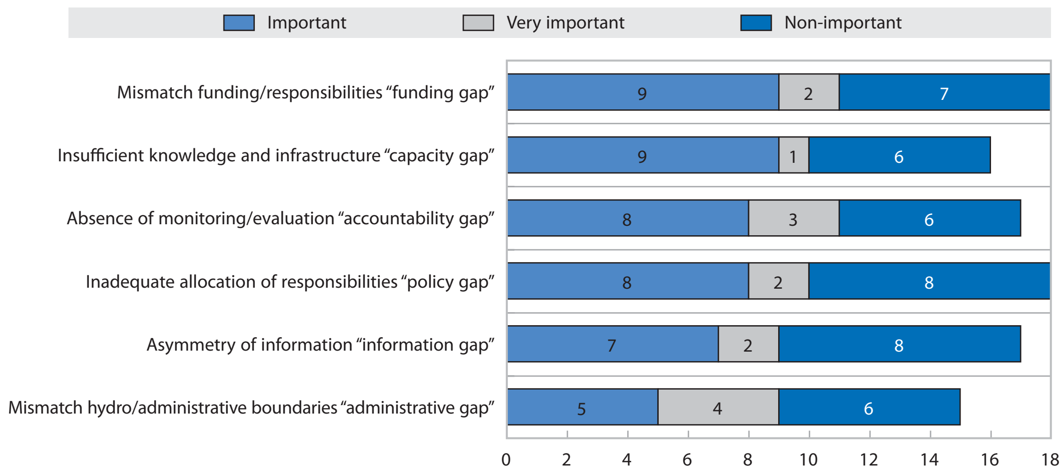
Multi-level governance gaps	Proxy indicator
Policy gap	Overlapping, unclear allocation of roles and responsibilities
Administrative gap	Mismatch between hydrological and administrative boundaries
Information gap	Asymmetries of information between central and sub-national governments
Capacity gap	Lack of technical capacity, staff, time, knowledge and infrastructure
Funding gap	Unstable or insufficient revenues of sub-national governments to effectively implement water policies
Objective gap	Intensive competition between different ministries
Accountability gap	Lack of citizen concern about water policy and low involvement of water users' associations

Source: OECD (2011c).

In two-thirds of OECD countries surveyed, the *funding (or fiscal) gap* (*i.e.* the mismatch between administrative responsibilities and available funding) is the main obstacle to vertical and horizontal co-ordination of water policies especially in a context critical investment required to update and renew OECD countries' water infrastructure that have become either obsolete or not in conformity with more stringent environmental regulations. For example in Korea, New Zealand and Mexico, sub-national governments often do not have the financial and capacity resources to carry out their water responsibilities, especially in rural areas, which heavily rely on grants and transfers from the federal government to build, extend and maintain infrastructure. Asymmetries of revenue and funding are also likely to undermine the co-ordination of water policies across ministries and public agencies. A ministry with a higher budget will have more ability to tilt policy towards its

Figure 3.5. **Multi-level governance gaps in OECD countries' water policymaking**

(17 OECD countries surveyed*)



* There are 18 responses for the 17 countries surveyed. As water is a regional issue in Belgium, Flanders and Wallonia replied separately.

Table 3.6. **Key multi-level governance in water policy making: An overview of OECD countries**

"Important" or "very important" gap	No. of countries or regions	Examples of countries or regions
Funding gap	11 out of 17	Australia, Belgium (Flanders), Chile, France, Greece, Israel, Korea, Mexico, New Zealand, Portugal, Spain, United States (Colorado)
Capacity gap	11 out of 17	Australia, Belgium (Flanders), Chile, Greece, Italy, Korea, Netherlands, Portugal, Spain, United Kingdom, United States (Colorado)
Policy gap	9 out of 17	Belgium (Flanders), Canada, France (sub-national actor), Greece, Israel, Italy, Korea, Spain (sub-national actor), United States (Colorado)
Administative gap	9 out of 17	Australia, Greece, Italy, Korea, Netherlands, Portugal, Spain, United Kingdom, United States (Colorado)
Information gap	9 out of 17	Australia, Chile, Italy, Korea, Netherlands, New Zealand (sub-national actor), United Kingdom, United States (Colorado)
Accountability gap	9 out of 17	Belgium (Flanders), Chile, Greece, Italy, Korea, Mexico, Netherlands, Portugal, United States (Colorado)
Objective gap	4 out of 17	Belgium (Flanders), Israel, Korea, Portugal

Source: OECD Survey on Water Governance (2010).

own agenda, which may be problematic if that agenda is not coherent with that of the other ministry. Often, ministries of finance and economy are not directly involved in making decisions during water policy reforms, which can raise implementation challenges at a later stage. The finance arrangements of ministries may hinder the adoption of more coherent policies. In Israel, for example, the Israeli Water Authority (IWA) is responsible for the national water management plan and for the budget (setting the tariffs and deciding on the expenses). IWA obtains the funds to run the national water-management plan from the state of Israel's national budget, rather than directly from the water payments of the users via tariffs. The fact that revenues from water tariffs are not allocated straight to the IWA raises efficiency considerations as well as inadequacies in funding in many areas. Readjustment of intergovernmental responsibilities for strategic water financial planning is therefore a national goal for the coming few years.

Despite the well-developed infrastructure and the regular transfer of expertise, the *capacity gap* is still identified as the second most important challenge in OECD countries – especially at the sub-national level; This refers not only to the technical knowledge and expertise, but also to the lack of staff and time as well as obsolete infrastructure. This is an interesting result, since governments often tend to consider capacity issues in the water sector a major concern for developing countries rather than for developed ones. Facing water scarcity and climate change (desalination, nanotechnologies, spatial technologies, recycling of water use, etc.) require transfers of know-how at the sub-national level, especially when service delivery is not managed by the private sector. Spain is an example of an OECD leader in the application of technologies and establishment of international standards on new water technology implementation and management of irrigation. More generally, in OECD countries, some skill sets are in good supply (*e.g.* mechanical engineering) while others may still be in need of reinforcement (*e.g.* planning, hydrology, climatology, financing) to implement integrated management. To date, insufficient knowledge and infrastructure is still an important obstacle to vertical co-ordination of water policy. Greece is a prominent example within OECD countries. It is behind schedule in the implementation of the 1991 EU Urban Wastewater Treatment Directive which required all municipal wastewater to be treated by 2005. Greece's biggest cities are in compliance with the directive, but smaller municipalities face major obstacles related to infrastructure.

Two-thirds of OECD countries surveyed still face a *policy gap* (*i.e.* the sectoral division of water related tasks) because of the fragmentation of responsibilities at national and sub-national level and the lack of institutional incentives for horizontal co-ordination between different policy fields; For example, in the United States, where there is no single agency in charge of water policy, the intervention of 50 000 federal and state agencies, committees and 3 000 county governments does affect water policy formulation across levels of government. Water policy coherence is therefore highly dependent on the set-up of institutions and the allocation of roles and responsibilities at central and sub-national levels. Most of the time countries experience a policy gap because water responsibilities are scattered between different levels of government and across several ministries. These can range from the ministry of the environment, to agriculture, health, fisheries, industry, finance, transport, public works, rural development, infrastructure, housing, spatial planning, etc. These policy areas relate to different organisational cultures and have different constituencies (farmers, trade unions, voters, private companies, etc.), as well as different degrees of sensitivity to lobbies. Unless co-ordination is encouraged, this multiplicity of actors is likely to favour segmented working methods and complicate decision-making processes even further. Narrow sectoral perspectives and silo approaches then prevail, instead of cross-cutting agendas tailored to specific issues

The *administrative gap* (mismatch between hydrological and administrative boundaries) still has a significant impact on water policy implementation, despite the adoption of river basin management principles; In Korea for example, one of the largest problems in water resource management is the lack of fit between administrative zones and hydrological boundaries. This deters effective river management, which requires integrated planning. Municipalities take only their own perspectives and plans in to account in executing their budgets, and the lack of an integrated approach and territorially customised water policy compromises the efficiency of budget execution. In the Netherlands, which is subject to the EU Water Directive, the mismatch between hydrological and administrative boundaries is still somewhat important, despite the division of river basins between different Water Boards and the jurisdiction of the Directorate-General for Public Works and Water Management. This is mainly due to the fragmentation of sub-national responsibilities and imprecise allocation of roles. For instance, both municipalities and water boards are responsible for wastewater transport pipes. The Union of Water Boards is currently working towards a clearer distinction of responsibilities between Water Boards, municipalities, provinces, and the Ministry of Transport, Public Works and Water Management. In the United States, the mismatch between hydrological and administrative boundaries is exacerbated by the fact that urban areas need water supplies from the mountains and as a result, often administer reservoirs that are hundreds of miles away.

The *information gap* remains a prominent obstacle to effective water policy implementation in half of the OECD countries surveyed. In particular, adequate information generation and sharing among relevant actors as well as scattering and fragmentation of the generated primary water and environmental data are important bottlenecks across ministries, agencies and levels of government involved in water policy. In addition, substantive problems with data inhibit integrated water policies in several ways (including jargon, a mix of terminologies, unclear definitions, overlapping meanings of terms related to water, etc.). New Zealand and Australia are two OECD countries where the information gap is a major concern for policy makers. In New Zealand, the lack of common information and a common national frame of reference has historically been the largest hurdle. No mandated methodology for calculating quantity limits has ever been established that reflects ecological values and wider community outcomes. Obtaining such information is a critical first step for developing a comprehensive system of water management at national level. To some extent, this information is already collected by local government, but central government leadership is essential to make sure that the information reported is robust, consistent and defensible. Only then can the necessary decisions to balance access to fresh water amongst competing interests be made. In Australia, most data has historically been collected by the states and is often not consistent or comparable at a national level. Further research is needed to provide a comprehensive understanding of Australia's water resources, despite the strong commitment by the Australian government to address these information gaps.

The *accountability gap* is noted as an obstacle to water policy implementation in half the OECD countries surveyed. Generally, the main issues relate to a lack of public concern and low involvement of water users' associations in policy making. But challenges related to the evaluation of water policies at central and sub-national level are also crucial to approach the accountability gap. Inadequate monitoring, reporting, sharing and dissemination of water policy performance also prevent policy coherence at horizontal and vertical levels. Periodic assessment of progress toward established policy goals is vital for understanding whether the applied efforts are effective and for adjusting policy where necessary. But feasibility is often limited due to considerations of political, financial and capacity, and this complicates the implementation of central government decisions at the sub-national level. In Greece, Israel and Italy, the absence of monitoring and evaluation of outcomes were considered important obstacles to water policy implementation at the territorial level. In Israel, the outcome of national water policies is not always quantified in a timely manner, due to difficulties in obtaining the relevant data from the IWA database.

Last but not least, OECD countries also experience an *objective gap* in striking a balance between the often conflicting goals in financial, economic, social, environmental areas for collective enforcement of water policy. One significant example is the design of water-pricing policies, which is often complicated by the need to balance financial and social objectives. Historically, water has been significantly under-priced, so price increases can pose a political challenge. Conversely, if tariff structures are not properly designed with social considerations in mind, price increases may disproportionately affect poorer households. The objective gap affects OECD unitary and federal countries alike. Korea is a unitary country where coherence is compromised by the competition between the five ministries involved in water policy, and by overlapping roles and responsibilities in water management. Tasks are divided in some instances, but are unclear overall. For example, river management requires the consideration of sufficient water quantity, flood control and the environmental functions of rivers. However, this is difficult to achieve in ecological restoration of rivers, especially when no national committee or policy organisation structure exists to bring the different actors together and create room for regular dialogue to prevent and manage possible overlaps. Water management cuts across many strategic directions and a lack of real recognition of conflicts between different government policies (*e.g.* energy and water) regularly create difficulties for local and regional authorities. A more holistic perspective is therefore needed from the centre, which acknowledges the conflicts undermining successful water management and sets clearer direction in certain areas.

Governance fragmentation at the metropolitan level

The increasing multiplicity of local actors in water policy making, both through the creation of metropolitan-wide governance mechanisms and through the involvement of grassroots organisations, further complicates metropolitan water governance. Although it takes different forms in different contexts, metropolitan governance reform often entails the creation of metropolitan-wide institutions, such as those that manage transportation and water supply. On the other hand, the bottom-up approach advocated by proponents of delegated water management can potentially both be complementary and also conflict with the drive for metropolitan co-ordination inherent in governance reform. This raises two issues for urban water governance: *i)* re-scaling metropolitan governance may (positively or negatively) affect water governance frameworks; and *ii)* strategies for metropolitan governance reform may offer interesting models for application in the urban water sector. Evidence from selected OECD metropolitan areas is provided in Table 3.7.

Table 3.7. **Governance challenges in selected OECD Metropolitan areas**

	Institutional setting of the metropolitan region	Main metropolitan governance challenges
Busan	The local labour market is more or less represented by the Busan Metropolitan City (the higher level of local government in Korea) and includes 16 lower levels of local governments (15 autonomous districts and one rural unit). The largest functional area, often referred to as the Southeast Region, extends to the Gyeongnam province and Ulsan Metropolitan City.	The need to build better co-operation with Ulsan and Gyeongnam (policy gap) to design a comprehensive competitiveness strategy based on the complementary assets of the largest Southeast Region; management of spill-over problems (*e.g.* urban sprawl and environmental concerns) due to the administrative gap; enhancing local capacity to design and implement strategic decisions (decentralisation is quite recent); increasing local democracy (especially at the lower level of local governments), and promoting a culture of citizen participation to bridge capacity, information and accountability gaps.
Helsinki	The functional urban region includes four municipalities that form the core of Helsinki metropolitan area and eight surrounding municipalities.	Dealing with urban sprawl and risk of further spatial polarisation and disparities; increasing co-operation among planning authorities of regional councils and municipalities especially for land use and housing. Further integration of the Greater Helsinki area requires making major investments in infrastructure and housing (Helsinki is a relatively small city from an international and EU perspective).
Istanbul	The functional area is mainly represented by the Istanbul metropolitan municipality, which includes 72 district municipalities and extends to two other surrounding provinces (Kocaeli and Yalova).	Managing major transport congestion; providing better co-ordination of strategic planning at a wider regional level and better implementation and enforcement in the planning process; formulating a long-term strategic vision; improving delivery of local public services; improving decentralisation management at the district municipality level; strengthening local capacity-building.

Table 3.7. **Governance challenges in selected OECD Metropolitan areas** *(continued)*

	Institutional setting of the metropolitan region	Main metropolitan governance challenges
Madrid	The functional labour market is slightly larger thatn the Comunidad Autonoma de Matrid (Spains's regional governments are known as an "autonomous communities"), which includes 189 municipalities (including the city of Madrid, which represents 54% of the total population).	Solving the problem of overlapping responsibilities and competition between the Comunidad and the city of Madrid (*e.g.* in economic development and plans for internationsalisation).
Milan	The restriscted definition of the functional labour market roughly corresponds with the province of Milan, which includes 189 municipalities including the city of Milan. The extended definition of the functional area includes the province of Milan and seven other provinces.	Enhancing co-operation to manage sectoral bottlenecks throughout the functional area (*e.g.* transportation and congestion, housing); building an integrated governance framework capable of producing public goods.
Montreal	The functional labour market includes 82 municipalities (the largest being Montreal, Laval and Longueuil) and is represented by a metropolitan agency (CMM); the area is also split into three parts, each belonging to different administrative provincial regions that extend well beyond the current functional area.	Stabilisation and consolidation of institutional reforms in the region; dealing with de-merger issues; implementation of decentralisation at the district level; legitimising the new metropolitan community and bolstering its finances; deterioration of municipal infrastructure is straining local finances.
Randstad	The polycentric Randstad region area includes most of the South Holland and Utrecht provinces, the southern part of the province of North Holland and the municipality of Almere in the province of Flevoland. At 6.6 million people, it covers the four largest Dutch cities (Amsterdam, Rotterdam, The Hague and Utrecht), a large number of medium-sized cities, as well as small towns and villages. The highest functional integration occurs at sub-Randstad levels: that is, city-region levels (Amsterdam, Rotterdam, The Hague and Utrecht) and wings' levels (North wings and South wings).	Congestion and bottlenecks in transportation, notably in relation to the two main ports (Schiphol airport and Rotterdam harbour) requires more co-ordination at a wider regional level; more formal co-operation at the Randstad level is needed to pursue the integration process; existing co-operation at the city-regions level is hampered by a lack of authority to implement (each municipality that is part of these co-operative arrangements can block the decisions); providing a better co-ordination process to manage existing environmental concerns, notably in relation to the "green heart" and water management (most of the area is below sea level), for example through improved co-ordination and rationalisation
Seoul	The functional area is referred to as the Capital region, which includes Seoul Metropolitan City (around half of the total population in the functional area), Incheon Metropolitan City and the Gyeonggi Province. Seoul Metropolitan City includes 25 districts (lower levels of government) with an average of 400 000 inhabitants.	Building formal co-ordination between the three local governments (Seoul, Incheon, Gyeonggi) to deal with a high concentration of population and industry, congestion and environmental problems, etc.; integrating sectoral co-ordination of local policies (spatial planning, land use management, transport and environment, economic development strategy) into a broader and strategy for competitiveness and sustainable development.
Stockholm	The local labout market includes two counties (Stockholm County and Uppsala County) and 36 municipalities in total. a larger expanded metropolitan area, the Stockholm Malar region, includes five counties and 65 municipalities.	Strong local autonomy and weak intermediate level (counties) do not allow for co-ordination of strategic planning decisions for transportation and economic development at the metropolitan level.

Source: OECD (2006), based on *OECD Metropolitan Reviews*.

Multi-level governance challenges in water policy require a holistic approach to co-ordination gaps because these are interrelated and can exacerbate each other. For instance, any country facing a sectoral fragmentation of water roles and responsibilities across ministries and public agencies (*policy gap*) may also suffer from the conflicting goals of these public actors (*objective gap*). Because of silo approaches, these may not willingly share information (*information gap*).This in turn undermines capacity-building at the sub-national level (*capacity gap*) because local actors, users and private actors have to multiply efforts to identify the right interlocutor in the central administration. Hence the need to identify the mutual interdependencies between different institutions involved in water policy making at local, regional and central levels. This implies recognising the impediments to effective co-ordination of public actors at the levels of administrative, funding, knowledge, infrastructural and policy levels, to address water information and data "gaps" and promote more effective water policies and shared strategies.

Multi-level Co-ordination of Water Policies

Encouraging co-ordination and capacity-building is a critical step toward bridging multi-level governance gaps in water policy. Meeting water governance challenges calls for a mix of well-integrated policy measures. This can be difficult to achieve in a context of fragmented responsibilities among various public actors as decisions are made at different territorial levels (national, regional, state, municipal, basin, etc.). Greater policy coherence among different institutions does not mean uniformity, but an attempt to create synergies between customised approaches. It requires mutually reinforcing co-ordination across government, departments and agencies for achieving the agreed-upon policy objectives, defining long-term strategies and adapting them to different contexts.

To cope with multi-level governance challenges, OECD countries have adopted several co-ordination mechanisms more or less formal and more or less flexible (see Table 3.8). They aim to create a framework for combining tools, funds and organisations or establishing a multi-stakeholder platform for dialogue for integrated water policy at all levels. Their creation relies on several factors, ranging from scarcity concerns, which is usually a driver for effective water management, to institutional mismatch or equity and efficiency objectives, even in developed and water-rich states. Each co-ordination mechanism can help bridge different gaps, and each specific gap may require the combination of several tools. All OECD countries surveyed have set up some co-ordination mechanisms at horizontal level, but countries where subnational actors play only an "implementer" role in water policy (Chile, Korea, Israel) have not necessarily adopted vertical co-ordination mechanisms. The following section offers closer scrutiny of a selection of tools, showing examples of countries and regions using them.

Table 3.8. **Governance instruments for co-ordinating water policies at horizontal and vertical levels**

	Horizontal co-ordination tools	
Gap(s) targeted	**Tool**	**Examples of countries and regions**
Information gap Objective gap	Multisectoral conferences between central government actors and between sub-national players	Australia, Canada, Chile, France, Italy, Mexico, Netherlands, Spain, United States (Colorado)
Policy gap	Co-ordination group of experts	Belgium (Flanders), France, Mexico, Netherlands, United Kingdom
	Inter-agency programmes	France, Mexico, Netherlands, New Zealand
	Inter-ministerial body or commission	Australia, Belgium (Flanders), Belgium (Wallonia), Chile, France, Greece, Israel, Italy, Japan, Mexico, Netherlands, New Zealand, Spain, United States (Colorado)
	Ad hoc high-level structure	Australia, Canada, Chile, France, Greece, Italy, Mexico, New Zealand, Portugal, Spain
	Central agency	Belgium (Flanders), Chile, France, Greece, Israel, Italy, Mexico, Portugal, United Kingdom, United States (Colorado)
	Line ministry with specific water prerogatives	Australia, Belgium (Flanders), Chile, France, Israel, Italy, Mexico, New Zealand, Portugal, Spain, United Kingdom
	Ministry of water (exclusively)	None of the countries surveyed

Table 3.8. **Governance instruments for co-ordinating water policies at horizontal and vertical levels** *(continued)*

Vertical co-ordination tools		
Gap(s) targeted	**Tool**	**Examples of countries and regions**
Administrative gap Capacity gap Funding gap Information gap Objective gap Policy gap	Water agency or river basin organisation	Australia, Belgium, France, Italy, Mexico, Portugal, Netherland, Spain, United States (Colorado)
Administrative gap Funding gap Objective gap Policy gap	Regulations for sharing roles between levels of government	All countries surveyed
Administrative gap Funding gap Objective gap Policy gap	Co-ordination agency or commission	Australia, Belgium, Canada, France, Italy, Korea, Mexico, Netherlands, New Zealand, Spain
Accountability gap Capacity gap Funding gap Information gap Objective gap Policy gap	Contractual arrangements	Australia, Canada, Chile, France, Italy, Mexico, Netherlands, Spain, United Kingdom, United States (Colorado)
Information gap Funding gap Capacity gap Accountability gap	Financial transfers/funds	Australia, Belgium (Flanders), Canada, Chile, France, Italy, Korea, Japan, Mexico, Netherlands, Portugal, Spain, United States (Colorado) *All countries surveyed except New Zealand and United Kingdom*
Accountability gap Capacity gap Funding gap Information gap	Performance indicators and experimentation at the territorial level	Australia, Canada, France, Italy, Korea, Mexico, Netherlands, New Zealand, Portugal, Spain
Policy gap Objective gap Capacity gap Information gap	Shared databases and water information systems	Australia, Canada, France, Japan, Korea, Mexico, Netherlands, New Zealand, Portugal, Spain
Administrative gap Capacity gap Funding gap Information gap Objective gap	Intermunicipal co-operation or specific bodies	Australia, Belgium (Flanders), France, Greece, Italy, Japan, Korea, Mexico, New Zealand, Portugal, United States (Colorado), Spain
Accountability gap Administrative gap Capacity gap Funding gap Information gap Objective gap Policy gap	Citizen engagement	Belgium (Wallonia), Chile, France, Greece, Japan, Korea, Mexico, Netherlands, New Zealand, Portugal, Spain, United Kingdom, United States (Colorado) *No participation in policy making: Italy and New Zealand*
Capacity gap Funding gap Information gap	Private sector participation	All OECD countries surveyed

Note: Targeted gaps are classified in alphabetical order.

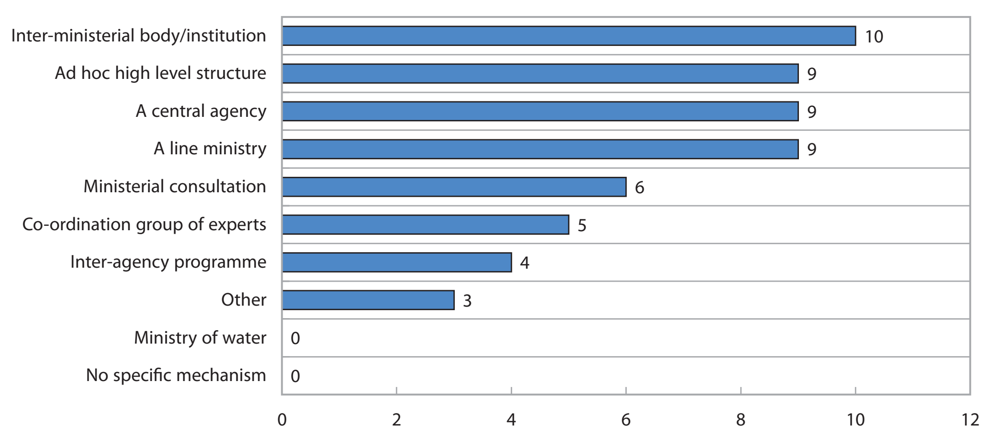
Source: OECD (2011c).

Co-ordinating water policy across ministries and public agencies

All OECD countries surveyed have co-ordination mechanisms at central government level (Figure 3.6). These mainly consist in line ministries, inter-ministerial bodies or mechanisms, or specific co-ordinating bodies. Most countries have also made efforts to co-ordinate water with other policy areas, including spatial planning, regional development, agriculture and energy (OECD, 2011). No OECD country has created a ministry specifically and exclusively dedicated to water. The water sector therefore differs from other policy areas such as health and energy, where there is frequently a specific ministry to ensure central co-ordination. Given the externalities of water on other policy areas, a totally clear-cut responsibility for water devoted exclusively to a "single actor" at central government level does not appear to be a panacea for co-ordinating water policy. Some countries, such as the Netherlands, have ministries that explicitly include "water" in their designations, but also embrace other policy areas such as rural affairs or agriculture. A number of countries have developed ad-hoc high level bodies for co-ordinating water policy (see Box 3.3). Inter-ministerial bodies, committees and commissions are the main governance tools used in upper horizontal co-ordination of water policy. More than half of OECD countries surveyed have created these platforms for dialogue and action between public actors in charge of water policy at the central government level. France, Belgium and Chile provide interesting examples.

Figure 3.6. **Horizontal co-ordination mechanisms* across ministries at central government level**

(17 OECD countries surveyed)



* A distinction is made between the line ministry which has the lead on water policy (but not only) and the Ministry of Water exclusively dedicated to water policy.

Source: OECD Water Governance Survey (2010).

In France for example, there is an "Inter-ministerial mission on water" under the leadership of the Ministry for Environment, Ecology, Energy, Sustainable Development and Maritime Affairs and, more specifically, the Water and Biodiversity Department. This administrative commission was created in 1968 in response to the water law of 1964, and brings together all ministries concerned by water policies, under the authority of the prime minister. It is responsible for advising the government on any legislative project related to water resources. Its prerogatives on inter-ministerial co-ordination, water management and administration were defined in 1987.

In Belgium, despite the strong regional characteristics of water policy, the co-ordination of the environmental policy is institutionally carried out by the Co-ordination Committee for International Environmental Policy (CCIEP). This consultative body was established in 1995 between the federal state and the three regions, and constitutes a legally binding co-operation agreement. The secretary and presidency of the CCIEP is being acted by the federal state and several technical working groups responsible for the co-ordination of specific environmental issues. Within this framework, the Inter-Ministerial Conference for the Environment (CCIM) Steering Group Water (presided over by the Flemish Environment Agency) is the consultative body in charge of the necessary co-ordination of the implementation of international water policy between the different Belgian authorities in charge.

Finally, in 2009, Chile set up an inter-ministerial committee on water policies to co-ordinate actions between departments and agencies involved in national water strategy. It also advises on strategic planning of water policy in the long term, makes proposals for institutional mechanisms, incentives and guarantees towards the implementation of water policies in rural and urban areas, and adopts the necessary agreements for the implementation of the national integrated water strategy.

Box 3.3. **Examples of ad hoc high-level structures and central agencies co-ordinating water policy**

In **Israel**, the Water Authority Council created in 2007 is responsible for all decision-making and policy-setting by the Israeli Water Authority. It seeks to co-ordinate the actions of ministries of Environmental Protection, Health, Finance, Foreign Affairs, and Infrastructure, which used to be collectively responsible for the decision-making process over matters concerning water and sewage. Under the previous arrangement, important decisions were often stale-mated by diverging interests of each agency/ministry and a lack of incentives for compromise, which presented the risk of absence of collective sense of responsibility for national decision-making on water and wastewater management. The Water Authority Council was established to alleviate these frequent deadlocks. All policies and plans that the Israeli Water Authority or any other Ministry proposes must be presented to the Water Authority Council Forum for approval before they can be passed. The efficiency of the Water Authority Council is contingent upon two criteria – creating equal representation of all interested groups, and ensuring that effective and timely decision-making is their priority. This unifies the responsibility for decision making on national water and wastewater management and has substantially improved the efficiency and timing of decision-making.

In **Mexico**, the role of CONAGUA, the National Water Commission, is to manage and preserve national waters and their inherent goods in order to achieve sustainable use, with joint responsibility of the three tiers of government (federal, state, and municipal), thus requiring co-ordination initiatives. This decentralised agency of the Ministry of Environment and Natural Resources (SEMARNAT) is the highest institution for water resource management in Mexico, including water policy, water rights, planning, irrigation and drainage development, water supply and sanitation, and emergency and disaster management (with an emphasis on flooding). CONAGUA enjoys considerable *de facto* autonomy, employs 17 000 professionals and has 13 regional offices and 32 state offices. The 2004 amended National Water Law (NWL) restructured CONAGUA key functions through the transfer of responsibilities from the central level to subnational entities. These are playing an increasing role in the water sector, limiting CONAGUA’s role to the administration of the NWL, the co-ordination of water policies, the conduct of national water policy, and planning, supervision, support and regulatory activities. The Technical Council of CONAGUA is an interministerial body in charge of approving and evaluating CONAGUA programmes, projects, budget and operations, as well as co-ordinating water policies across departments and public administration agencies. It is composed of the highest representatives from SEMARNAT, the Ministry for Social Development (SEDESOL), the Ministry of Agriculture, Rural Development, Fisheries and Food (SAGARPA), the Ministry of Treasury and Public Credit (SHCP), the Ministry of Energy (SENER), the Ministry of Public Administration (SFP), the National Commission of Forestry (CONAFOR) and the Mexican Institute of Water Technologies (IMTA).

Box 3.3. **Examples of ad hoc high-level structures and central agencies co-ordinating water policy** *(continued)*

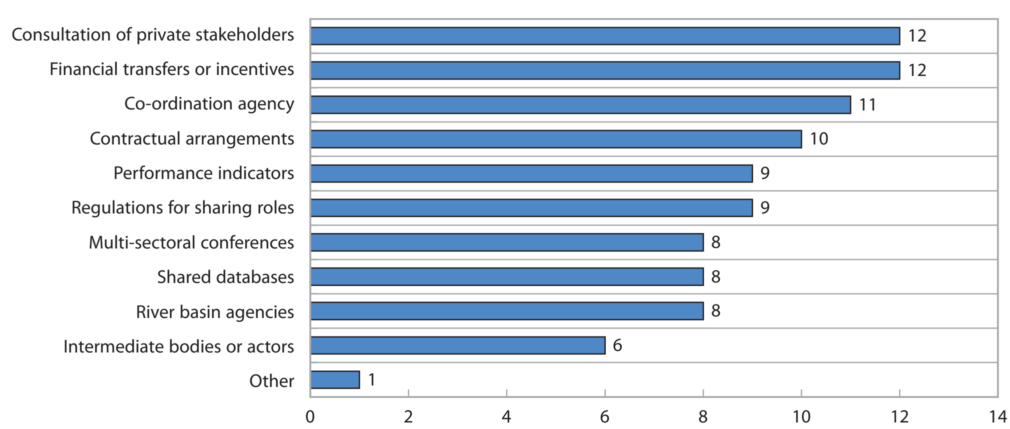
Several OECD countries have a National Water Council. In **Greece**, this council gathers representatives from 26 organisations, including the seven ministries related to water, political parties, NGOs and other stakeholders. In **Portugal**, the council represents 50 government and non-government stakeholders and has a useful role. In **Spain**, this high-level consultative agency was created in 2009 and includes autonomous communities, local entities, river-basin authorities, and professional and economic unions related to water. Horizontal co-ordination of water policies is ensured by the participation of the main directors-general of the Ministry of Environment, Rural and Maritime affairs (water, quality and environmental protection, sustainable development and rural affairs, natural and forestry areas, coastal and marine), the presidents of all river basin authorities, as well as the directors from other ministries such as civil protection and emergencies (Ministry of Interior), energy policy (Ministry of Industry, Tourism and Trade), public health (Ministry of Health and Social Policy), economic policy (Ministry of Economy and Treasury) and the directors of the Geological and Mining Institute of Spain (IGME) and the Center for Studies and Experimentation of Public Works (CEDEX).

Co-ordinating water policies between levels of government

OECD countries resort to a wide variety of mechanisms for co-ordinating water policies across levels of government (Figure 3.7). These include, for example, the consultation of private actors (including citizens' groups, water users "associations and civil society") and financial transfers and incentives across levels of government (*e.g.* earmarked versus general-purpose grants for financing infrastructure). Other instruments they can consider are co-ordination agencies, contractual arrangements, (multi)sectoral conferences, performance indicators, regulations, shared databases, river basin organisations, regulation and performance indicators, and intermediate bodies. Box 3.4 provides some examples of the use of performance indicators in a number of OECD countries. Some OECD countries have chosen to use all the mechanisms listed above (*e.g.* France, Mexico), while others have adopted none, due to highly centralised water policy and limited involvement of sub-national actors (Korea, Israel).

Figure 3.7. **Vertical co-ordination mechanisms across levels of government**

(17 OECD countries surveyed)



Source: OECD Water Governance Survey (2010).

Box 3.4. Performance indicators in the water sector: Some OECD examples

In **Australia**, the National Water Commission's Biennial Assessment of the implementation of the *National Water Initiative* reports progress in water reform at the subnational level.

In the **Netherlands**, each Water Board uses systems to monitor progress in water policy, such as monitoring water quality and (water) ecology, planning and monitoring of space that is set aside for water retention. The STOWA (institute of Applied Scientific Research) is leading the drive toward standardisation of monitoring systems for water quality, water quantity and ecology. The Union of Water Boards organises a benchmark of the Water Boards every two years, and the benchmark is made public in the publication *Waterpeil*.

In **Belgium**, the Flemish Environment Report (MIRA) has been published since 1994 as an Indicator, Policy Evaluation, Scenario and Forecasting report. It includes trend analysis as a basis for evaluating progress. In addition, the Co-ordination Committee on Integrated Water Policy (CIW) has developed a follow-up system on the regional level for the implementation of *Water Framework Directive* measures. This consists at present of an MS Excel or Access application containing data listing basic information (who, what, when, etc.) as well as data that follow progress (expenses, time schedule, etc.).

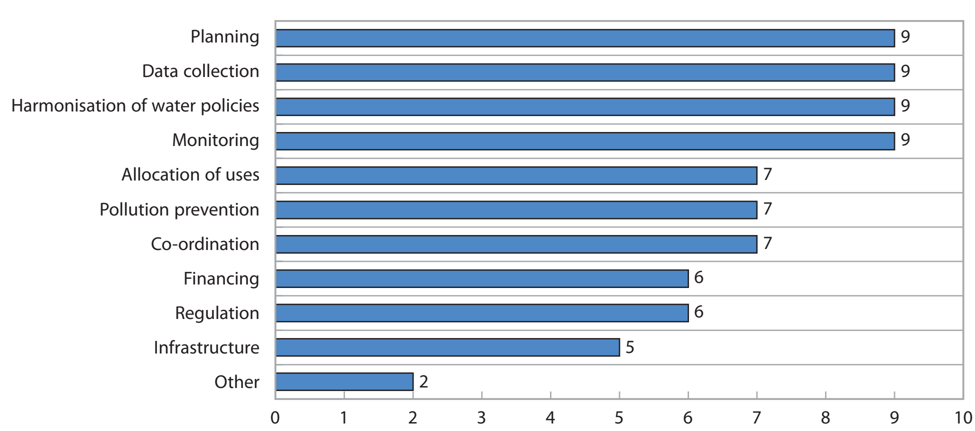
In **France**, the *Contrat d'objectifs Etat-Agences* is a national reporting tool that evaluates water agencies' policies.

In **Arizona**, a *Water Policy Monitoring and Reporting Service* was designed for municipal water resource managers, industry executives, attorneys and those interested in keeping current with the trends influencing the price and availability of water in Arizona.

In **Portugal** since 2004, all water utilities operating under concession contracts have the quality of their services (water supply and sanitation) monitored annually through a set of 20 performance indicators. This water quality regulation will be extended to all water utilities during 2011.

Finally, the **European Union** has also set up a methodology to evaluate water policies within its boundaries.

Figure 3.8. **Missions of river basin organisations in OECD countries**
(17 OECD countries surveyed)



Source: OECD Water Governance Survey (2010).

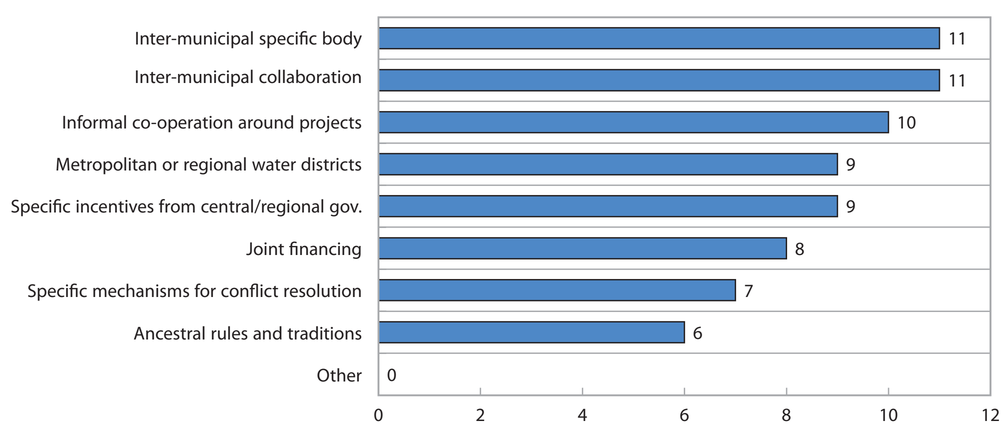
In recent years, river basin management has been proposed as one element for addressing the *administrative gap*, ensuring a holistic and hydrological approach to co-ordinate water policy across subnational actors and between levels of government. On the one hand, the basin perspective makes it easier to integrate physical, environmental, social and economic influences on water resources. On the other hand, the decentralisation of water governance has increased the number of relevant (administrative) boundaries and organisations. In combination with the introduction of basin management, problems of interplay now arise that have not so far been sufficiently addressed by practitioners and by scientific research. Where they exist, river basin organisations are a powerful tool for addressing vertical co-ordination challenges and interactions at the local level, though their missions, constituencies and financing modes vary across OECD countries (Figure 3.8).

Co-ordinating water policies across sub-national actors

In addition to river basin organisations, OECD countries employ a wide range of mechanisms to manage the interface between actors at the sub-national level and to build capacity in the water sector (Figure 3.9). These mechanisms range from inter-municipal collaboration or dedicated bodies to informal co-operation around projects, metropolitan or regional water districts, specific incentives from central and regional governments, joint financing between local actors involved in water policy, as well as the adoption of specific mechanisms for conflict resolution or ancestral rules. Water policy governance in France's *Provence-Alpes-Côte d'Azur* region provides an interesting example of a regional approach to multi-level governance (see Box 3.5) Other tools frequently used in the water sector include training, workshops and conferences as well as experimentation policies at the territorial level.

Figure 3.9. **Managing the interface between sub-national actors in water policy**

(17 OECD countries surveyed)



Source: OECD Water Governance Survey (2010).

Inter-municipal collaboration is widely used in OECD countries to, help subnational governments reach a "critical mass", increasing efficiency, enhancing capacity of subnational governments in water policy and fostering lower horizontal co-ordination (Table 3.9). It helps bridge a number of gaps, including those of capacity, administrative and funding, to meet the substantial financing requirements for the construction, operation and maintenance of water and sanitation infrastructure. Most countries are concerned with the question of "relevant

Box 3.5. **A regional approach to multi-level governance of water policy: The example of the PACA region in France**

Despite the availability of water and the existing infrastructure networks, France's *Provence-Alpes-Côte d'Azur* region has experienced several years of drought. This situation was a result of sporadic water shortages in specific areas and substantial regional disparities in water resources, especially between the coastal areas, where demand is high, and the hinterland. The *Water Resources Prospective and Management Scheme* (SOURSE), launched in 2009, is an ambitious EUR 400 000 project to build by 2030 a strategic vision and operational framework across levels of government (including the state and the *Rhone-Mediterranée-Corse* water agency) and to define the terms for effective water governance at the regional level.

This strategic multi-level and multi-actor initiative, based on wide consultation, aims to ensure access to water for all on a permanent basis, while preserving the state of rivers and groundwater. It develops a model of public governance of water for equitable sharing of water by 2030, taking into account the economic, demographic and environmental evolution of the territory. It is organised under the auspices of the EU *Water Framework Directive* and the French national organisation for the development and management of water resources (the *Schéma Directeur d'Aménagement et de Gestion des Eaux,* or SDAGE) and is mainly funded by the European Regional Development Fund.

The project addresses water challenges throughout the PACA region, over the medium to long term, under three guiding themes, demography, economic development and climate change. It seeks to:

- specify knowledge about water and its various operations, its renewal terms related to the functioning of aquatic environments and the evolution of activities associated with them by 2030;
- identify new proposals for intervention in the region for sustainable management of water resources;
- identify how to direct or to redirect management methods if necessary;
- enhance awareness and involvement of local actors, for a new common and shared governance;
- put the analytical framework into perspective, with potential changes in business lines and territories.

This process involves the regional partners in consultation in each of three steps:

1. Achieving a shared diagnosis, on the basis of six workshops held in the region in the fall of 2009 and the first restitution workshop seminar held in December 2009;
2. A forward-looking phase, to define and analyse a combination of plausible scenarios for water policy by 2030. Its achievement was mainly based on a working group that met in three succeeding stages between November 2010 and January 2011 and was completed by workshops conducted on six areas of the SOURSE.
3. Formalisation of the project by developing strategic directions a critical phase of the process, which will transform the strategic stakes in the decision-making processes into quantitative targets and organisational terms for governance at the regional level.

In addition to the project and its various components (strategic, operational and multi-actor governance system), one of the goals of this phase is to produce a charter of commitment to the *Principles of Shared Water Resources.* This charter will be presented and signed at the Regional Water Forum (*Etats généraux de l'Eau*) that will conclude the Regional Year of Water in February 2012. This will prepare for the World Water Forum, to be held in Marseilles in March 2012, a large-scale celebration of this partnership, which has mobilised all water stakeholders in the territory for more than two years.

Source: OECD Water Governance Survey, 2010.

municipal scale" for public services. The issue of a "perfect size" in water management has been a long-standing topic of debate over economic and public finance. The key question is whether an optimal size can be identified that would allow both optimal conditions for efficient water resources management and effective service delivery. However, detecting the presence of economies of scale at the municipal level and identifying an "optimal," or "perfect," size is difficult and varies greatly across countries.

Table 3.9. **Tools and strategies for addressing multi-level governance gaps in metropolitan areas**

Gap	Metropolitan context	Tools and Strategies
Accountability gap	The failure to demonstrate adherence to capital plans for water and sewage infrastructure through publicly available audited financial statements It also raises the issue of transparency and institutional quality at the metropolitan level	• Consultation processes • watershed committees • collaborative planning processes, watershed partnerships • public participation • strictly enforcing bid validity and contract negotiation periods • ensuring good record-keeping • reviewing bids for unusual patterns • integrity pacts • using probity advisors and auditors • registering complaints • strengthening bid evaluation teams and regulatory scrutiny of major investments • accounting controls through regular external (financial) audits
Administrative gap	Geographical "mismatch" between hydrological boundaries and geopolitical/administrative boundaries	• aligning institutions with hydrological boundaries • performance-based contr • •partnerships established between the national level and the local level, integrating water sensitivity into urban planning and growth-management strategies
Capacity gap	"Local" water management actors have insufficient expertise, knowledge and infrastructure to effecti apply water policy	• interagency collaboration on information-sharing • consolidation of urban water utilities
Funding gap	Unstable or insufficient revenues undermine co-ordinated governance	• traditional financial transfers between levels of governments (whether these are earmarked or non-earmarked grants) • the attraction of a broader range of sources of finance, such as loans, bonds and private investors
Information gap	Lack of access to sufficient scientific/technical information, depriving policy makers of a common frame of reference	• monitoring and evaluation of water-related goals • establishment of online sources of historical data on water resources and quality • establishment of benchmarks to evaluate fresh water quantity or quality within municipal urban plans • accords to improve environmental data
Objective gap	The adoption of convergent water-policy making targets in a metropolitan area by different stakeholders	• jointly used plants • shared water resources • countywide or national associations of utilities • joint procurement systems • joint training • pooling of common equipment • joint lobbying to legislative
Policy gap	Jurisdictional fragmentation of water-related tasks amongst government ministries, agencies and non-governmental actors hinders integrated policy development	• multi-stakeholder water governance partnerships • advisory collaborative bodies • multi-stakeholder "learning networks" between government, community, industry and researchers • regional assemblies, power-sharing instruments • interministerial co-ordination

Governance instruments for managing mutual dependencies in the water sector at horizontal and vertical levels reveal a wide variety of mechanisms in place across and within OECD countries. No governance tool can offer a panacea for integrated water policy, and no systematic one-to-one correlation exists between tools and gaps. A given tool can solve several gaps, and solving a specific gap may require the combination of several tools. Measuring the degree of performance of such governance tools or assessing their impact on the efficiency, equity and sustainability of water policy would require more in-depth and specific work at national, sub-national and basin levels in selected OECD and non OECD countries.

Moving forward on meeting the water governance challenge

The discussion in this chapter has focused on the governance challenges presented by the multi-level and relatively fragmented nature of policy making in the water sector, and the resulting co-ordination gaps in designing and implementing effective governance arrangements. In order to move forward on addressing the multi-level governance challenges, the OECD has proposed a tentative set of guidelines that are intended to serve as a tool for policy makers to diagnose and overcome multi-level governance challenges in the design of water policy (OECD 2011c). These guidelines can help enhance the prospects for crafting successful water reform strategies in the future. They are intended as a step towards more comprehensive guidelines that may be built on in the future, based on in-depth policy dialogues on water reform with countries and recognised principles of water policy, economic bases and good governance practices.

- ***Diagnose multi-level governance gaps in water policy making across ministries and public agencies***, between levels of government and across subnational actors. This will help clearly define roles and responsibilities of public authorities. Beyond the *what,* policy makers need to focus on the *how*, which requires the identification of possible overlaps in the allocation of roles and responsibilities, asymmetries of information, sectoral fragmentation of water-related tasks, insufficient knowledge, unstable or insufficient revenues at all levels of government, possibly conflicting objectives, as well as accountability concerns undermining the transparency of water policy making. The *Multi-level Governance Framework*, organised around seven categories of "gaps", can be a useful diagnostic tool for policy makers in this exercise.
- ***Involve sub-national governments in designing water policy***, beyond their roles as "implementers" and allocate human and financial resources in line with responsibilities of authorities. Regional and local actors are already key players in OECD countries' water policy implementation. But they can also play a crucial role in identifying policy complementarities and synergies at the local level. They are the most likely to understand local needs, territorial challenges and engage relevant interlocutors. Whenever possible, discretion should be accorded to the local level for implementation of integrated management. Only when solutions cannot be realised at this level should consideration be given to the next level in the hierarchy, *i.e.* the regional, state or national level. The need often arises to co-ordinate planning and management between agencies and areas at the national or international level. Caution is also necessary with the process of "total" decentralisation of water governance. Basin-level management, for example, may require national or international governance to avoid inequities in water allocation within a water basin and also ensure that the public good aspects and values of water are given sufficient recognition. Strategic planning and incentives for policy coherence at all levels can actually limit local "capture" and specific "vested" interests may compromise integrated policy.

- ***Adopt horizontal governance tools to foster coherence across water-related policy areas*** and enhance inter-institutional co-operation across ministries and public agencies. Integrated water policy requires platforms for dialogue and exchanges between policy makers at central government level. The process of integration should be ensured through the establishment of highly visible inter-ministerial and inter-departmental councils and committees, with responsibility to ensure substantive dialogue and co-ordination. These bodies could also be responsible for final negotiation and bargaining, together with performance evaluation on the achievement of integrated management of natural resources. They need to be designed coherently, be consistent with the institutional organisation of water policy, and offer high-level political commitment for ambitious water policy reforms.
- ***Create, update and harmonise water information systems and databases*** for sharing water policy needs at basin, country and international levels. Assessing the effectiveness of water information systems and databases in bridging the information gap is a difficult task. It requires conducting a cost-benefit analysis at local, regional, national and international levels, to determine how current water information and data are collected and used by policy makers, and the costs and benefits of collecting, analysing and communicating this information. Increased efforts are needed to communicate messages from the reporting and analysis of water data to policy advisors and the wider public. That also implies assessing institutional obstacles and opportunities by identifying areas of institutional overlap and synergies in water data collection; mobilising local stakeholders when designing water information systems; fostering co-ordination between data producers and users; and encouraging multi-disciplinary approaches.
- ***Encourage performance measurement to evaluate and monitor the outcomes of water policy at all levels of government.*** The diversity of tools in place shows that there is no optimal design for an indicator-based performance measurement system in the water sector. Its development should be a collaborative effort between the national and sub-national level and agencies, and the information it yields ought to cover inputs, processes and outputs that are relevant for ongoing activities. For such information to be used in an effective fashion, clear objectives for the data need to be established and proper indicators selected. Systems are needed that can generate, validate and distribute the data; the information must be used in an appropriate and timely fashion; incentive mechanisms can be considered to encourage actors to follow a particular course of action; and strategies for how the performance information will be used – whether "benchmarking" or "bench learning" – should be planned for.
- ***Respond to the fragmentation of water policy at the sub-national level by facilitating co-ordination across sub-national actors and between levels of government***. River basin management, inter-municipal co-operation and co-ordinated bodies at local and regional levels can help bridge co-ordination gaps, ensure a holistic and hydrological approach to water policy and create critical mass for water investment at the territorial level. Coherence involves both water resources and water uses (for urban or rural areas) for an integrated hydro-institutional system throughout the water cycle. Such tools need to be backed up by scientific, institutional, economic and financial information, a clear definition of their roles and functions, strong advocacy for their effective use as well as a co-ordination of their actions when they are used simultaneously.
- ***Foster capacity-building at all levels of government.*** This implies combining investment in physical water and sanitation "hard" infrastructure with the provision of "soft' infrastructure, which is essentially the institutions upon which water outcomes

rely. The development of skills, technical expertise and knowledge and the availability of staff and time are preconditions for effective governance of water policy. Often, policy makers focus on the construction and maintenance of water networks, offering a "technical" response to water challenges. This has proved to be insufficient to face climate change, risk management (floods, droughts) and cross-border issues in the water sector. Institutional strengthening and capacity-building at all levels is crucial for effective water policies in response to the challenges of the 21st century. In the context of fiscal and budgetary constraints, such capacity building is a prerequisite for channelling limited financial resources most effectively, in both developed and developing countries.

- ***Encourage a more open and inclusive approach to water policy making through public participation in water policy design and implementation.*** Public participation should be encouraged both in the planning process and in critical reviews of implementation, and would highlight areas where further integration is required. Broader involvement of citizens, interested parties and non-governmental organisations (NGOs) is also vital for successful integrated water policy design and implementation. Widening public participation is a means to increase transparency of environmental policies and encourage citizens' compliance with it. Transparency in establishing and implementing goals and reporting standards is an important way to empower citizens and influence the direction of environmental protection.
- ***Assess the effectiveness and adequacy of existing governance instruments for co-ordinating water policy at horizontal and vertical levels.*** To be relevant and credible, the assessment of water governance arrangements has to be conducted within a policy dialogue, at the scale of a given territorial area (national, rural, urban, basin or cross-border), and in the light of current, past and future reforms in the water sector.

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Chapter 4

Meeting the water coherence challenge

The water sector is not always master of its own fate. Policies in other areas such as agriculture and energy can have a significant impact on the economic, social and environmental sustainability of the water sector. The nexus between water, energy, food and the environment has been attracting increasing attention in recent years, and presents significant challenges for water policy reform efforts. The importance of water in energy production and use (such as for hydropower, thermal power stations, biofuels) is matched by the importance of energy in water (through pumping and transfer of water, desalination). Similarly, water and agriculture are inextricably linked, not least because agriculture accounts for around 70% of water sue globally. Increasing the coherence of policies across these areas is essential if governments wish to meet the range of policy goals while not undermining the sustainability of the water resource base. This chapter examines the coherence issues raised by the linkages between water, energy and agriculture and presents a number of steps that governments need to take to address the water coherence challenge.

Introduction

The third fundamental area of water policy reform addressed in this report relates to policy coherence. The policy coherence challenge arises as a result of the fact that the water sector is not always master of its own fate. Policies in other areas such as agriculture and energy can have a significant impact on the economic, social and environmental sustainability of the water sector. The nexus between water, energy, food and the environment has been attracting increasing attention in recent years, and presents significant challenges for water policy reform efforts. The policy recommendations from the recent Bonn Conference on the Water Energy Food Security Nexus emphasised the need to "ensure the interdependency between water, energy and food security is explicitly identified in decision-making within and across all levels to realise the potential for mutually beneficial action and avoid conflicting policy objectives and unintended consequences" (Bonn Conference 2011).

The importance of water in energy production and use (such as for hydropower, thermal power stations, biofuels) is matched by the importance of energy in water (through pumping and transfer of water, desalination). Similarly, water and agriculture are inextricably linked, not least because agriculture accounts for around 70% of water sue globally. Increasing the coherence of policies across these areas is essential if governments wish to meet the range of policy goals while not undermining the sustainability of the water resource base. From a governance perspective, this means ensuring vertical and horizontal co-ordination across end between levels of government and addressing the whole life cycle of water policy across fields of public policy to foster an overall strategic approach and deliver effective, efficient and sustainable policies. Achieving this outcome requires strong mechanisms, tools and processes to manage and co-ordinate policy, budgeting and regulatory development but also high political commitment and leadership, cultural changes, monitoring and learning from international experience and evidence.

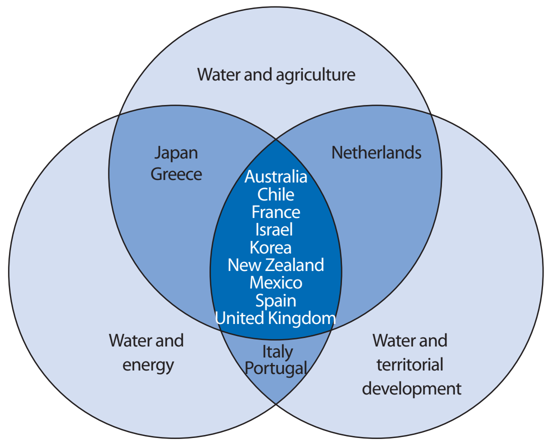
This chapter examines the coherence issues raised by the linkages between water, energy and agriculture. It builds on the outcomes of the OECD work on governance in examining the areas where the policy areas overlap and require significant co-ordination. The chapter focuses in particular on those inter-linked areas where there is significant policy attention, and provides policy guidance for how to address tensions between the policy priorities. It looks first at the governance arrangements in the water and agricultural spheres, and then considers the water-energy and water-agriculture linkages in turn. One of the key outcomes of the analysis is that further work needs to be done as the information base is still relatively poor for decision making in this important area.

Framing the coherence challenges

Policy coherence is a general term that refers to the systematic promotion of mutually reinforcing actions on the part of governments. It underscores the fact that better water governance is critical to fostering inter-institutional mechanisms for horizontal co-ordination and encouraging synergies and complementarities between different policy fields related to water. In particular, there is a need to ensure that there is a framework for the explicit or implicit sharing of policy-making authority, responsibility, as well as related implementation and co-ordination challenges at central government level, *i.e.* across different ministries and/or public agencies.

The previous chapter provided an extensive review of the multi-level governance challenges facing governments in the water sector. It highlighted the fragmented nature of the governance arrangements and the range of co-ordination gaps that arise as a result. The water governance survey also helped to provide an overview of the linkages between key policy areas. As can be seen in Figure 4.1, a number of the OECD countries surveyed have taken steps to improve horizontal co-ordination, or at least acknowledge it as an issue.

Figure 4.1. **Horizontal co-ordination across policy areas**



Source: OECD (2011, p.84).

Governance arrangements and trends in the energy and agricultural sectors have an important influence on progress towards policy coherence around water. The strong emergence of environmental issues in the energy and agricultural sectors has led to policy overlaps and an increasing need for policy co-ordination between sectors. At the same time, the increasing attention been paid to governance issues in the energy and agricultural sectors offers an opportunity for better articulating, institutionally, policy co-ordination and coherence around water management. On the other hand, improved policy coherence is undermined by differences in policy development and implementation frameworks – diverging multi-level governance arrangements in the case of energy and water, and differences in spatial and temporal time frames in the case of agriculture and water. Efforts to increase policy coherence need to take also into account the energy and agriculture sectors are experiencing a trend towards decentralisation of policy implementation that may favor the emergence of policy coherence at sub-national levels.

The current institutional complexity around water management makes it difficult to achieve policy coherence. While there is great diversity in institutional set-ups, water management in OECD countries is commonly characterised by institutional complexity. Regulatory functions are in some cases carried out by ministries, in others by specific regulatory agencies, and in others by other specific actors at national level. In all OECD countries surveyed for this report, there are multiple actors involved in water policymaking and regulation – as many as 15 in some cases – and in half of them the set of actors involved goes beyond the traditional lead ministries. Over the past decades there has been a trend towards increasing the number of actors – both local and supranational ones. The large and increasing number of actors involved favors the emergence of "silo approaches", divergent views, and co-ordination failures around water management.

Most OECD governments have engaged efforts improve institutional co-ordination between water and other policy areas. These efforts include high political commitment, joint action of ministries and agencies at sub-national level, sound legislative mechanisms, and regular meetings of relevant stakeholders. The many governance tools tested generally aim to create a framework for combining tools, funds and organisations – most often through inter-ministerial commissions but also through multi-sectoral conferences and inter-agency programmes among others.

Governments need to design home-grown solutions by combining the available governance tools. There is no "panacea governance tool" that can offer a comprehensive solution to the challenge of policy coherence between water, energy and agriculture, as solutions need to have a "good fit" with local governance and norms. Yet, there are a number of governance tools that have already proven useful and that should be considered in any "policy menu". The key examples include those mechanisms aiming to increase transparency and flexibility, providing early warnings of incoherence, and facilitating dialogue and dispute-solving.

There is a strong need to put in place incentives for institutional cooperation within a comprehensive governance improvement strategy. The absence of those incentives currently represents the most important obstacle for improved horizontal co-ordination. Other major obstacles include difficulties in implementing central government decisions at sub-national level, overlapping and unclear allocation of responsibilities, and the interference of lobbies. Additional obstacles include the lack of high political commitment and leadership in water policy, and the absence of strategic planning and sequencing of decisions. Given that all these obstacles are interrelated and exacerbate each other, they need to be tackled together.

Greater attention needs to be paid to the institutional capacities to promote and implement coherent policy approaches. This will require in particular strengthening the capacities of the institutions in the three sectors for better integration and joint planning, giving more careful consideration to the cumulative and inter-related impacts of water policies as well as institutional and regulatory regimes, and moving towards a more coherent set of policy instruments.

Impacts of governance in the energy and agriculture sectors on water governance

Both the energy and agriculture sectors have been experiencing policy overlaps as well an increasing need for policy co-ordination. Those two trends are particularly, although not exclusively, due to the emergence of environmental issues. In the case of the energy sector, this is primarily related to climate change concerns, and in the agricultural sector to biodiversity concerns. The emergence of environmental issues as a policy driver has also had impacts on institutional settings, with many countries creating ministries that combine energy and environment or agriculture and environment.

The increasing attention paid to governance in the energy and agricultural sectors may help in achieving greater policy coherence around water. In OECD countries, increasing attention is being paid to governance issues as it becomes more difficult to overlook the fact that policies are developed and implemented within a particular governance context. In developing countries, attention has been paid to governance issues for quite some time, but governance reforms have been slow. Increasing attention to governance and governance reforms offers an opportunity for better articulating, institutionally, policy co-ordination and coherence around water management. At the same time, there may be a risk that the efforts absorbed by internal governance reforms leave less time, resources and disposition for entering into cross-sectoral co-ordination.

On the other hand, differences between sectors as regards policy development and implementation work against improved policy coherence. In the case of energy and water, diverging multi-level governance arrangements in the two sectors often add complexity. While in many countries water regulation has been pushed towards sub-national jurisdictions (municipal and state water governments), the majority of energy regulation and investments remain within the power of federal or national agencies. In the case of agriculture and water, differences in spatial and temporal time frames in the two sectors demands an approach to governance capable of operating both inside and outside the spatial frame of the farm and water catchment, and able to deal with the dynamic temporal relationships between water and agricultural systems (Fish *et al.* 2010).

Efforts to increase policy coherence between water, energy and agriculture need to take also into account the energy and agriculture sectors are experiencing a trend towards decentralisation of policy implementation. We have mentioned above that implementation (including compliance monitoring and enforcement) of energy policies will increasing be taking place at the regional or municipal level, and that there is a move towards more decentralised governance in irrigation management. This trend will favour the emergence of policy coherence at the sub-national levels, providing opportunities for better co-ordination for actors at the municipal, river basin or provincial level. This trend is also likely to generate changes in legal frameworks so as to the better define the roles of the different actors, thus providing opportunities from actors mapped primarily to other sectors to find a channel to legitimately enter into sector policy discussions.

The current governance challenges in the water, energy and agricultural sectors suggest the need to adopt practical approaches to improving policy coherence. At first sight, the water-energy-food nexus would seem to demand a "triangular approach" to improving policy coherence. However, there is a strong risk that aiming for full policy coherence simultaneously across the three domains will slow down progress. A more practical approach would be to aim for "triangular" progress in those key issues where all the three sectors have a major intersecting influence and, for the other issues, focus the efforts on achieving "bilateral" progress between the most relevant sectors.

Linkages between energy, water and the environment

The nexus of water and energy is important and pervasive. Humans are depleting fossil energy resources and consuming or degrading water supplies faster than alternatives are coming online. There are also renewable energy and water resources that do not deplete over time, but have limited flows that restrict their use temporally or geographically. As countries confront water resource constraints, their arsenal of policy options has typically included energy-intensive solutions such as long-haul transfer and desalination. The corollary is also true: many countries address energy constraints with water-intensive options such as steam-cycle power plants or biofuels.

However, this approach, whereby water planners assume they have all the energy they need and energy planners assume they have all the water they need, is not likely to work effectively in the future. In order to optimise the consumption, conversion, transfer and use of precious water and energy resources, governments would benefit from implementing policies that enable coherence between these two commodities. By contrast, countries that deploy incoherent policies might find themselves with severe scarcity of one resource or the other, or both.

Options to increase water security often have energy security costs. New sources of freshwater require vastly more primary energy. From desalination to long-haul transfers, making and conveying potable water from these sources takes energy to heat the water, remove dangerous microbes, force the untreated water through membranes and filters, and then move it to the point of end use. Growing populations and depleting water supplies are pushing many countries to the boundaries of technologies for providing new freshwater supplies, only to find that their constrained water situation only exacerbates their energy constraints. In addition, water efficiency improvements are in some cases made at the expense of energy efficiency. For example, efforts to reduce water consumption at power plants are accompanied by the tradeoff of increased costs and lower power efficiency, also resulting in higher greenhouse gas emissions.

Water is a critical aspect of meeting future energy demands. In the central scenario of the 2010 World Energy Outlook, world primary energy demand increases by 36% between 2008 and 2035, with demand increasing for each fuel and fossil fuels accounting for over one-half of the increase (IEA, 2010). Almost every alternative to crude oil as a source of liquid fuels for transportation withdraws and consumes more water while often exacerbating challenges to water quality. Water is also a critical aspect in meeting climate goals. Carbon capture and storage requires, in addition to extra energy from the power plant itself, water-cooling. Biofuel and bioenergy production, another important element of climate change mitigation mixes, relies to a large extent on agricultural feedstocks. As it is the case with the energy intensity of water services, the water intensity of energy services depends on geographic location and has been decreasing over time thanks to innovation.

Key water-energy linkages

Water for cooling thermoelectric power plants

Thermoelectric generation requires water to mine, process, and convert primary fuels into electricity, and these operations impact and depend upon local water resources. For thermoelectric power plants to operate reliably they usually require consistent and sufficient access to a significant amount of cooling water. In the United States (US), the thermoelectric power sector withdraws 49% of all water and 41% of freshwater (more than any other sector), but only consumes 3% of freshwater (Kenny *et al*., 2009; Solley *et al*., 1998). There are large differences in water use for cooling. This is true even within specific cooling technologies, due to power plant design, fuel, efficiency, and operating conditions (Twomey and Stillwell, 2009). The water withdrawal of power plants can vary considerably from below 300 L/MWh to over 3 000 L/MWh, even among similar types of generation with similar cooling technologies

Water shortages and heat waves have already had detrimental impacts on electricity reliability, especially in drought-prone and water-scarce regions of the world. Periods of drought increase the risk of electricity supply interruptions from generators that require water for operations. Unfortunately, water supplies are often most constrained during the summer months when ambient temperatures are highest, which is also when electricity demand is greatest in many regions. Drought severe enough to limit water use by electricity generators that need the water can force facilities to reduce generation or shut down. Heat waves can also affect power plants because higher temperatures limit the cooling effectiveness of the water source, and can push power plants up against environmental limits (specifically, thermal pollution limits for water that is returned from the power plant). Hydropower has been compromised due to water shortages associated with dry climate and drought in many regions of the world. Water supply constraints have also limited the development of new water-intensive generation in very dry regions (Feeley III *et al*., 2008).

The increasing water demands and environmental protections have induced technological changes in power plant cooling. Power plants constructed over 50 years ago almost exclusively used open-loop cooling designs that withdraw water at high flow rates and return the heated water back to the environment. Water was perceived as abundant, and environmental regulations were practically nonexistent. During the 1960s and 1970s environmental concerns about water increased. These concerns led to increased pressure on the claims that existed for most water in the large rivers and reservoirs. Thus, new power plants were forced to innovate new designs that withdraw less water, leading to the widespread implementation cooling towers for many new power plants. In the US, 42% of large power plants use wet recirculating cooling towers, 15% use cooling ponds, 43% use once-through cooling, and only 1% use dry-cooling (NETL, 2008). Once-through cooling systems operate as often as closed-loop, but once-through designs are being phased out for new plant sites in the United States due to ecosystem impacts, regulations and water availability limitations (CASLC, 2006; Sweet, 2010). These once-through systems can harm marine ecosystems when aquatic life get trapped in intake structures and disturbed by the higher water temperatures of the discharge (Tchobanoglous and Schroeder, 1987).

Technological innovations cannot solve all the concerns. The closed-loop designs employed by cooling towers serve many environmental interests by greatly reducing the entrainment of aquatic wildlife in intake structures and preventing the artificial heating of aquatic environments. One drawback, however, is that even though cooling towers withdraw less water than open-loop cooling, they consume more.

Water impacts of hydropower and other renewable electricity

Hydroelectricity provides the largest share of non-thermoelectric generation, accounting for 15% of worldwide generation. The water use implications of hydroelectric power differ significantly from thermoelectric generation since it does not withdraw or consume water for cooling. Instead, hydroelectric facilities use the force of gravity to pass water through turbines to generate electricity.

Hydropower is often a highly water consumptive technology. Although hydropower does not require water for cooling like thermal generation, large volumes of water evaporate from the surface of reservoirs behind dams. In some cases, this increased evaporation is several times larger than the evaporation associated with thermal power plant cooling. However, the increased evaporation from the additional surface area of the reservoirs varies significantly globally based on climatic conditions. And, because reservoirs often have multiple purposes (*e.g.* recreation, navigation, flood control, water supply) in addition to hydropower, attributing all reservoir evaporation to power production is often dubious.

The construction of the dams and reservoirs creates greenhouse gas emissions. Although electricity at hydropower facilities is produced with almost no greenhouse gas (GHG) emissions at the point of generation, some contend that they release notable amounts of methane (Whittington, 2007), and their environmental and water quality impacts can be significant. In particular, greenhouse gas emissions are associated with the anaerobic decomposition of organic matter that is submerged during the creation of reservoirs and from the embedded energy in the construction of the dam.

Conventional hydropower development through dam building often significantly alters river ecosystems. As a result, the new construction of large dams is contentious in most OECD countries. Therefore, efforts to identify opportunities for increasing hydropower generation have focused on smaller-scale opportunities (“small hydro”) or improved efficiency and expansion of hydropower at existing facilities through uprating processes. However, hydroelectricity development is expanding in many areas of the world; 157 GW of additional hydroelectric capacity was planned in 2008 worldwide, over 80% of which was planned in Asia (Sternberg, 2010). The Three Gorges Dam in China, the largest hydroelectric dam in the world, is expected to reach a generating capacity of 22 GW when it reaches completion in 2011 (Sternberg, 2010). Large-scale hydropower capacity additions are also underway in India, Iran, Turkey, and Brazil.

Hydropower facilities also induce temperature impacts on the environment. The entire aquatic environment around a dam is changed from the pre-dam condition causing temperature changes above and below the dam. Aside from a long length of the river that is subsumed, the species that live in the free flowing river must migrate away from or adapt to the now stagnant lake that varies in temperature from warm to cold from the top to the bottom of the water column.

The water use implications of non-hydropower renewable electricity generation vary widely across technologies. Distributed renewable electricity technologies, such as wind turbines and solar photovoltaic (PV) panels, do not use thermoelectric processes and have minimal water requirements for electricity generation. These systems require small volumes of water for cleaning, but otherwise use no water directly for generation, though water is used in manufacturing equipment for these systems. Other types of renewable technologies such as the most common concentrating solar power (CSP) designs, enhanced geothermal, and biomass powered-plants use conventional thermoelectric processes to convert heat into electricity raising the same water use concerns as thermoelectric power plants using traditional fuels.

Concerns over water issues are leading to the adoption of dry cooling in CSP. Many solar developers favour CSP over PV because CSP systems readily achieve utility-scale and easily couple to thermal storage technologies and natural gas turbines that allow facilities to more consistently produce electricity during the day and into the night hours (DOE, 2009b).

Enhanced geothermal systems require injecting large volumes of water to exploit the dry hot rock. Geothermal power plants utilise naturally-occurring convective hydrothermal sources inside hot rock to create steam and generate electricity. However, the majority of the global geothermal resource is dry hot rock that does not contain adequate water to recover the embedded thermal energy that is necessary to run steam-powered turbines. Thus, an external water supply is necessary to use this worldwide geothermal resource. The injected water absorbs the geothermal heat and is pumped to the surface to power the steam cycle. The same water volume is then injected back into the rock to form a closed loop system.

Electricity from biomass energy requires water for combustion and non-combustion purposes. Electricity generation from combustion of renewable biomass requires similar cooling water use as coal- and nuclear-fuelled thermoelectric facilities (Twomey and Stillwell, 2009). Volumes of water allocated for non-combustion purposes vary widely depending on what type of feedstock is used, where it is harvested, and whether or not it requires irrigation. Some biomass sources, such as forest trimmings and pulp and paper industry waste, use only natural precipitation for biomass growth. In contrast, dedicated energy crops and crop residues often come from irrigated lands with large volumes of human-applied water in addition to natural precipitation. However, these dedicated energy crops and residues are also targeted for liquid transportation fuel production, so it is not obvious how to allocate the water requirements (see additional discussion of the water requirements for biomass below).

Water impacts of liquid fuels[1]

The water demand for irrigated biofuels is very high compared to conventional transportation fuel sources, although highly dependent on regional differences. Given that (when measured in calories) the global energy market has twenty times the size of the food market, even low percentages of biofuels in the total energy mix will have a major impact on water availability (and, as a result, on food security). Non-irrigated biofuel feedstocks also cause water quantity concerns. Biomass agriculture and biofuels production need to be well-integrated into a broader water resource management perspective. Both irrigated and non-irrigated biofuel feedstocks need significant amounts of water for evapotranspiration (ET) during photosynthesis. This ET from natural water is sometimes included in analyses of water consumption, and often termed the green water footprint (Gerbens-Leenes *et al*., 2009). Thus, there are still water concerns for biofuels that are not irrigated, and the change in ET from a previous land use to biofuel feedstock agriculture must be considered for water resources management. Second and third generation biofuels, such as lignocellulosic harvest and forest residues as well as dedicated lignocellulosic crops, present opportunities to decouple irrigation from biofuels and significantly reduce water demand for feedstocks, but the feedstocks still consume water via ET of precipitation (Gerbens-Leenes *et al*., 2009; King and Webber, 2008; Lapolaa *et al*., 2009).

Water concerns about biofuels include as well the water quality dimension. Increased production of biofuels can increase water pollution marked by increases in nitrogen and phosphorus agricultural chemical concentrations and hypoxia in surface waters draining from farmland. This increase in nutrient loading from crop production has contributed to the growth of the large hypoxic areas, or “dead zones” in coastal seas. Nevertheless, water quality concerns related to biofuels are lower than those related to oil and gas production (conventional or unconventional).

Water demands for upstream oil and gas production often do not raise the same concerns as biofuels related to water quantity, but they can have similar or worse water quality concerns. Whereas the oil and gas industry often injects large quantities of water into hydrocarbon reservoirs to stimulate production during secondary recovery, this water is often saline and not drawn from fresh surface or groundwater. For example, because United States shale gas production via fracturing is occurring in some urban areas and relatively close to some freshwater aquifers, concerns have arisen regarding competition for water quantity during production and concern for water quality during disposal of fracturing fluid water (Soeder and Kappel, 2009; Ground Water Protection Council, 2009; Verrastro and Branch, 2010; Grubert and Kitase, 2010).

Refineries can have significant local water quantity impacts. The processing and refining step of both petroleum and unconventional petroleum (*e.g.* oil sands) tend to consume similar quantities of water in the range of 1-3 L H2O per L of fuel product (Gleick, 1994). For corn-starch based ethanol, the water consumption is slightly higher at 3-6 L H2O per L of product (Keeny and Muller, 2006; King and Webber, 2008; Wu *et al*., 2009), and for sugar cane ethanol in Brazil, higher still at 12-24 L water per L ethanol.[2] Thus, while the water per liter of fuel might not seem high, the size of biorefineries necessitates the consumption of hundreds of millions of liters per year for a single point source location, creating potentially significant local impacts (Keeny and Muller, 2006).

Impacts of water treatment, distribution and use on energy demand

Collection, conveyance, treatment, distribution, and heating of water for public water supplies consume large quantities of energy usually in the forms of electricity and natural gas. This energy consumption for water varies with distance to the water source, existing water quality, water treatment standards, distribution system terrain, and end-use of water. Moving water requires energy, except in locations where geographic terrain allows for gravity-fed systems. Pumping water long distances, uphill, or from deep aquifers usually requires more energy for water collection than use of local surface water sources for drinking water. Use of groundwater for drinking water requires energy for well pumping, which increases with depth to the water table: pumping from a depth of 37 m requires 0.14 kWh/m³ while pumping from 122 m requires 0.53 kWh/m³ (Natural Resources Defense Council, 2004).

Use of alternative water sources can dramatically increase energy consumption for drinking water treatment. As shown in Table 2.3, desalination of brackish groundwater or seawater can increase energy for water treatment by a factor of 6 to 27 over use of local surface water supplies (2004; Goldstein and Smith, 2002; King *et al*., 2008; Klein *et al*., 2005; Stillwell *et al*., 2009) – although this factor is decreasing as new technologies are developed. Despite these large energy consumption consequences, various municipalities worldwide turn to desalination after drought or other circumstances have strained existing water supplies.

Much embedded energy is wasted by irrigating lawns and operating toilets using high quality drinking water. After source water is collected, water in industrialised countries is typically treated to achieve minimum health standards. Though only a small portion of the water leaving a water treatment plant typically ends up being used for drinking, all water produced by drinking water treatment plants is generally required to meet pertinent government drinking water standards. Standard water treatment employs physical and chemical treatment processes to remove contaminants. Depending on the water source, groundwater treatment can require little more than chemical disinfection due to the natural filtration characteristics of soil.

Water distribution is a major of consumer of energy. After source water has been treated to acceptable health standards, the treated water is then distributed to residential, commercial, and industrial users. In the United States pumping treated water in distribution systems is an energy-intensive step that typically represents 85% – approximately 28 billion kWh (Goldstein and Smith, 2002) – of the total energy consumed during the water process (*i.e.* collection, conveyance, treatment, and distribution) (Goldstein and Smith, 2002). Additionally, aging water distribution infrastructure increases the energy required to deliver drinking water because of losses that arise from leaks and friction on the distribution pipe walls.

Wastewater treatment offers significant opportunities for energy savings. Following water use by residential, commercial, and industrial customers, adequate sanitation of wastewater is required to protect human health and the surrounding environment. Wastewater treatment requires more energy than conventional surface water or groundwater treatment since wastewater facilities employ physical, biological, and chemical treatment operations that process both solid and liquid waste (see Table 4.1).

Water recycling is also energy-intensive. After wastewater has been sufficiently treated, the effluent water can be further treated for direct or indirect reuse of water. For water reuse as a drinking water supply, energy-intensive membrane treatment is usually required after advanced wastewater treatment operations to ensure removal of disease-causing agents and other contaminants.

Table 4.1. **United States national average values of energy for wastewater treatment increase as effluent quality increases**

Wastewater Technology	Energy for Wastewater Treatment (kWh/million L)
Trickling Filter	250
Activated Sludge	340
Advanced Treatment without Nitrification	400
Advanced Treatment with Nitrification	500

Source: Goldstein and Smith (2002).

Coherence between water and energy policies: Policy objectives and technological options

Countries have different policy objectives related to energy and water resources and services. Some of the most relevant and universal objectives for the energy-water nexus include:

- *Ensuring water availability.* This relates to efforts that increase freshwater supply, reduce freshwater consumption for the same level of service (efficiency), or conserve freshwater consumption in aggregate (conservation).
- *Protecting water quality.* This *relates* to efforts to mitigate impacts from human activity that alter the ambient natural aquatic environment due to, but not limited to release of total dissolved solids, unnaturally warm or cold water, dissolved gases, and dissolved nutrients.
- *Increasing energy security.* This relates to efforts that increase energy supply, reduce energy consumption for the same level of service (efficiency), or conserve energy consumption in aggregate (conservation).
- *Mitigating climate change.* This relates to efforts that reduce or avoid anthropogenic greenhouse gas (GHG) emissions in aggregate or sequester carbon from the atmosphere.

A variety of technological options are available for countries to pursue water and energy policy objectives independently. Table 4.2 summarises different technological solutions and the policies that enable their widespread adoption. Note that the indirect economic effects involving supply and demand feedbacks from pursuing the listed policies and technologies impact of these policies or technologies on water or energy prices and demand are not represented. For example, desalination is a technology that, if pursued as a part of policy for providing potable water supply, is intended to *increase* the secure supply of freshwater for higher consumption, typically at a higher price required to pay for infrastructure and energy consumption. In reality, because the energy and monetary costs of desalinated water are higher than conventional surface and groundwater supplies, higher prices for water desalinated water might deter increased consumption per capita while aggregate consumption may go up or down.

Different technologies impact water and energy policy objectives in different ways. For each policy objective, a given technology may *(i)* help to achieve the policy objective, *(ii)* hinder achievement of the policy objective, *(iii)* imply choices and tradeoffs that make its effect upon the policy objective site-specific or unclear, or *(iv)* have no appreciable impact on the policy objective.

Table 4.2. **Impacts of different technologies on water and energy policy objectives**

Technologies	Policy objectives			
	Ensuring water availability	Protecting water quality	Increasing energy security	Mitigating climate change
Low flow fixture	↑	—	↑	↑
Energy-efficient appliances	↑	—	↑	↑
Distributed rainwater collection (non-potable uses)	↑	↑	↑	↑
Distributed rainwater collection (potable uses)	↑	↑	↓	↓
Solar hot water heating	↑	↑	↑	↑
Geothermal heat pumps	↑	↔ to ↑	↑	↑
Electricity peak shifting	↔	↔	↔	↔
Electricity peak shaving	↑	↑	↑	↑
Groundwater pumping	↔	—	↓	↓
Solar photovoltaic	↑	—	↑	↑
Wind power	↑	—	↑	↑
Combined heat and power	↑	—	↑	↑
Wet-cooled power plants	↓	↔	↑	—
Dry-cooled power plants	↑	—	↓	↔
Concentrating solar power (steam cycle)	↓	—	↑	↑
Hydraulic fracturing (for natural gas from shale or enhanced geothermal)	↓	↔	↑	↔
Hydropower	↑	↓	↑	↑
Desalination	↑	↓	↓	↓
Carbon capture and storage	↓	↔	↔	↑
United States corn ethanol (Midwest)	↔	↓	↔	↔
Brazilian (State of Sao Paulo) sugar cane ethanol	↔	↔	↑	↑
Municipal waste to energy	↑	—	↑	↑
Greywater and reclaimed water use	↑	—	↔	—
Inter-basin water transfer	↔	—	↓	↓

Note: ↑ the technology helps to achieve the policy objective
↓ the technology hinders achievement of the policy objective
↔ technology has choices and tradeoffs that make its effect upon the policy objective site-specific or unclear
— the technology has no appreciable impact on the policy objective.

Source: Adapted from King *et al.* (2010).

In terms of simultaneous impacts on policy objectives, technologies can represent "win-win" solutions, "trade-off" solutions, or "mixed" solutions:

- Technologies that show a "win-win" scenario in terms of reaching both energy security and water availability include low-flow fixtures, energy-efficient appliances, rainwater collection for non-potable uses, solar hot water heating, geothermal heat pumps, electricity peak shaving as a demand response method, solar PV and wind power, combined heat and power, hydropower, and converting municipal waste to energy.
- Technologies that involve trade-offs include biofuels development, groundwater pumping, electricity peak shifting for demand management, carbon capture and storage, greywater reuse for potable purposes, and inter-basin water transfer.
- Other technologies have mixed benefits for energy and water security. We list the impacts on the additional policy objectives of mitigating climate change and protecting water quality as those that have more indirect relationships with obtaining water and energy security from a quantitative standpoint. The technologic impacts on these other two objectives are quite varied.

Approaches to enhancing policy coherence

Options to enhance policy coherence can be classified as exploiting win-wins, solving trade-offs and avoiding conflicts between sets of objectives. It has been discussed above that the technological options available to pursue one policy objective (*e.g.* increasing water availability) can have positive, negative or neutral consequences in terms of other policy objectives (*e.g.* decreasing energy consumption).

Exploiting win-wins

There are some win-win scenarios in the water-policy nexus. These refer chiefly to increasing water and energy efficiency. For example, Singapore has made great efforts in water conservation. In 2006, the Ministry of Environment and Water Resources (MEWR) challenged citizens to reduce their daily water consumption by 10 L through water conservation, labeling of water-efficient appliances, and use of dual-flush toilets (MEWR, 2010a) and challenged non-domestic uses to decrease water consumption of non-domestic users by 10%. The net effect of these proactive conservation policies has been a decrease in per capita water consumption from 172 L/person/d in 1995 to 157 L/person/d in 2007 (MEWR, 2010a). Given the high energy intensity of Singapore's water supply – desalination and recycling and reuse represent 25% and 30% of total water supply, respectively (Onn, 2005; PUB, 2010) – water conservation provides strong benefits also in terms of reducing energy consumption.

Avoiding conflicts

In some cases, there are no win-wins to be exploited, but there is a possibility of pursuing one policy objective without undermining other policy objectives. For example the amendment in 1980 of the Israeli Law for Planning and Building requiring the builder to install solar hot water systems on new residential buildings (Grossman, 2007). Thus, increased access to water in households did not undermine fossil fuel energy consumption objectives. Today, over 90% of all Israeli homes have solar hot water systems that can provide hot water needs for 9-10 months out of the year saving 21% of domestic sector electricity consumption, or 5% of national electricity consumption (Grossman, 2007). Yet another examples is the use, in areas of the Middle East, of waste heat from thermoelectric power plants, including concentrating solar power plants, for thermal desalination of seawater to produce a reliable drinking water supply (Cardona *et al*., 2007; Trieb and Muller-Steinhagen, 2008). In this case, the policy of augmenting water availability with desalination avoids conflicting with energy consumption objectives.

Managing trade-offs

In many cases, it is not possible to avoid conflicts among policy objectives, but those can be reduced. For example, in Brazil the effluent from the biorefineries is high in nutrient content, and in the past this caused major problems by eliminating much of the aquatic life in local rivers. However, today it is common practice to recycle this “vinasse” by reapplying those nutrients onto the fields, although it is currently unknown if the eventual flow of these nutrients within the hydrological system will cause contamination of groundwater or surface water. Another example is Israel, where the co-ordination between policies for water allocations and energy consumption is explicitly addressed in the Israeli Water Authority’s 2010 Master Plan for national water and wastewater management, which includes several measures for minimising water-related demands on the national power supply (that account for approximately 6% of the total national electrical demand). In order to limit daytime energy consumption rates, the Israeli Water Authority allows water pumping and purification operators the freedom to minimise their energy demands during electricity peak daytime hours.

Institutional gaps hindering policy coherence in water and energy

Policy co-ordination efforts within governments are commonly compromised by institutional gaps (Charbit and Michalun, 2009; OECD, 2011). They include:

- *Policy Framework*: Different political agendas, visibility concerns and power rivalries across ministries and agencies at central level as well as problems from national ministries dictating vertical approaches to cross-sectoral policies that would benefit from co-design at the local level
- *Administrative roles*: Unclear and overlapping roles and responsibilities among government ministries as they relate to economic, social, and physical boundaries of water and energy flows
- *Capacity resources*: A lack and/or asymmetry of knowledge, enforcement capacity, and infrastructural resources within all levels of government
- *Funding resources*: Asymmetry of revenues and distribution of resources across ministries and levels of government
- *Informational challenge*: Data gaps and inconsistencies between and within the levels and ministries of government
- *Time frame and strategic planning*: Different schedules and deadlines occur between ministries
- *Evaluation*: Without evaluation, governance practices cannot be assessed, but very often feasibility is limited

The policy framework gap in the water-energy nexus often includes mismatches in priority and decision-making levels. In Australia, the development of a unified energy-water policy in has been challenged by the mismatch between the country's energy and water resources – developing water policy that protects the nation's limited water resources has been a critical national initiative for decades, while the development of cogent energy policy has been of less concern since the country's vast energy resources have always allowed the country to have cheap and abundant energy (ABS, 2006). In many countries, water regulation has been pushed towards sub-national jurisdictions (municipal and state water governments), while the majority of energy regulation and investments remain within the power of federal or national agencies.

The administrative gap is made particularly acute by the multiplicity of agencies. Energy and water resource management is often spread across many agencies and governmental levels. In the US, there are upwards of 20 federal agencies and bureaus that are in charge of water resources; thus, many agencies overlap in responsibility for water quantity and quality (Amos, 2008; Webb and Joshua, 2009) and none has clear authority. Furthermore, in the United States federal energy and water policy makers are only a small piece of the puzzle; municipal, state, and tribal governments, as well as private entities, also share a large role in managing energy and water resources. Consequently, energy and water decisions have historically been made independently of each other – that is energy planners typically assume they have the water they need, and water planners assume they have the energy they need.

Existing multi-level governance arrangements can add to the complexity of institutional co-ordination. For example, in the US, the vertical hierarchy of policymaking regarding energy and water management is dissimilar. Energy policy is usually structured in a top-down fashion with powerful federal agencies (such as the Department of Energy and EPA) setting rigid standards (*e.g.* renewable fuels standards). By contrast, water policy in the United States is usually structured in a bottom-up fashion, with decisions driven by local water agencies and authorities, as the management of water supply is generally the responsibility of the states. Thus, local governments are forced to meet federal standards, often without sufficient input.

The funding resources gap in the water-energy nexus relates as well to the very different financing frameworks. Unlike water investments, energy-related activities usually recover large returns to governments by means of oil and gas profits and royalties, excise taxes on transportation fuels, property taxes, etc. In the US, unlike water, federal funding across energy agencies has substantially increased in the past few decades, with large increases focused on increasing energy supply (GAO, 2005).

The informational challenge is multi-faceted. It includes:

- *Lack of consistency in terms and scientific units*. In the water area, similar terms such as "diversion," "demand," "use," "withdrawal," and "consumption" are used. Even within a country, different units may be used – for instance, "acre-feet" in the Western US, "gallons" in the Eastern US. A further example is flow rates: the same water withdrawal for power plant cooling can be described on different time scales from seconds (*e.g.* "average cubic feet per second" as collected by the Department of Energy) to years (*e.g.* "acre-feet per year" as reported by the US Geological Survey) thus sending confusing signals as to what time frames are important for water and energy planning and regulation.

- *Differences in data collected***.** In the US, datasets from the states and the Energy Information Administration on water use for the electricity sector do not uniformly agree, which can cause errors during analysis and policy formulation (King *et al*., 2008)

- *Divergences in data collected*. In the US, state and federal agencies neither always collect the same type of data (*e.g.* withdrawal versus consumption) nor at the same flow point in the system (*e.g.* at the power plant intake versus at the point of withdrawal from a river).
- *Gaps in data***.** Funding resources for data collection (especially for water) have decreased in the US. For example the US Geological Survey stopped collecting water consumption by use, state and sector. One important type of energy data not collected for water distribution is energy consumed for agricultural irrigation (the US Department of Agriculture reports irrigation costs in dollars, but not in units of electricity consumed). (USDA, 2004).

The time frame and strategic planning gap is also present in the water energy-nexus. Forward-looking water plans are often on the 50-60 year horizon, whereas energy plans are up to 20-30 years ahead at best. These differences are the consequence primarily in the different amounts of time it takes to build water infrastructure (it takes decades to build large-scale waterworks, whereas only years to build power plants), and how long that water infrastructure lasts (canals, dams, etc., can last hundreds of years, whereas most power plants or transmission lines last decades). Because private companies acting under market forces often dictate the location of energy infrastructure, water infrastructures are located using more public interest criteria. Thus, water planners trying to plan 50 years ahead for new power plant cooling water cannot possibly know where that demand will manifest itself.

Moving forward on coherence between water and energy policies

Institutional re-organisation

Changes in organisational structures in government can facilitate policy co-ordination. For instance, in 2007 various ministries and departments were merged in **France** to form the Department of Ecology, Energy, Sustainable Development and the Sea (MEEDDM). According to the French administration, this merger was motivated by the interdependence of issues and the need for a completely open plan as part of a policy for sustainable development. In **Spain,** the National Water Council includes representation of the energy sector by the head of the Directorate General for Energy Policy and Mines, Ministry of Industry, Tourism and Commerce as well as a representative from the Spanish Association of Electrical Industry (UNESA) (OECD, 2010c).

Enhanced data collection and analysis

Good data are needed to have a solid foundation for integrated policymaking. Governments could create well-structured and maintained databases and reporting functions. They could require energy production facilities to report water consumption and withdrawal data in the using regular reporting procedures. The same applies to the reporting of energy consumption data by major water users and producers such as desalination plants, wastewater and water treatment facilities, and irrigation pumps (preferably stating the water body and basin from which the water is withdrawn, the quantity of water in units of volume per time, and the associated energy production). While data by itself does not represent actionable information, there are quite a few examples around the world of analytical efforts to help understand the water-energy nexus and guide policy development.

- In the **EU**, the European Cooperation in Science and Technology (COST), funded via the European Science Foundation through a European Commission contract, has been working through the Australian National University (ANU) over the last two years to provide a global context based on scientific input for policy decisions within the water-energy nexus

- In the **United Kingdom**, the Department of Energy and Climate Change has worked alongside the Department for the Environment, Food, and Rural Affairs and found that 89% of energy embodied in household water is used for hot water. Based on this result, the United Kingdom government is working with the Energy Saving Trust to develop policy to target hot water use as a way of mitigating emissions from energy consumed to heat household water (OECD, 2010c).
- In the **United States**, the Department of Energy has co-ordinated an effort among the various national energy labs that culminated in a widely-cited energy-water nexus report to Congress and a website (*www.sandia.gov/energy-water/*) to act as a centralised location for information (DOE, 2006). Also in the US, the California Energy Commission issued a series of reports over the last five years to inform policy development aimed to improve cohesion between the state's energy and water planners (Klein *et al*., 2005). In the process, California discovered that approximately 19% of its electricity and 32% of natural gas is used for all aspects of water usage in the state (treatment, conveyance, water heating, oil and gas extraction, etc.) (Klein *et al*., 2005).
- In **Australia**, researchers at the Australian National University and the University of Technology Sydney have formed the Climate-Energy-Water Links project to build upon existing water resource planning by adding the energy dimension to the policies.
- In **Brazil**, the AgroHidro and Water Resources Research Network has been created to better plan for water resources, including the implications for energy, and guide industrial and agricultural practices, and the newly formed Bioethanol Science and Technology Laboratory in Campinas, São Paulo is aiming to focus initial research on energy and greenhouse gas balances as well as the water quantity and quality impacts of expanded sugar cane agriculture.
- In **Tunisia**, electricity consumed for pumping of groundwater is used to corroborate estimates of total groundwater withdrawal (OECD, 2010c).

Co-ordinated planning

Despite improvements in data and analysis, co-ordinated planning is yet far from common. For instance, in **California** the Long-Term Energy Efficiency Strategic Plan, adopted by the California Public Utility Commission in 2008, noted that one limitation of planning was that it did not address the water-energy nexus. Nevertheless, there are already some efforts towards more integrated planning. In **France**, the Master Plans of Development and Water Management (SDAGE) – which represent France in the management plans required by the Water Framework Directive (WFD) – are co-ordinating hydropower operations and conservation of aquatic environments as far as possible to remove or operate dams to achieve or maintain good ecological potential (OECD, 2010c). In **Portugal, t**he long term National Energy Strategy is jointly prepared by Ministry of Economy and the Ministry of the Environment and Land Use Planning (OECD, 2010c). **Australia** and **Israel** have integrated energy consumption and GHG emission impacts into desalination planning. Some experiences are mixed.

Public consultation

By allowing all public concerns to be considered, public consultation of water and energy policies and programmes is already representing an important mechanism to increase policy coherence. For example, in response to water shortages, **Australian** cities have turned to seawater desalination as a water supply. Yet public concern over embedded energy and greenhouse gas emissions led desalination facilities in Perth and Sydney to construct policy and business agreements to conceptually couple grid-connected wind farms to offset the carbon emissions of the desalination plants (Barta, 2008; SPG Media Water Technology, 2009;). In **Brazil**, the Belo Monte hydropower project (to be the third largest hydropower project in the world) on the Xingu River in the eastern Amazon basin was redesigned as a run-of-river style instead of a traditional large reservoir, thus flooding only a third of the area from the original plan two decades earlier.

Programmes

Given the size and importance of government programmes in water and energy infrastructure, it is important to include policy coherence considerations in their design. One recent example (spring 2010) is the launching by the California Public Utility Commission of the US's largest home energy-efficiency retrofit program with the goal to save 20% in residential energy usage. The program will include some water-efficiency measures such as low-flow shower heads, and there is increased use of innovative financing for these programs. The San Francisco program, GreenInvestSF, for example, ties financing to property taxes and allows inclusion of water conservation measures beyond those currently in the energy utility program (Exloco, 2010)

Regulations

Governments make ample use of regulations in both policy domains to achieve individual policy objectives. *Regulatory analysis requirements* managed by central and arms-length government agencies can be powerful co-ordinating mechanisms. In **Canada**, the Federal regulatory process requires departments and agencies to identify costs and benefits, affected parties and impacts, and provide opportunities for them to take part in consultations. Through the regulatory impact analysis statement (RIAS), the government considers multi-dimensional impacts and helps contribute to horizontal and vertical policy coherence. Examples of regulations in one policy domain that take into account objectives in another domain include:

- *Permitting.* At the state level, the 2009 **Texas** Legislature developed a bill that considered water part of the permitting process for power plants.
- *Building codes*. **Hawaiian** law requires as of January 1, 2010 energy-efficient hot water systems, which many interpret as a mandate for solar water heating systems on single-family homes (Hawaii, 2010).
- *Zoning.* In **Brazil,** the recently enacted Agroecological Zoning in São Paulo for sugar cane and ethanol production includes measures to assure that new biorefineries are limited to water withdrawal less than 1 m^3/tonne of cane[3] processed (versus 20 m^3/tonne 20 years ago) and the consideration of soil and water availability in the siting of farms.

Operational management

There are also opportunities for improving policy coherence at the implementation end of the policy process. For example, in **Mexico**, the Technical Committee on Operation of Hydraulic Works (CTOOH) meets weekly to address all operational aspects of dams within Mexico, including hydroelectric power, such that water management sufficiently addresses all concerns and minimises risks, such as flooding. CTOOH is composed of representatives from the National Water Commission (CONAGUA), Federal Electricity Commission (CFE), the Mexican Institute of Water Technology (IMTA), and the Engineering Institute of the National Autonomous University of Mexico (IIUNAM). In particular, Mexico is reviewing the possibility of using mini-hydro plants in existing water infrastructure. Initial estimates are that there are 112 feasible small projects that could be developed by the private sector for a total installed capacity of 6 600 MW and annual generation of 16 000 GWh (OECD, 2010c).

Economic instruments

Current pricing and subsidy structures for water and energy offer major opportunities for increasing policy coherence. Getting the prices right is key because they provide the incentives to develop and adopt the most appropriate technologies in each situation. The OECD has carried out extensive work on economic instruments for environmental management; water pricing and removal of subsidies. It is worth highlighting that pricing approaches also include efforts in industrialised countries to implement "smart" meters to give customers more information about their consumption and to enable pricing that varies with time-of-use and other factors. The coupling of data collection and effective labelling of utility bills with smart meters is necessary to create a coherent policy around time-of-use pricing. While there is substantial research about behavioural responses to fluctuation in energy prices, there is less research about the behavioural economics of water prices.

Linkages between agriculture, water and the environment

Agriculture and water systems need to be managed to achieve economic, social and environmental policy objectives. The sustainable management of agriculture and water is critical to the survival and well being of both farming and society more broadly, especially to provide adequate water to ensure food production and also water for other users (*e.g.* urban, energy and industrial) as well the environment (rivers, lakes, groundwater, wetlands, etc).

Encouraging greater policy coherence between agriculture and water requires seeking synergies and recognising necessary trade-offs. It also requires distinguishing between short term policy responses to immediate issues (*e.g.* a drought or flood) and long term strategic policy development (*e.g.* research to raise agricultural and water use productivity) (UNESCO, 2009). But policy coherence is also an all encompassing notion, in that while this chapter focuses on coherence between agriculture and water policies, countries are normally seeking to achieve coherence across all government policy domains.

For many OECD countries, policies across the agriculture, water, energy and environment spheres are formulated without sufficient consideration of their interrelationship in any comprehensive manner or their unintended consequences. Support provided to lower the costs of water supplied to agriculture, for example, by not reflecting the scarcity value of water can undermine efforts to achieve sustainable management of water, especially in situations experiencing water stress. Agricultural support policies linked to production can also exacerbate off-farm pollution through providing incentives to intensify and extend production more than would be the case in the absence of this form of support. But isolating and quantifying the overall economic efficiency and environmental effectiveness of agricultural support on water is difficult and further analysis on causation is needed.

Recognition and practical implementation of policy coherence across different scales of decision-making – from the farm through to water catchment, national and international levels – is a gap in many countries. Policy coherence also relates to broader national and international questions, including which institutions and how they make decisions to allocate water across sectors and for environmental needs, including across international boundaries (OECD, 2010a).

More coherent policy approaches, however, are beginning to take shape in a growing number of OECD countries. This is particularly evident with climate change as many countries have started to co-ordinate the previously separated policy domains of water policy, flood and drought management policies, and agri-environmental policies. For example, the restoration of agricultural land in flood plains by planting trees has helped to reduce impacts of floods, improved water quality, and led to co-benefits such as restoring biodiversity and sequestering greenhouse gases (OECD, 2010a).

Key water-agriculture linkages

The linkages between agriculture and water are highly complex and dynamic. Climate change and climate variability increases the complexity of managing agricultural and water systems (OECD, 2006a; 2010a). The immense range of linkages between agriculture and water set it apart in many ways from the interface between water and the urban, energy and industrial sectors.

The complexity and diversity of linkages between agriculture and water systems, compared to most other water users, have important implications for addressing policy coherence because the agricultural sector in most OECD countries:

- usually accounts for the major share of water withdrawals for consumptive use;
- increasingly is becoming the focus to lower diffuse pollution, because of the success in reducing point sources of pollution from industry, sewage and urban centres;
- importantly is linked to the energy sector, principally through the: use of energy to pump water either through irrigation canals or where water is extracted from surface water and groundwater; and the impact on water resources and quality as a consequence in some OECD countries of the increased production of agricultural feedstocks to produce bioenergy;
- frequently the main land using activity, hence, the impacts of droughts and floods can have significant impacts on the sector, while agriculture can also contribute to ameliorating the harmful consequences of floods on the rest of the economy;
- significantly as agriculture is a major user of land and water, the sector can have important consequences (positive and negative) on ecosystems, such as wetlands and coastal zones; and,
- gradually agricultural and water systems are becoming vulnerable to climate change and climate variability, although there is significant regional variation within and across countries.

Water resources

Irrigated agriculture makes a substantial and increasing contribution to the growth in agricultural production across many OECD countries. The growing risk from climate change induced droughts has potentially significant consequences for the sustainability of the agricultural sector, the environment and provision of water to other sources (IPCC, 2008). The withdrawal of water resources from surface and groundwater sources in some regions of the OECD is leading to concerns with (OECD, 2006a):

- reduced flows in rivers and lakes;
- natural recharge rates of aquifers being exceeded; and,
- increased competition for water resources between farmers and other water users, including the maintenance of ecosystems.

Agriculture can address these concerns by improving water use efficiency in irrigated systems. This can be achieved through improvements in farm management practices, such as in terms of using drought resistant varieties and changing crop rotations, and also through upgrading irrigation practices and infrastructure. While there has been improvement in water application rates per hectare of irrigated land, in many cases problems remain in the form of poor maintenance of irrigation infrastructure and low rates of adoption of efficient irrigation technologies (OECD, 2010a). Existing technologies can dramatically reduce inefficient water use in agriculture – for example, monitoring, sensing and computing technologies can be combined to predict short-term (48 hours) rainfall, calculate how much water a specific crop type needs and, through mobile phone technology, adjust automated irrigation systems resulting both in the reduction in water use and increases in crop yields.

For those countries where water stress is becoming a problem to all water users, including maintaining environmental flows, other options to lower use of freshwater resources in agriculture are being considered and developed. A notable example has been the growing use of recycled effluent water, mainly from sewage and industrial wastewater, by the ***Israeli*** agricultural sector (Box 4.1).

Box 4.1. **Using recycled effluent water to lower freshwater use by Israeli agriculture**

Since the early 1960s Israel has embarked on an ambitious plan to recycle effluent water (REW, mainly from sewage but also industrial wastewater) for use largely by agriculture but also some other water users. The share of effluent recycled by Israel, about 70%, is now possibly the highest globally. Given that other countries are beginning to examine the greater use of recycling effluent in view of the growing pressure on freshwater resources, Israel's experience over many decades is one that can provide lessons on the costs and benefits of using REW in agriculture.

REW now contributes about a third of the water supplies for irrigated agriculture, with this share expected to grow substantially over the coming decade. REW is supplied to farms from nearby urban areas, but in some cases transported over distances in excess of 100 km. Support for use of REW by agriculture is mainly provided by: lowering the REW price relative to freshwater to encourage substitution on farm; offering grants that cover 40%-60% of the investment costs of treating, storing and supplying REW to agriculture; and support for the on-farm costs associated with adapting irrigation systems to using REW.

Box 4.1. **Using recycled effluent water to lower freshwater use by Israeli agriculture** *(continued)*

A benefit of developing the supply of REW for agriculture has been to address the growing pressure on freshwater resources. The government also views this as a low cost and beneficial way of disposing of sewage that might otherwise be treated to a lower standard and lead to environmental pollution. With Israel's rapidly growing urban centres, REW use has had the advantage of helping to address the problem of sewage disposal. Farmers also see REW beneficial in terms of: overcoming limited freshwater allocations; providing a lower cost source of water compared to freshwater; and improving crop yields and reducing fertiliser costs due to high levels of nutrients in REW.

The expanding use of REW has raised a number of concerns in terms of the economic, agronomic, environmental and human health costs of using REW in agriculture. The support provided for REW raises economic issues as to whom should bear the full costs of recycling, the urban/industrial producers of the effluent or agricultural users of REW the beneficiaries of effluent treatment, which would result in savings if these costs were not financed by the government. The main agronomic difficulties associated with using REW have mainly concerned the high concentration of pollutants in REW, even after treatment, damaging to soils and crop growth, in particular, high levels of salinity and excess boron. High salinity of REW has also led to environmental costs, especially REW leaching from irrigated agriculture leading to growing salinity of aquifers. Aquifers have also been affected by the leaching of nutrients from irrigated agriculture, in part, resulting from the high concentrations of nutrients in REW.

REW is mostly used to irrigate non-edible crops, but there are concerns with its use for food crop cultivation, although research on these links is still required. Pathogens and micro-organisms in REW can be passed through the soil into plant root systems and contaminate fruit, salmonella is an example. Also REW containing residual hormones from the dairy and meat industry, flushed birth control pills and similar chemicals might be causing endocrine disruption in males. Recent research, but as yet inconclusive and still under progress, has made the possible link between the drop in male fertility in Israel over the past decade with the presence of endocrine disrupting chemicals found in REW and leached from agriculture into aquifers used for drinking water.

To address the environmental and health costs of using REW in agriculture, the government has implemented and revised health and environmental REW treatment standards. A considerable research effort has been undertaken to address the problems associated with using REW, both for farmers, but also in terms of health and environmental costs. One such success story has been the use of soil aquifer treatment to ensure greater purification of REW. For Israel to move toward more sustainable use of REW, however, will further require: examining the stringency of treatment standards; investing in treatment infrastructure; and developing research, especially the concerns related to the possible links between use of REW in agriculture and endocrine disruption in the male population.

Source: OECD (2010d).

Water quality

With the achievement in reducing industrial, sewage and other 'point' sources of pollution, focus has switched in many OECD countries to lowering agricultural pollution (OECD, forthcoming 2012). This is because water pollution from agriculture mainly originates from diffuse sources with many crop and livestock farms spread across agricultural landscapes. With structural changes in the livestock sector toward larger more intensive units, however, agriculture is also increasingly contributing to point source pollution.

Agriculture is a significant source of water pollution from nitrogen, phosphorus, pesticides, soil sediment and also a growing number of emerging contaminants (*e.g.* veterinary medicines). Agricultural pollution has a substantial redistributive impact in society, through the treatment costs to remove these pollutants from drinking water. Costs of agricultural pollution are also imposed on society by: impairing recreational (*e.g.* bathing) and amenity (*e.g.* waterscapes) benefits associated with water; damaging commercial fisheries; and harming ecosystems.

The impact of agriculture on water quality has been either stable or deteriorating across OECD countries from the mid-2000s to 2010, with few cases where significant improvements are reported (OECD, forthcoming 2012). This marks a change from an earlier period, 1990 to the mid-2000s, when an OECD study (OECD, 2008a) concluded there was an overall slight reduction in agricultural pressure on water systems. Many OECD countries have adopted programmes seeking to restore degraded ecosystems on farmland, such as wetlands.

Certain farming practices and management systems, however, can result in improvements in water quality. Illustrative of these beneficial practices and systems include, creating riparian buffers, taking land out of production near watercourses, and undertaking conservation tillage, organic farming, and other beneficial farming practices and systems. But if poorly managed these practices and systems will also lead to pollution of water systems. There may be some private interest by farmers in minimising pollution of water courses, such as providing uncontaminated drinking water for livestock, but generally ecosystem services in improving water quality are undersupplied by farmers

Water and energy

The linkages between agriculture, water and energy, principally concern: the energy consumption required to pump and convey water for irrigated and livestock farming; and also the impacts on water resources and water quality from the production of agricultural feedstocks to produce bioenergy.[4]

Except in gravity fed systems, irrigated farming requires energy to pump water from surface water (rivers, lakes or reservoirs) or groundwater to fields through irrigation water storage and conveyance networks. Livestock farms (including irrigated livestock farms), especially those under more intensive systems of management, such as housed pig, poultry or dairy operations, also require energy to convey water from surface water, groundwater or through a mains delivery system.

Recent increases in energy prices have led to a growing interest in expanding bioenergy production in many OECD countries. Bioenergy (biofuels, heat and electricity) production from agricultural feedstocks (*e.g.* grains, cereals, oilseeds, grasses, woody materials) can have significant impacts on water quality and availability (OECD, 2010a; OECD, forthcoming 2012).

The overall impacts on water resource use of cultivating agricultural feedstocks to produce bioenergy, however, is complex and remains unclear. It is a largely empirical question and needs to be assessed in a way that compares the effects of alternative uses of resources. Research suggests, however, that the quantity of water needed to produce each unit of energy from second generation biofuel feedstocks (*e.g.* lingo-cellulosic harvest residues and forestry) is much lower than the water required to produce ethanol from first generation feedstocks (such as from maize, sugar cane, and rapeseed). But this can vary according to the location and practices adopted (OECD, 2010a).

The water quality impacts from production of agricultural feedstocks for bioenergy may be caused by the use of agro-chemicals in intensive bioenergy feedstock production systems, such as the use of fertilisers which pose a risk for eutrophication. In addition, the feedstock processing plants to convert raw materials to bioenergy can also have impacts on water quality. For wood plantations used as bioenergy feedstocks, the clearance of streamside vegetation in wood management systems may also change the physical properties of water systems, such as the turbidity, stream temperature and light infiltration of water bodies. If nutrient inputs are required for wood plantations, infiltration and runoff of nitrogen may also pose a risk to groundwater (OECD, forthcoming 2012).

A key conclusion from most studies on the links between bioenergy production from agricultural feedstocks on water is that in general feedstocks from annual crops such as maize and oilseeds can have a more damaging impact on water systems than feedstocks produced from grass and woody materials, such as reed canary grass and short rotation woodlands. Another important conclusion is that the location of production and the type of tillage practice, crop rotation system and other farm management practices used in producing feedstocks for bioenergy production will also greatly influence water systems. But a note of caution is important here, as the potential impacts on water resource and quality from growing bioenergy feedstocks on agricultural, have not been fully evaluated (OECD, forthcoming 2012).

Droughts and floods

The increasing frequency and severity of drought and flood events is leading to higher budgetary costs for governments in supporting affected farmers, rural and urban communities, and an increase in farmer insurance costs. Given the prospects for increasing flood and drought events associated with climate change, modifications to farmland use and farm management practices are likely to play an important role in mitigation and adaptation strategies for flood and drought risk management (OECD, 2010a).

The management of agricultural land through drainage systems can have large effects on infiltration and run-off which affects the speed at which water can enter water courses. This can increase the risk and severity of *flooding*. The use of land can also be changed in order to help prevent and mitigate against floods. Accepting greater flood risk on agricultural land can help to reduce flood risk in urban areas It can also be more cost efficient to use agricultural land as a space for floods, than constructing flood reducing infrastructure (OECD, 2010a).

Flood protection projects which use to concentrate on mainly engineering solutions, such as constructing storm drains or river straightening to improve water flow rates, are beginning to adopt a broader approach to flood management, for example, by including agriculture as part of the solution to flood control. In some cases flood risk management in agriculture is being combined with other objectives, such as nature conservation by, for example, creating wetlands or water meadows which can provide both habitats and act as a sink for flood water. In cases where farmers purposefully manage land to retain and store floodwater to reduce flood risk for the benefit of others, there can be scope for policies to reward them accordingly, although this may be highly localised (OECD, 2010a).

The expectation is that *drought events* will occur more frequently in the future as a result of greater climate variability. So improving the resilience of agriculture to droughts will also be important, including by developing water storage capacity. It is essential in drought prone areas for agriculture to improve its water use efficiency (or even consider abandoning agriculture completely in more extreme cases), in part, to free water for other users and environmental purposes. This might be achieved through, for example (OECD, 2010a):

- reducing leakages in delivery systems;

- drought water banks;
- option markets for water;
- developing on-farm rain harvesting practices and systems, *e.g.* conservation tillage;
- making greater use of recycled sewage and drainage water and desalinated water;
- improving soil moisture measurement;
- increasing adoption of efficient water application technologies, such as nanotechnologies;
- encouraging greater adoption of drought resistant cultivars; and,
- recharging groundwater during times of low seasonal water demand, and in years of high rainfall to help offset years of low rainfall.

Water and ecosystems

As agriculture is the major land using activity in many OECD countries, its influence on habitats and wildlife species (*i.e.* ecosystems) is significant. As such, agriculture has a direct impact on species' habitats and indirect impacts on the existence of the species themselves, but the interactions and relationships that control impacts are complex. Overall changes in farming management practices and systems and the intensity of input use are key driving forces on the quality and conservation of ecosystems, including the management of water resources on farm and disposal of farm waste into water bodies (OECD, 2008a).

Wetlands provide a good example of the linkages between agriculture, water management and ecosystems. Wetlands are highly valued ecosystems and their degradation and/or loss is of international significance as recognised through both the Convention of Biological Diversity and the Convention on Wetlands (Ramsar Convention). For many decades the expansion of agricultural production across most OECD countries has involved the drainage of farmland, often leading to the destruction of aquatic habitats on farmland (*e.g.* ponds, wetlands). Equally, aquatic ecosystems, such as lakes and rivers, continue to be polluted from farm waste run-off and leaching through soils, for example, from livestock wastes, fertilisers and pesticides (OECD, 2008a).

Since the early 1990s, however, there has been an increasing effort by many OECD countries to adopt programmes that seek to restore degraded ecosystems on farmland, such as wetlands, and also reduce the pressure on water bodies from farm pollutants. Some countries are also engaged in the conversion of agricultural land back to wetlands and other aquatic ecosystems. But even when agricultural land is converted back to a wetland it may take many decades or longer, for the wetland to be restored to its 'natural' state (OECD, 2008a; 2010a).

Water and climate change

The most recent Intergovernmental Panel on Climate Change assessment and OECD government reports confirm that agricultural and water systems are becoming increasingly vulnerable to climate change and climate variability, although there is significant regional variation within and across countries (IPCC, 2008; OECD, 2010a). Climate models project that climate change and variability will intensify and accelerate the dynamics of hydrological cycles, such that agriculture will need to adapt to the increasing frequency and severity of floods and droughts.

Climate change projections make clear that changes in water availability, the timing and seasonality of precipitation, and warming, as well as the growing incidence and severity of floods and droughts, will require high levels of adaptive responses to address these issues so as to enhance the resilience of agricultural systems to produce enough food, fibre, fuel and ecosystem services.

In some countries, however, that are presently climatically constrained in terms of expanding agriculture, climate change may lead to benefits and positive opportunities for agriculture. Better understanding of climate variability and extension of risk management approaches in agriculture to existing climate variability, can help build a more solid foundation for addressing climate change in the future (OECD, 2010a).

Changes in climate and climate variability that affect the profitability of agriculture will in turn lead to changes in the location of crop and livestock production, and technologies and management practices used to produce individual crops and livestock. These economic responses to climate change could lead to indirect consequences in changing pollutant run-off and leaching rates as well as the use of water resources (OECD, forthcoming 2012).

Relationships between climate change and water pollution and resource use by agriculture are likely to be complex. Flooding, for example, could mobilise sediment loads and associated contaminants and exacerbate impacts on water systems. On the other hand, more severe droughts could reduce pollutant dilution, thereby increasing toxicity problems. But the expectations are that whatever the impacts on water systems, the task of achieving sustainable management of water in agriculture will become more difficult in the coming years as a result of climate change (OECD, forthcoming 2012).

These conclusions are tentative, not only because of the overall uncertainties of current climate change research, but more specifically that the linkages between climate change, agriculture and water resources and quality are not yet extensively researched, especially in terms of their impact at the sub-national level (OECD, forthcoming 2012).

Coherence between agriculture and water policies: Key obstacles

There are four main obstacles to moving toward greater policy coherence between agricultural and water policies, including the:

- difficulties and failure to adequately address the complexities of agriculture and water linkages;
- differences in spatial and temporal scales between agricultural and water policies;
- incoherencies between certain agricultural policies and current water policies, acting to constrain opportunities to move toward the sustainable management of water; and the,
- inconsistencies and rigidities in the institutional structures that govern the agricultural and water sectors.

Difficulties and failure to address the complexity and diversity of agriculture and water linkages

Given the now widely recognised complexity and diversity of linkages between agriculture and water described above – across the domains of water resources and quality, energy, droughts and floods, ecosystems and climate change – it is not difficult to understand why ideas of coherent policy making has become a key feature of emerging approaches toward the sustainable management of agriculture and water systems (Fish *et al.,* 2010). But the very complexity of these linkages is also an obstacle in forging more coherent policies.

The main goals of Ministries of Agriculture, for most OECD countries, has been for many decades to increase agricultural production, improve farm incomes, and provide a secure and low cost supply of food for consumers. While these still remain important goals for governments, since the early 1990s most countries have been grappling with new policy priorities, especially those concerning the environment, natural resource management and climate change. Over the same period government budgetary resources have become stretched, and policy makers have found themselves required to address a more complex policy world in agriculture and water but with fewer resources (Howlett and Rayner, 2007).

The obstacle created by the complexity and diversity of agricultural water linkages relates to the perception of water in the policy realm. These perceptions stem from: differing political agendas; conflicting interests in water uses; varying power rivalries across ministries and other concerned agencies; and competing interests, such as different government ministries, farmers, the water industry, and environmental pressure groups.

Water needs to be seen as a broad concept that is important for agriculture and the environment but also for wider issues such as recreation, nature, households, industry and land use planning and management. This requires that there is a common, shared rationality which governs the perception of water in the policy realm. If water is appreciated as a resource with many competing uses then the need for coherence between policies follows naturally. When this is not the case, the concept of water is an obstacle which needs to be overcome. Such an obstacle becomes a greater problem in the case of increased water scarcity. If one policy field does not appreciate the wide variety of uses for water then conflicts will increase as the resource becomes scarcer. In these situations the need for coherence is even greater.

Differences in the spatial and temporal scales between water and agricultural policies

Coherence between policies will be easier and have greater scope when activities in one policy sphere align in space and time with activities in another policy area. But frequently another obstacle to policy coherence between agriculture and water policies is that the spatial and temporal frames over which governments make their decisions differ. This requires an approach to governance capable of operating both inside and outside the spatial frame of the farm and water catchment, and able to deal with the dynamic temporal relationships between water and agricultural systems (Fish *et al.,* 2010).

From a scientific perspective the sub-catchment or watershed may appear to be the most logical *spatial scale* for the integration of agriculture and water management. But many of the market and institutional processes and structures that drive and regulate both agriculture and water management operate at entirely different spatial scales (Fish *et al.,* 2010). Some OECD countries, for example, tend to use a uniform approach in applying policies to address nutrient management to control water pollution from agriculture, while spatial targeting to a water catchment might have a more positive impact on controlling pollution, such as differentiation by farm type (OECD, forthcoming 2012).

Moreover, as the spatial scale of policy decision-making is expanded from a single farm up to an entire catchment area and beyond, an increasing number of stakeholders (*e.g.* farmers, other water users, etc), interactions, feedbacks and nonlinearities are brought into play. This complicates and introduces many uncertainties into the process of achieving coherence between agriculture and water policies, especially when data are lacking to assist policy makers in their decision-making process (Fish *et al.,* 2010).

Different *time schedules and planning* in policies concerning agriculture and water, also act as an obstacle to policy coherence. Some agri-environmental policies, for example, operating under limited budgets and short term deadlines, may seek to implement projects that have an immediate effect on water pollution (OECD, forthcoming 2012). Water policies, however, frequently have long term policy goals, for example, where projects are developing large-scale irrigation systems requiring the construction of canal networks, reservoirs and dams.

Differing time scales between ministries and agencies concerned with agriculture and water are relatively easy to co-ordinate through, for example, synchronising budget cycles, and co-ordinating regulatory time schedules. But in practice this can be complicated by having to overcome short term and competing interests, especially where these interests have been entrenched over long periods (Chapter 2).

Incoherencies between agriculture and water policies

Agricultural 'policy layering' has resulted in a further obstacle to achieving policy coherence between agriculture and water policies. 'Policy layering' or 'policy drift', refers to the process where policies have evolved incrementally over a long period of time, often in an *ad hoc* fashion, and have resulted in a wide mix of policy goals and instruments. While agricultural policies may contain a unifying overall logic, more often they are the result of policy instruments and programmes being stacked on top of each other over many years.

Over time continued policy layering can lead to policies that are both complex and costly to administer. This can often lead to counter-productive instrument mixes and incoherent goals, which can be difficult to reform, since even dysfunctional and conflicting policies can confer benefits on interest groups that may resist their alteration or elimination (Howlett and Rayner, 2007; Rayner and Howlett, 2009a; Rayner and Howlett, 2009b).

Examples of the process of policy layering, and the resulting incoherencies between agriculture policies and water policies across the various linkages highlighted in Section 4.2. are outlined below.

1. *Water resources, quality, and ecosystems*: Agricultural and agri-environmental support policies across OECD countries provide an intricate mix of incentives and disincentives toward sustainable water resource management. The use of crop and livestock market price support provides incentives to intensify agricultural production. Additionally, support for farm inputs, especially water (lowering water charges and for on-farm irrigation infrastructure costs) misalign farmer incentives. This can aggravate water resource-use inefficiencies and lead to greater pollution and other environmental damage to water bodies, especially where water stress is a serious issue and the value of water is high (OECD 2010a).
2. *Water and energy*: Continued use of support for energy in agriculture, both directly through support for diesel and electricity use, and indirectly for feedstocks to produce bioenergy, can increase pressure on water resources. This is most evident where support for energy, by reducing pumping costs, in some countries is leading to excessive extraction of groundwater. Removal of this form of support may contribute to more sustainable water use in agriculture (OECD 2010a). Bioenergy production from agricultural feedstocks can have significant impacts on water quality and availability, but this can vary according to the location and practices adopted.

3. *Droughts and floods*: The rising cost of widespread and catastrophic flood and drought relief, for agriculture and society as a whole, is exacerbated in some cases by the fragmentation of responsibility and the lack of policy coherence in agricultural, environmental, land and water policies to address these problems. Where farmers are guaranteed government support for limited, recurrent, and localised flood and drought risk, this does not give farmers the right incentives to improve self-reliance and risk management for such events (OECD 2010a).

Agricultural policy reforms across most OECD countries over the past 20 years, however, has led to an overall reduction in support levels (as measured by the OECD's Producer Support Estimate) and a decrease in the share of support most linked to commodity production and unconstrained use of inputs (such as water and energy). The shift to decoupled agricultural policy measures is likely to lead to a positive outcome for water systems. The cause and effect relations here, however, are complex and other policies may also be needed to support agriculture policy reforms, such as ensuring water allocation to meet environmental needs (OECD 2010a).

Inconsistencies and rigidities in the institutions governing the agricultural and water sectors.

In developing policies to improve coherence between agriculture and water policies a major obstacle is the integration of institutional structures that were designed for single industries (agriculture and water). This results in policy gaps, overlaps, conflicts and ambiguities that lead to inefficiencies in the policy making process and fail to resolve conflicts among competing water uses (Rayner and Howlett, 2009a).

Most OECD countries are still organised institutionally by Ministries and agencies that only deal with agriculture or water as single entities, and as a consequence policies are developed and executed within sectoral boundaries with little consideration for overall management of water resources. The independent management of water by agriculture or other water using sectors (*e.g.* energy, industry), including flows to maintain the environment, is suboptimal as it does not take into account the resource needs of all sectors and balance them to ensure sustainability of the water system. Greater policy coherence between agriculture and other water users, taking into account environmental needs, is viewed as the best way forward for building the resilience needed to adapt to climate change (World Bank, 2010).

The OECD (2010) *Water Governance Survey,* regarding coherence between water and agriculture policies across 18 OECD member countries, concluded that obstacles to policy coherence included, for example (see also Chapter 3 for a broader discussion):

- absence of knowledge and information to guide policy makers decisions and inform farmers and other stakeholders; and the,
- lack of political commitment and leadership in water policy in the context of agriculture.

While many OECD countries are making efforts to overcome these institutional obstacles, surmounting them in the agriculture and water sphere are significant because of the:

- legacies of previous policies, legislation and institu*ti*ons;
- complexity of co-ordinating the multi-level system of institutions not only horizontally across different Ministries and agencies at the central level of government as well as

at the local level and between water basin authorities, municipal authorities and other stakeholders, but also vertically across levels of government from the international, national to local levels (Box 4.2; Fish *et al.,* 2010; OECD, 2006b);

- political and administrative boundaries, such as the issue of co-ordinating between the central government and federal states in some countries, and also that some agricultural programmes are managed according to administrative boundaries and not water catchments (Rayner and Howlett, 2009b); and the,
- wider political economy of agriculture, which may not be in step with the goals of sustainable water management. Processes such as agricultural policy reform and trade liberalisation are major drivers of change in farming, yet this is rarely fully addressed within water policy, while the water community often sees agriculture as a source of water resource and quality problems failing to acknowledge its vital role in food production and rural livelihoods (Fish *et al.,* 2010).

Box 4.2. **Institutional organisation for agricultural water resource governance across OECD countries**

The institutional frameworks governing water management across most OECD countries, within which water in agriculture is managed and allocated across competing demands, can be broadly characterised as follows, although there are some marked differences from this general description:

- *National/Federal level of government:* Ministries of Agriculture, Environment, Infrastructures, etc., have overall but split responsibilities for determining policy objectives and targets for water resources (where appropriate), involving co-ordination across Ministries and sub-national layers of government. In most countries these responsibilities extend to monitoring and research activities, control of regulatory arrangements, especially governing groundwater, and also transboundary water resource issues.
- *Provincial/Regional/State level of government*: Water resource planning and management functions are usually conducted at this level, although this is generally organised in terms of jurisdictional (State/Provincial) boundaries (*e.g.* **Australia, Canada, Japan, United States**), while some countries also organise water resource management through Regional Water Management Boards which may be in control of one or several waterbasins (*e.g.* **Greece, Italy, Mexico, Poland**).
- *Waterbasin (or water catchment) authorities*: These authorities are typically involved with managing water rights, licences for water abstract and financial control (*e.g.* collecting and determining water charges) and inspection of irrigation infrastructure.
- *Water user associations/cooperatives*: Water user groups operate usually at the sub-basin level, involved with the day to day management responsibilities of the irrigation system.

Source: OECD (2010a).

Coherence between agriculture and water policies: Key benefits and risks

In recognition of the obstacles to achieve policy goals common to the agriculture and water sectors, many OECD countries are beginning to take steps toward improving coherence between agricultural and water policies. This is particularly evident with climate change as most countries have started to co-ordinate and integrate the previously separated policy domains of water, agriculture, flood and drought control, and agri-environmental policies (OECD, 2010a).

Some of the key benefits and associated risks that can flow from greater coherence between agriculture and water policies and institutions are summarised in Table 4.3, with illustrations and discussion provided in the remainder of this section. In essence greater policy coherence is intended to combine policy instruments and their institutional settings so that they support one another. Improving policy coherence also attempts to: integrate existing and sometimes competing policy initiatives into a cohesive strategy; co-ordinate the activities of multiple institutions and stakeholders; and, generally, shift toward a more holistic approach in managing agriculture and water systems (Howlett and Rayner, 2007).

Table 4.3. **Potential benefits and risks associated with greater coherence between agriculture and water policies**

Benefits[a]	Risks[a]
• *Encouraging a more holistic approach* to agriculture and water linkages, especially by taking into account the vast array of human and environmental land-water interactions	• Understanding the complexity and dynamics of a holistic approach, can make policy decisions more difficult and inefficient
• *Facilitating the encouragement of co-benefits* in achieving agriculture and water policy goals and satisfying competing demands	• Achieving co-benefits may not always be technically feasible
• *Seeking efficiencies* and leverage of additional financial, technical, administrative and political resources	• Maintaining commitment to long term goals when evidence of progress may be limited
• *Lowering budgetary costs of programmes* where incoherencies or conflicts exist, especially concerning agricultural water resource and pollution	• Improving coherence may lead to resistance from interest groups affected by policy alteration or elimination
• *Ensuring commitment to long-term goals* and future visions	• Ensuring the benefits and costs of greater coherence are fairly distributed among the stakeholders
• *Re-framing of complex issues and questions*, leading to enhanced problem solving capacity	• Failing to broker agreement in the face of uncertainty, limited data or contested knowledge
• *Encompassing all stakeholders* so they can benefit from the streamlining of policies and institutional processes	• Some stakeholders, who currently benefit from policy incoherence, may be less enthusiastic
• *Developing greater knowledge* and access to alternative sources and forms of scientific understanding, data and other information	• Diverting the process due to asymmetrical power relations among stakeholders
• *Enhancing learning* leading to the exploration of underlying values, assumptions, attitudes and expectations	• Potential implementation gaps arising from difficulties in translating agreed plans into policies, projects and actions
• *Improving relations* at the personal, social and inter-organisational levels	• Increasing costs due to the numbers of stakeholders involved and the added complexity of decision making
• *Legitimising decisions* through consensual decision-making	• Maintaining trust among organisations with different cultures, norms and practices
• *Re-allocating roles and responsibilities* according to organisational capacities and skills	• Potential dissatisfaction with changes in roles and responsibilities

Note: a. The list of benefits and risks are not listed in any order of importance.

Source: OECD Secretariat drawing on Fish *et al.* (2010); and Rayner and Howlett (2009b).

Encouraging a more holistic approach to water and agriculture, can stem from moving towards more coherent policy approaches across these policy domains. It is essential to recognise that agriculture and water interrelationships are part of broader systems including: natural water and nitrogen cycles; human and environmental land-water interactions; and interactions between water, agricultural, environmental and energy policies.

Facilitating the encouragement of co-benefits in achieving agriculture and water policy goals and satisfying competing demands, can be an important beneficial spin-off from improving policy coherence. For example, national initiatives, such as "Making Space for Water" (**England & Wales**), "Space for Rivers" (**the Netherlands**), or **Hungary's** Improvement of the Vásárhelyi Plan, have encouraged a re-appraisal of land management options for floodplain areas. Agricultural land in washlands, polders and flood retention basins may be used for floodwater storage (reservoirs) to mitigate flood risk elsewhere in the catchment. They provide opportunities to deliver multiple benefits, such as floodwater storage and enhancement of biodiversity, and potentially provide alternative sources of income to land managers (OECD, 2010a).

But achieving such coherence might not always be technically feasible. Symbolic is a single pollution source, such as nitrogen from livestock farming which can simultaneously cause water and air pollution. Hence, a logical response for a farmer to meet water quality regulatory standards might be to reduce the nutrient content of manure spread on fields by allowing more nitrogen to be released from manure storage facilities, thereby releasing ammonia into the air to the detriment of air quality policy goals (OECD, forthcoming 2012).

Seeking efficiencies and leverage of additional financial, technical, administrative and political resources, is an advantage of greater coherence between government institutions in the agriculture and water domains. This is especially the case in the current period of budgetary constraints and cuts across many OECD countries. Combining ministries and other government agencies, can result in cost savings and efficiencies and hence, possibly give scope to additional resources being used for some priority areas, such as water and climate change. But merging government institutions does not automatically ensure delivery agencies are complementary or necessarily more cost effective in the management of programmes.

Lowering budgetary costs of programmes were incoherencies or conflicts exist, can provide significant benefits from achieving improved policy coherence. This might arise from both a reduction of budgetary costs where policies are in conflict and also help achieve sustainable agriculture and water management goals. As discussed in Section 4.3, removing perverse incentives in agriculture, such as providing agricultural support for production and inputs (water and energy), can lead to efficiencies in agricultural water resource use and improvements in water quality through lowering agricultural pollution, although this might also need to be supported by other policies, such as ensuring water allocation to meet environmental needs.

There continue to exist across OECD countries conflicts between agricultural support programmes that provide incentives to increase production and those policies seeking to reduce the environmental damage, including for water resources and quality, that such programmes can provoke. Some 50% (2007-09) of total OECD agricultural producer support continues to be based on commodity output and non-constrained variable input use, although this is a marked reduction from the 85% share in 1986-88 (OECD, 2010a).

Ensuring commitment to long term goals and future visions is a key benefit of improving coherence between agriculture and water policies, especially in the context of climate change. Integrating sustainable water resource management in agriculture within the broader context of regional land use planning is important as part of an economy-wide mitigation strategy to address both future flood and drought risks, that could be exacerbated by climate change.

Re-framing the complexity of agriculture and water linkages through greater coherence, can help to enhance problem solving capacity across cooperating institutions. The merger of agriculture and environment ministries (with responsibilities for water) in some OECD countries makes co-ordination an internal exercise which may be easier than co-ordinating across separate ministries. Such a solution could work well provided that the ministry does not become excessively large, in which case the merged ministry can suffer the same problems of co-ordination.

An advantage of achieving coherence in policies and institutional processes is that all stakeholders in the agriculture and water sectors can gain. The involvement of all stakeholders can be a key consideration in seeking greater coherence of agriculture and water policies, as it opens the possibility to change the behaviour of farmers, the agro-food chain, the water industry, and other stakeholders by (Blackstock *et al*., 2010; Gouldson *et al*., 2008):

- *engaging* different actors to address the problems of water either on-farm or more broadly at the water catchment level;
- *enabling* change by educating and raising awareness of farmers and building the capacity of other stakeholders in a water catchment in the realisation of policy goals;
- *encouraging* desirable forms of behaviour and discouraging undesirable forms;
- *ensuring* that minimum standards of water quality are met by, for example, enforcing compliance with regulations and/or open the possibility for recovering the costs of water supplied to farms.

Opening access to information and knowledge is a further benefit of improving coherent approaches to agriculture and water governance. As agriculture's linkages to water are complex, to improve the efficiency of policy decision making requires considerable technical and socio-economic information about the likely impact (science), costs (economics) and farmer reactions (social) of management changes. Improving institutional coherence can make efficiencies in developing information and knowledge systems to: help ensure water catchment stakeholders have the best science available to make decisions; provide farmers with the support and resources to use and incorporate technical and economic information into their farm planning; and provide water catchment managers and farmers the training to use technical and economic information (Box 4.3; OECD, 2010c).

A further beneficial result from improved coherence is the *enhancement of learning*, that can lead to the exploration and questioning of underlying values, assumptions, attitudes and expectations. Those involved in greater cooperation between different agriculture and water institutions can typically learn about the values and norms of the other interests and stakeholders involved. Such engagement can also lead to more fundamental changes, where the values, beliefs and norms of a participating group are transformed (Fish *et al.,* 2010)

Improving relations at the personal, social and inter-organisational levels where greater cooperation is sought between agriculture and water institutions (both government and non-government), are useful in constructing coherent policies. Mergers of Ministries of Agriculture and Environment, for example recently in **Spain** and the **United Kingdom**, have sought to develop synergies and improve relationships between personnel in the newly merged Ministries (Chapter 3).

Legitimising decisions through consensual decision-making can also be an advantage of coherent policy actions. This involves creating groups or committees to oversee co-ordination at the level of central government but also at the local government level, such as exists, for example, in **France** through the Interministerial Mission on Water (at central government level) and the Inter-Services Missions, which co-ordinates policies at the local level. Such organisational structures can have success in general day to day co-ordination of activities, but only tend to be as effective as their most committed member to the new committee/mission, while trust and commitment can quickly be eroded by more reluctant members.

Re-allocating roles and responsibilities, according to organisational capacities and skills, is another benefit that can flow from seeking coherence between agricultural and water institutions and policies. But policy and institutional coherence can lead to greater complexity and cost of policy delivery than traditional agricultural and water sector policies, and may also stretch the competencies of staff in different Ministries and other relevant agencies, exacerbating the drive toward greater coherence. Furthermore, if one ministry is responsible for both agriculture and water it could lead to complacency that specific problems may have been resolved when in fact they are not.

Box 4.3. **Improving the institutional coherence and governance of water information systems**

In considering how to enhance the institutional coherence and governance of water information systems (WIS) toward more effective and efficient water management and policy decision making, the OECD Workshop on *Improving the information base to better guide water resource management* (Zaragoza, Spain May, 2010), recommended the need to:

- Encourage national and trans-boundary leadership and co-ordination to establish best practice principles, and where appropriate underpinned by legal arrangements, to support effective regional and local decision makers for sustainable long term water resource management.
- Adopt policy performance management principles to monitor and evaluate long term water policies and to ensure baseline water planning arrangements balance social, economic and environmental needs. This takes into account that water governance needs to match long term planning cycles, both to avoid management by crisis (*e.g.* droughts and floods) and also to consider the impact of climate change.
- Assess the institutional obstacles and opportunities for effective use of existing national or international WIS by policy makers. In particular, by identifying areas of possible institutional overlap in water data and information and possibilities for synergies to encourage the building of flexible, responsive and adaptive institutions, which work together to address present and future water resource management challenges.
- Mobilise local stakeholders (river basin organisations, sub-national governments, etc.) in the design of information systems to enhance territorial and integrated water resource management approaches to water policies. The data must be comprehensible at a "place-based" scale, and for local, regional and national applications.

Box 4.3. **Improving the institutional coherence and governance of water information systems** *(continued)*

- Foster dialogue and co-ordination between data producers and users and encouraging multi-discipline (*e.g.* economists, statisticians, engineers, ecologists, businesses) approaches in improving and developing WIS institutions and governance.
- Support those collecting Overseas Development Assistance (ODA) statistics to improve water resource information in their data collection efforts in support of improved water management in developing countries, particularly those countries experiencing growing water stress.

The Workshop also recognised the importance of addressing institutional water information and data "gaps" with a systematic approach, and recommended the need to:

Identify the mutual interdependencies between different institutions involved in water policy-making at local, regional and central levels. This implies recognising the impediments to effective co-ordination of public and private actors at administrative, funding, knowledge, infrastructural, and policy levels in order to address water information and data "gaps" and encourage more effective and efficient institutional sharing of water data and information.

- Develop work on "institutional information" to meet physical, social, economic and financial information needs, in terms of:
- Who does what at central and sub-national government levels in terms of water policy design and implementation?
  - Where are the key governance "gaps" both horizontally and vertically across institutions?
  - What are the major obstacles for effective co-ordination across ministries, other levels of government, and public and private water utilities?
  - What are the limitations and opportunities of existing governance mechanisms to make them more effective in delivering water policy reforms and managing water resources more efficiently?

Source: OECD (2010c).

Moving forward on the water and agriculture coherence

It is clear that over the coming decades there will be substantial growth in global demand for food and water, with both farming and water systems under increasing pressure from climate change. This outlook suggests a major challenge for policy makers lies ahead in meeting the future needs for food, while reconciling the competing demands for water resources and the necessity to reduce the pollution of water systems.

Moving toward greater coherence of agriculture and water policies, institutions and governance can make a significant contribution to meeting the challenges of the agriculture and water interface. A pragmatic, efficient and effective approach to achieving greater coherence between agriculture and water systems is one capable of integrating multiple stakeholders – farmers, water industry, environmental groups, the agro-food chain, and energy interests – and reconciling competing interests (OECD, 2002).

Many OECD countries are already making important steps in the direction of improving the coherence between the agriculture and water sectors. While this is being achieved through a wide variety of policy instruments, institutional structures and governance processes, there are some common features of these achievements across OECD countries including (OECD, 2006b; 2010a; forthcoming 2012):

- lowering overall agricultural support and shifting from direct production and input agricultural support to decoupled payments over the past 20 years in many OECD countries has, in part, led to improvements in water resource use efficiency and helped to lower water pollution pressure from agricultural activities than would otherwise have been the case had support not been lowered and decoupled;
- integrating agriculture and agri-environmental policy measures so policies addressing water resource use and diffuse pollution in agriculture are part of an overarching national water policy framework, so that all water users, water for the environment, water pollutants and polluters, are considered together, and not just agriculture;
- establishing agricultural mitigation and adaptation strategies to address climate change, which is frequently contributing to greater policy coherence, for example, by: raising agricultural productivity and improving water use efficiency by farmers in areas of water scarcity; and altering management practices that can contribute to slowing water transport across farmland and reducing flood damage in urban areas;
- evolving towards greater decentralisation of institutional arrangements concerning water governance, from national governments levels to one encouraging higher levels of local engagement and involvement of water users in resource management in agriculture; and,
- addressing information deficiencies across the agriculture-water interface to better guide and co-ordinate policies and policy makers, such as the comprehensive river basin assessments and major improvements to water information support systems, being undertaken by some countries.

Although countries are having some success in achieving policy and institutional coherence, this remains a long term aspiration that has yet to be fully translated into an operational strategy for dealing with agriculture and water in a coherent fashion. Future government strategies must be capable of maintaining agricultural production systems – to produce food, fibre, fuel, and provide ecosystem services – without comprising the long term sustainability of water resources and viability of ecological systems (Fish *et al.,* 2010).

Toward this endeavour it will be important for policy makers to consider the following elements in their drive toward greater coherence between agriculture and water policies (Dworak *et al,.* 2006; EU Commission, 2007; OECD, 2006b; 2008b; 2010a; 2010b; forthcoming 2012; Rayner and Howlett, 2009a).

- *Ensure strong political commitment*: the success of policy coherence in agriculture and water policies relies on high level political commitment, leading to increased focus on evidence based policy coherence, which is critical to foster political support. In this regard the role of parliamentarians is critical, as they are key players in promoting national agricultural and water reforms and they can explain to their constituencies the positive or negative impacts of reforms for the agriculture and water sectors.
- *Unravel policy and institutional legacies*: disentangling the policy legacies of decades of single industry (agriculture and water) policies is a highly complex undertaking, but this is critical if greater policy and institutional coherence is to be

achieved. This is of particular importance where agricultural production and input support policies lead to inefficiencies in water resource use, the undervaluation of scarce water resources, and exacerbate water pollution.

- *Design an optimal policy mix to ensure coherence*: an important challenge that policy makers face is designing and implementing coherent agriculture and water policies that do not impede structural adjustment or create new distortions in these sectors. In particular, this should involve considering the full range of policy instruments, market approaches, communicative strategies and cooperative agreements between different agriculture and water stakeholders, and also recognise that policy coherence is an all encompassing notion across the full range of government policies.
- *Develop a shared vision among relevant stakeholders*: this refers to the process by which stakeholders can develop a common vision, agree shared values, make collective informed decisions and manage together agriculture and water linkages from the catchment to national and international levels. This process involves integration of water users, polluters, scientists, government institutions and other interested stakeholders. Tradeoffs can then be initiated between these various interests, in an open and transparent way and where the focus is on synergy and win-win solutions in seeking greater coherence.
- *Provide support systems for stakeholders:* to support the implementation of more coherent policies, requires training and education of the main stakeholders (*e.g.* farmers, water mangers). This support system should form a pivotal strategy for raising awareness of sustainable management of agriculture and water systems.
- *Improve the impact assessment of policy coherence*: policy coherence impact assessment could be improved by strengthening linkages between *ex-ante* impact assessments, *ex-post* joint evaluations and joint programming and monitoring systems, and by enhancing multi-stakeholder monitoring of the impact of policy coherence in the agriculture and water sectors at the local, regional, national and international level.
- *Develop the evidence base of policy coherence*: there is only limited research documenting the evidence of coherent policies, partly due to the difficulties of evaluating agriculture and water cross-sectoral policies, especially in quantitative terms. A key challenge is to identify indicators that would capture the impacts of policy coherence (and incoherence) when cause and effect are not always identifiable and where results may appear only in the medium to long-term, including a clear commitment to gather field based evidence in a systematic fashion.
- *Communicate the benefits of policy coherence*: increasing awareness and dialogue at different levels of government and society more broadly, of the benefits that can flow from greater policy and institutional coherence should be widely communicated, as well as the costs of inaction.

Success in achieving greater coherence between agriculture and water policies will ultimately depend on removing policy inconsistencies, especially where agricultural support policies conflict with sustainable water management goals. The pursuit of policy coherence will also depend on developing relationships by connecting farms, catchments, national and international scales of policies and institutions. This will inevitably involve a vast range of stakeholders – farmers, water industry, environmental groups, etc. – who are unlikely to have interacted closely in the past. Encouraging greater cooperation across these stakeholders will require developing mutual understanding, so that policy and institutional coherence can be fostered to achieve the sustainability of agriculture and water systems.

Moving forward on the water, energy and agriculture coherence challenge

In summary, it is clear that, despite some progress being made in a number of countries, there is still a long to go to achieve effective coherence between water, energy and agricultural policies. This chapter has considered the various linkages between the policy spheres and has provided a range of policy imperatives for governments to pursue in the search for greater coherence. Bringing these policy insights and guidance together, the key obstacles to moving toward greater policy coherence can be summarised as:

- difficulties and failure to adequately address the complexities of energy, agriculture and water linkages;
- differences in spatial and temporal scales between energy, agricultural and water policies (*e.g.* forward-looking water plans are often on the 50-60 year horizon, whereas energy plans are up to 20-30 years ahead, and agricultural planning is generally within a much shorter time horizon).
- incoherencies between certain energy and agricultural policies and current water policies, acting to constrain opportunities to move toward the sustainable management of water; and
- inconsistencies and rigidities in the institutional structures that govern the energy, agricultural and water sectors.

From a governance perspective, policy coherence therefore requires ensuring vertical and horizontal co-ordination across and between levels of government. It means addressing the whole life cycle of water policy across the different policy spheres to foster an overall strategic approach that can deliver effective, efficient and sustainable policies. Achieving this outcome requires strong mechanisms, tools and processes to manage and co-ordinate policy, budgeting and regulatory development, but also high political commitment and leadership, cultural changes, monitoring and learning from international experience and evidence.

Success in achieving greater coherence between energy, agriculture and water policies will ultimately depend on removing policy inconsistencies, especially where energy and agricultural support policies conflict with sustainable water management goals. The pursuit of policy coherence will also depend on developing relationships by connecting farm, firm, catchment, national and international scales of policies and institutions. This will inevitably involve a vast range of stakeholders who are unlikely to have interacted closely in the past. Encouraging greater co-operation across these stakeholders will require developing mutual understanding, so that policy and institutional coherence can be fostered to achieve the sustainability of energy, agriculture and water systems.

Options to enhance policy coherence include exploiting win-wins (such as taking steps to increase both water and energy efficiency), managing trade-offs where conflict cannot be avoided, and reconciling conflicts between sets of objectives. It will also require strong political commitment and leadership. Depending on national circumstances, pursuit of these options will require a significant re-calibrating of policy frameworks, including:

- Unravelling policy and institutional legacies and paying greater attention to current pricing and subsidy structures for agriculture, water and energy that may be currently reducing policy coherence and providing conflicting incentives;
- Examining the potential for institutional re-organisation, with a greater degree of co-ordinated planning;
- Enhancing data collection and analysis, and developing information support systems for stakeholders and a strong evidence base for policy makers;
- Greater public consultation, including the development of a shared vision among relevant stakeholders – farmers, water industry, environmental groups, the agro-food chain, and energy interests;
- Expanding the impact assessment of policy coherence through ex ante and ex post evaluations of policies;
- Increased use of regulatory analysis requirements managed by central and arms-length government agencies to improve co-ordination and facilitate a thorough examination of the optimal policy mix;
- Steps to improve policy coherence at the implementation end of the policy process; and
- Communicating the benefits of policy coherence.

More coherent policy approaches are slowly beginning to take shape in a growing number of OECD countries. This is particularly evident with climate change as many countries have started to co-ordinate the previously separated policy domains of energy policy, water policy, flood and drought management policies, and agri-environmental policies. For example, lowering overall agricultural support and shifting from direct production and input agricultural support to decoupled payments over the past 20 years in many OECD countries that has, in part, led to improvements in water resource use efficiency and helped to lower water pollution pressure from agricultural activities. But much more needs to be done in both OECD and non-OECD countries.

Notes

1. The section on water and agriculture also considers the linkages between agriculture, water and bioenergy.
2. Based upon biorefinery consumption of 1-2 m^3 water per tonne of sugar cane and 85 L of sugar cane per tonne.
3. 1 tonne of sugar cane translates to approximately 85 L of ethanol.
4. The next section on water and agriculture considers the linkages between agriculture, biofuels, bioenergy and water in more detail.

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