Water Performance of Buildings

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List of Acronyms

AICC	Average Incremental Carbon Costs
ANQIP	*Associação Nacional Para a Qualidade Nas Instalações Prediais* (in Portuguese) - National Association For Quality In Building Installations
BRE	Building Research Establishment (UK)
BREEAM	BRE Environmental Assessment Method
DGNB	*Deutsche Gesellschaft für Nachhaltiges Bauen* (in German) – German Sustainable Building Council
EC	European Commission
ECA	Enhanced Capital Allowances
EPBD	Energy Performance of Buildings Directive
EU	European Union
HQE	*Haute Qualité Environnementale* (in French) – High Environmental Quality
LCC	Life-cycle Cost
LEED	Leadership in Energy and Environmental Design
MS	Member States
WELS	Water Efficiency Labelling and Standards
WF	Water factor
WPB	Water Performance of Building
WuP	Water-using Product

Main Definitions

Building water use: The quantity of water that is supplied to a building, excluding any losses that occur prior to the entry point of the building (e.g. distribution network losses are excluded, but not losses in the building pipes), plus any additional water supplied on the building site (e.g. any rainwater harvesting or reuse).

Rainwater harvesting: The process of collecting, diverting and storing rainwater. Note that rainwater harvesting does not reduce water demand, but it will reduce the water abstraction requirements. Rainwater may however not be used for all end applications.

Water abstraction: volume of water that is abstracted from natural hydrological sources such as groundwater or surface water.

Water consumption: amount of water that is abstracted but does not return to water bodies within a defined system (e.g. pipe leakage, drinking, gardening, etc.).

Water demand: volume of water needed to meet the demand for water services, including losses from pipe leakage and evaporation prior to delivery. Water can be used for agricultural, industrial or municipal uses. With regard to municipal water use, two types of water demand can be defined:

- The domestic water demand represents the water from the municipal distribution network that is needed by the residential buildings.
- The tertiary water demand represents the water from the municipal distribution network that is used by the non-residential buildings, such as hospitals, hotels, offices and schools.

Water reuse: Water that would otherwise be discharged can be treated and purified for reuse. Note that as for rainwater harvesting it does not reduce water demand, but will reduce water abstraction requirements. Grey water may however not be used for all uses.

Water supply: volume of water needed to meet water demand. Water supply can be through a number of sources: abstraction from hydrological sources (such as groundwater and surface water), rainwater harvesting, and water imports and non-conventional water sources (such as fresh water from desalination plants or recycled water). Non-conventional sources are generally accounted for separately, as they will not directly improve the efficiency of water use but reduce the amount of water required from primary sources.

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Executive Summary

The report presents the potential impacts that would result from implementing selected policies that aim at improving the water performance of buildings. The study was commissioned by the European Commission (EC) within the framework of the Blueprint to Safeguard Europe's Water, along with other complementary studies addressing other sectors of water use (e.g. agriculture, or distribution networks). The study includes the identification of policies at Member State level that increase water efficiency of buildings, identifies and selects possible policy options and assesses their potential impacts with regards to environmental, social and economic issues.

Problem definition

Given an increasing population in the EU, and the potential effects of climate change, water is increasingly recognised as a challenge to tackle in the EU. Reducing demand and enhancing water efficiency is a key to reducing human pressure on water bodies and related ecosystems, and if these cannot be implemented, other sources of water such as treated greywater (i.e. wastewater generated from domestic activities such as laundry, dishwashing, and bathing) can be envisaged (following the water hierarchy of the EC's 2007 Communication on Water Scarcity and Droughts). Water management is an issue that is both local and seasonal and is interlinked to water quality issues. As the public water supply represents 21% of the total water use in the EU - with buildings accounting for the major use, many initiatives are currently being implemented at local or national levels to reduce the water use in buildings, to promote water savings, to stop the wastage as well as to improve synergies at the EU level in order to facilitate the comparability of the building's performance. This study investigates the benefits of implementing an EU approach to water performance of buildings.

No "typical" building exists, especially in relation to water use. For the purposes of this study, buildings are categorised according to their age (new, to be refurbished (TBR), and existing buildings) and their usage (residential or non-residential). Current water use in the EU is around 160 L/person/day in residential buildings, including personal washing (showers and baths, accounting for about 35% of the use), toilet flushing (25%), washing clothes (14%), dish washing (8%), drinking and cooking (5%), room cleaning, garden irrigation and car wash (5%) and other uses (8%). Non-residential buildings (e.g. in the food and drink sector, retail, education, health and social work, recreation, culture and sport, public administration, etc.) mostly use water for WC and urinals (70- 95% of the use). In hotels, however, the water use pattern is similar to the residential sector.

Water-efficient measures have additional benefits as they will contribute to the Resource Efficiency Roadmap[1] that was published by the EC in 2011. Indeed, they will induce direct reductions in energy use and thus GHG emissions for EU households (with regard to the energy used for pumping, treating, and most importantly heating the water). Targeting all types of

[1] Under the Europe 2020 strategy, pushing the EU to become a smart, sustainable and inclusive economy. More information available at : www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0571:FIN:EN:PDF

buildings ensures the involvement of all EU citizens, through their usage of water, and may result in savings in other sectors of activities, by raising awareness on the issue of water quantities. Based on the results from the EC public consultation (see Annex 4), awareness-raising campaigns are indeed generally supported by the EU population, compared to other potential water measures.

The implementation of water-efficient measures in buildings will affect different types of stakeholders. Building constructors will be primarily affected by the possible implementation of policies addressing the water performance of buildings, as they will have to innovate to increase water efficiency of the buildings, especially if minimum requirements are set through a legally binding measure. The design and construction costs may increase compared to a less efficient building, and future owners would have to pay a higher price when buying the building/flat, but well-planned and properly-designed installations are generally more cost-efficient than complementary installations that would have to be introduced and/or adjusted during a future refurbishment. In addition, the distribution of costs between tenants and owners is important to take into account, as the owner will make most investments, while the tenant will gain the benefits of reduced water (and energy) bills. Water companies will also be affected as a reduced water use will impact infrastructure and adjustments may be needed to ensure safe and sufficient water supply and sanitation systems.

Analysis of subsidiarity

Climate change is affecting all Member States, and river basins - many of which are transboundary - will have to face different water issues (e.g. water scarcity, droughts, floods and water quality problems). Southern MS will most likely be the most impacted. Initiatives at MS level are increasing, but are not harmonised and are fragmented across the EU. At EU level, the Water Framework Directive sets objectives to be achieved by all Member States, but water quantities are relatively less considered than water quality, and achieving the goals often requires collaboration as water is a shared resource that requires a holistic and integrated approach. In order to enhance the protection of water resources and sustainable water management, a coordinated effort is necessary by all decision-makers, users and stakeholders at all levels. The European level is highly relevant to provide directions and ensure coordinated and balanced efforts. Indeed, there are little incentives for some MS to become more water efficient (especially those upstream) if other MS do not pursue a similar objective.

Proposing action at EU level does not mean imposing a one-size fits all to the MS. Water issues are different in each river basin and it is important to set adequate targets with regards to the challenges. Addressing the water performance of buildings at regional/national levels is also advocated by some stakeholders as some EU regions (e.g. BE, DE) already show a low water use per capita. EU-wide common indicators could be introduced, with different objectives depending on the level of advancement of the river basins, to ensure that the challenge is met. Overall, reduced water use will be beneficial throughout the EU, through the knock-on effect on energy, financial cost reductions and reduced pollution by reducing wastewater.

Based on the outcomes from the EC public consultation, EU measures to address water efficiency in buildings are perceived as important and useful by the EU citizens, although the regional specificities should be properly addressed. Overall, EU-level action was supported.

- Objectives of an EU initiative

The objectives of an EU initiative targeting water performance of buildings would necessarily build on the water-related objectives of the EU, including the WFD and daughter Directives. The specific objectives of introducing EU initiatives were to:

- Improve water efficiency in buildings,
- Increase water savings in water scarce areas and seasons,
- Improve the behaviour of water users to encourage responsible water use,
- Increase reuse of water where relevant, and
- Foster energy savings by reducing water pumping, heating and treatment requirements.

Policy options

Several policy options were selected on the basis of a comprehensive mapping of existing schemes in the EU-27 and schemes outside the EU, and the consideration of several criteria: technical feasibility, potential for water savings, EU applicability, potential risks and costs of investments.

This enabled to shortlist the options with high potential, defined on 3 policy levels - Horizontal Policies, Product, and Building level policies - and 10 potential policy options were selected (see Table 1). Regarding the Product and Building level options, different policy instruments were further investigated based on progressively stricter implementing measures: voluntary schemes, mandatory schemes, and minimum requirements. The influence of accompanying those measures by information and education campaigns as well as financial incentives was also assessed. Thus, the envisaged policy options look at implementing financial measures as well as information campaigns.

Table 1 - List of policy options

Horizontal Policies	Product-level Policies	Building-level Policies
Water metering / smart-metering (H1)	Voluntary Labelling (P1)	Voluntary water performance rating/auditing of buildings (B1)
Water pricing and cost strategy (H2)	Mandatory Labelling (P2)	Mandatory water performance rating/auditing of buildings (B2)
Awareness raising and education (H3)	Minimum water efficiency requirements for water-using products (P3)	Minimum water performance requirements of buildings (B3)
		Certification scheme for water reuse and harvesting (B4)

- Horizontal policies

With the implementation of water metering (H1), the consumer is likely to become more engaged in monitoring its water use, identifying potential leaks and using its water more efficiently. Water metering may however be difficult to install in existing buildings for technical or costs reasons.

Water prices are often estimated to be too low compared to the actual value of water but the elasticity of water prices is also low. A new water pricing strategy (H2) could however provide a strong signal to manage water more efficiently and influence the return on investment. Results of a water pricing policy will largely depend on the price setting chosen, so H2 is not investigated quantitatively in this study.

Measures to increase awareness raising and education (H3) are acknowledged as important by all stakeholders and enable to target a wide public by encouraging individual changes in water behaviour for all types of buildings (homes, office, factory, etc.). The impacts of such measures are still difficult to predict as it takes time to observe (and measure) a change in the consumer behaviour.

- Product-level policies

Regarding product-level policies, voluntary schemes (P1), mandatory schemes (P2), and/or minimum requirements (P3) could be envisaged. Toilets and showerheads are the water-using products (WuPs) to be addressed in priority, given their high shares in the residential (where toilets and showerheads represent 45% of the water use) and non-residential (where toilets and urinals represent 80% of the water use) water use patterns. More generally, product-level policies are expected to achieve better outcomes when accompanied by informative and financial measures and when more stringent regulation is adopted (from voluntary to mandatory labelling and then minimum requirements).

- Building-level policies

Considering the building level allows an understanding of the whole system's water use, which may allow the identification of synergies and trade-offs in improving the water performance of buildings. This scale also leaves flexibility in the implementation of water-efficient measures to comply with the requirement. Rating and auditing schemes can be envisaged: while the auditing of a building provides information that can be used for awareness-raising, by providing checked information on how much water is used, rating adds the information on whether a standard is met and allows a comparison between buildings.

In addition, through water reuse and harvesting, non-potable water sources can substitute potable water for specific uses in buildings, where the lower water quality does not affect consumer's health (e.g. toilet flushing or gardening). These options contribute to reduce pressure on water bodies. Water reuse relates to collecting and reusing greywater[2], i.e. wastewater generated from domestic activities such as laundry, dishwashing, and bathing while water harvesting relates to rainwater that can be collected and stored from roofs, impermeable surfaces and tanks.

[2] "Grey" water must be distinguished from "black" water, which contains human waste.

Assessment of impacts

The analysis is built from literature review and experts/stakeholders' feedbacks and focuses on the main impacts that are identified in the table below.

Table 2 - Categories of impacts

Environmental impacts	Economic impacts	Social impacts
Water use	Tenant / Owner distribution of costs	Public behaviour and acceptance
Energy consumption and carbon emissions	Capital costs	Employment
Wastewater generation and supply issues	Operation and Maintenance costs	Sanitary and health issues
	Administrative and Enforcement costs (including red tape)	
	Potential side costs (including assets / infrastructure lifespan)	

The impacts are analysed and discussed with regard to a baseline scenario where no EU action is implemented. The projections of the baseline scenario include:

- At horizontal (overall) level: 1% of water savings until 2025 and 1.5% of water savings from 2026 to 2050 for all types of buildings, thanks to existing initiatives and raised awareness.
- At product-level: 15% of savings for residential buildings and 30% of savings for non-residential buildings, with an uptake of 5% for existing buildings and 10% in new buildings.
- At building level: 25% of savings for residential buildings and 40% of savings for non-residential buildings until 2025 (and respectively 10% and 12%, from 2026 to 2050, since further improvements are expected to be lower), with an uptake of 0.1% for existing buildings and 1% in new buildings until 2025.

For water and energy uses as well as economic impacts, the impacts were quantified based on the existing information collected from the literature and further adjusted after feedbacks from experts/stakeholders. For each selected policy option (except H2), the potential water savings were quantified by considering the water saving potential (%) compared to an inefficient building and the estimated uptake (%) of the implementing measure. Both figures are the key input data to a model that enables to compute and forecast the additional water savings by 2025 and 2050 (using a lifetime period of 40 years for all buildings), compared to a baseline scenario. Given the low availability of quantitative data, data gaps, and difficulty to compare data from several sources, it was not possible to quantify and/or monetise the impacts for all categories. In such cases, a qualitative assessment is provided.

- Environmental impacts

All the policy options are primarily aimed at saving water, and/or reducing the pressure on water bodies but different ranges of water savings have been evaluated. The numbers provided must be taken with caution, as they reflect an assessment using several sources and may be higher if consumers are taking more actions to reduce their water use, or lower in the opposite case:

- For horizontal policies, about 2.6% (H1) to 3.1% (H3) of water savings (compared to the baseline scenario) are estimated by 2050.
- For product-level policies,
  - Voluntary schemes (P1) would enable to reach about 1.5% to 6.1% of water savings by 2050, depending on the existence of accompanying information campaigns and/or financial incentives.
  - Mandatory schemes (P2) would enable to reach about 3.8% to 6.1% of water savings by 2050, depending on the existence of accompanying information campaigns and/or financial incentives.
  - Minimum requirements (P3) would enable to reach more than 13% of water savings by 2050.
- For building-level policies,
  - Voluntary schemes (B1) would enable to reach 2.9% to 9% of water savings by 2050, depending on the existence of accompanying information campaigns and/or financial incentives.
  - Mandatory schemes (B2) and minimum requirements (B3) would enable to reach around 8% of water savings by 2050.
  - A certification scheme to promote rainwater harvesting and water reuse (B4) would enable to reach more than 5% of water savings by 2050.

Reducing water use would contribute to the reduction of the energy needs and GHG emissions. Energy is indeed embedded in the water used in buildings, through the energy required to pump the water from a water body, circulate it to the required floor of the building, to heat the water (for hot water, this is the main contributor to the energy use of water), and finally to treat the wastewater. Awareness-raising at building-level actions could even further enhance the reduction in energy and carbon costs by setting up synergetic actions. However, an integrated approach is needed in order to determine the potential carbon benefits and/or drawbacks of rainwater harvesting and greywater recycling schemes (B4), as such systems involve the construction of a secondary pipeline with additional raw materials, compared to a direct connection to the public water supply.

Regarding the environmental impacts of wastewater, reducing water used in buildings would reduce the amount of wastewater and thus pollution, but it could adversely affect the sewer collection systems. Low outflows (induced by lower flush volumes) may cause blockages or other operational problems.

- Economic impacts

With regard to economic impacts, the main issue lies in the misalignment between owner costs and tenant benefits. Under usual leasing arrangements, landlords take charge of the capital costs of efficiency measures while many of the benefits of green buildings apply to the user of the property (e.g. via reduced bills). When investments in water-efficient schemes are made in new buildings, cost compensation could be organised within the rent for the future tenant whereas refurbishment does not allow such as rent flexibility in some Member States, if the tenant remains the same. In order to address this issue, "green leases" could be developed. The landlord and the tenant have to agree on how the positive externality of lower operational costs can be internalised by the landlord.

Regarding product-level policies, it is generally advantageous in terms of capital costs to make retrofitting as a part of a refurbishment programme or to introduce them directly in new buildings (both for non- and residential buildings). Costs will also be incurred to manufacturers who have to develop more efficient products. In case of mandatory labelling and minimum requirements, compliance costs for manufacturers will also arise. On the other hand, manufacturers may benefit from higher prices paid by customers that buy more efficient devices.

At building-level, green buildings may contribute to economic benefits for the landlord (via increased rents for the residential sector and green marketing for the non-residential sector), although this is still an emerging market and the extent of these benefits may be low, especially given the current economic crisis that the EU is facing. Moreover, the administration and enforcement costs induced by the establishment of certification schemes would also need some public funds.

Financial incentives that accompany any potential measure will have an important impact on the return on investment, and will thus impact the decisions by customers to introduce water-efficient products or implement a sustainable building scheme. These financial aids are costly for the entity providing the budget, generally the Member State.

- Social impacts

Regarding social impacts, the main issue relate to public acceptance and thereby the uptake of water-efficient schemes. Indeed, the use of such schemes could be perceived as a compromise on the comfort of use and therefore not well accepted by the consumers. This could also be accompanied by a consumer concern on sanitary and health issues as observed for the use of alternative waters (B4 – certification scheme for rainwater harvesting and greywater recycling), because of potential risks during reuse (greywater), or because of the stagnation of water in pipes or storage tanks, which encourages biological activity (rainwater). However, in general the risks associated with these systems are considered low, especially if the water is used for flushing and gardening.

The development of water labelling/rating schemes or other certification at product-and building-levels will bring employment opportunities for WuP manufacturers and building constructors. However, it will require the education and training of skilled workers in order to design and implement water-efficient schemes, requiring the development of such education/training. Additionally, administrators would be needed to control the good application of the certification schemes and of any accompanying financial schemes. Synergies with administrations controlling the implementation of the Energy Performance of Building Directive (EPBD) may be fostered.

Comparison of the policy options

Table 3 summarises the potential environmental, economic, and social impacts for the different policy options. In each cell of the matrix a score is given, forming the basis for identifying the most suitable policy approach in an efficient and effective manner.

- Short-/long- term perspectives

In the short-term, horizontal and product-level policies are best suited as they lead to significant water savings at reasonable costs for the tenants / owners but also for the relevant authorities. Moreover, they could be relatively-easily implemented in existing buildings (except for water metering (H1)), which represent the majority of the stock. It could be expected that the consumers would progressively replace water-using products with more efficient ones while awareness on water issues (through H3) continues to grow. Consumer behaviour is indeed identified as a key driver for water use in buildings and awareness-raising (H3) may actually lead to larger savings than what is currently assessed (3% - also depending on the type of information campaigns), but low communication could also reduce expected beneficial impacts of other policies (e.g. if WuP are not used efficiently). Product-level policies could be quite easily understood by consumers, and implemented by using/introducing EU labelling schemes and mandatory measures such as for energy-related products. It would also be relevant to introduce water efficiency requirements with regards to new buildings early, as otherwise the stock of relatively inefficient buildings will grow during the time that the policy is not implemented. This however requires some common understanding of the criteria for identifying a water-efficient building.

In the long-term, building-level policy options offer more potential for job opportunities if proper training can be offered to certifiers and building experts to prepare the transition. Building-level schemes also provide more potential for water savings but the investment costs may represent a strong deterrent for constructors and owners. Therefore, building-level policies are relevant in a long-term strategy as they could first be implemented in new buildings where related costs could be integrated at an early stage in the construction (see above) and, in the case of existing buildings, progressively added when these are refurbished. Given the renovation and construction rates (a 40 year lifetime is considered), the stock of water-efficient buildings will grow progressively.

Table 3 - Environmental, economic and social impacts of policy options to address the water performance of buildings (by 2025)

		Environmental Impacts			Economic Impacts			Social impacts	
		Water saving	Energy savings	Other environmental impacts	Capital + operational costs	Administrative burden	Other economic impacts	Employment	Other social impacts
No action	No action	o	o	o	o	o	o	o	o
Horizontal Policies	H1	2.5%	++	-	-	-	o	o	o
	H2	?	?	-	?	-	o	o	-
	H3	3.0%	++	-	-	o	o	o	o
Product-level Policies	P1 (standalone)	0.9%	+	-	-	-	o	+	o
	P1 + inf. camp.	2.1%	+	-	-	-	o	+	o
	P1 + inf. camp. + fin. inc.	3.4%	++	-	--	-	o	+	o
	P2 (standalone)	2.1%	+	-	-	--	o	++	o
	P2 + inf. camp.	2.9%	++	-	-	--	o	++	o
	P2 + inf. camp. + fin. inc.	3.5%	++	-	--	--	o	++	o
	P3 (standalone)	6.2%	+++	-	-	--	o	++	o
	P3 + inf. camp.	>6.2%	+++	-	-	--	o	++	o

		Environmental Impacts			**Economic Impacts**			**Social impacts**	
		Water saving	Energy savings	Other environmental impacts	Capital + operational costs	Administrative burden	Other economic impacts	Employment	Other social impacts
	P3 + inf. camp. + fin. inc.	>6.2%	+++	-	--	--	o	++	o
Building-level Policies	B1 (standalone)	1.0%	++	-	--	-	+	+	-
	B1 + inf. camp.	2.5%	++	-	--	-	+	+	-
	B1 + inf. camp. + fin. inc.	4.1%	+++	-	--	-	+	+	-
	B2 (standalone)	4.1%	+++	-	--	--	+	++	-
	B2 + inf. camp.	7.8%	+++	-	--	--	+	++	-
	B2 + inf. camp. + fin. inc.	11.1%	+++	-	--	--	+	++	-
	B3 (standalone)	10%	+++	-	--	--	+	++	-
	B3 + inf. camp.	>10%	+++	-	--	--	+	++	-
	B3 + inf. camp + fin. inc.	>10%	+++	-	--	--	+	++	-
	B4	5.2%	-	o	--	--	o	++	--

Legend: Inf. camp. = information campaigns, fin. Inc. = financial incentives.

(+) reflects a beneficial effect / (o) no effect / (-) a negative effect / (?) unknown effect

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- Overlapping effects

Overlaps can occur between different types of implementing measures and the combination of policy options may not always be cumulative in terms of total water savings. The most evident overlapping case deals with building schemes (B1/B2/B3) that often include water metering, so as to improve identification of leaks (overlapping with H1), and/or the installation of water-efficient products (overlapping with P1/P2/P3) or of systems to use alternative water types (overlapping with B4). Therefore, for policy scenarios where B1 / B2 / B3 would be implemented along with H1, P1/P2/P3 and/or B4, scenarios were investigated to adjust the results of the model to take into account the overlaps in the estimated water savings.

- Analysis by sector / building type

Although a strong difference in the number of buildings is observed between residential (>98%) and non-residential buildings in the EU (but not necessarily in square meters, nor in water use), potential water savings in non-residential areas are promising as this sector represents more than 40% of water savings by 2025 and 15% by 2050 for building-level policies (compared to the residential sector).

Regarding the age of the buildings, new buildings will be easier to target, as it would be possible to integrate water-efficient schemes (e.g. building design, installation of water-efficient products) at an early stage in order to comply with possible certifications or labels, at lower costs compared to introducing these once the building is constructed. Moreover, with the current development and use of several building schemes for new buildings in different MS, the risks of confusion for the public and of burden for the construction sector would be avoided if a harmonised approach is adopted for the EU.

Combination of options / Policy mixes

Based on the discussions on the short-/long-term perspectives, overlapping effects and the types of buildings, two policy mixes - combining several policy options - are investigated.

Scenario S1 is built to target significant outcomes in terms of water (and energy) savings, but with limited implementation costs. It aims for relatively high savings in the short-term. The combined (and cumulative) policy options considered in this scenario are:

- H1 - Water metering
- H3 - Awareness-raising
- P2 - Mandatory labelling for WuPs (with information campaigns and financial incentives)

Based on the model, such a scenario would lead to almost 9% of water savings by 2025 and about 11% by 2050. A graphical representation of the impacts of scenario S1 is presented in the following figure based on the direct compilation of the impacts of individual policy options:

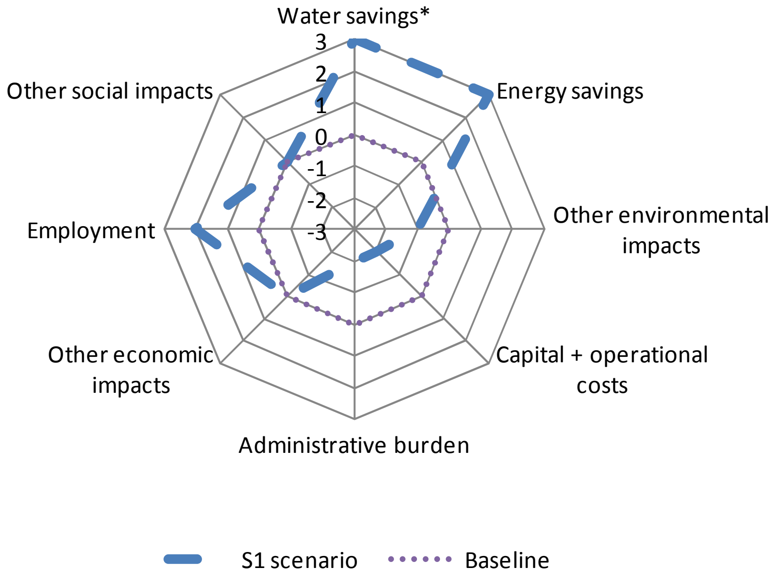

Figure 1 - Graphical assessment of impacts for the S1 scenario (positive values indicate a beneficial impact, negative values indicate a negative impact)

Similarly, a scenario S2 that targets more ambitious water savings compared to the baseline, with longer return on investments, is built. It includes the following measures:

- H1 and H3 (same as for scenario S1)
- P3 (Compared to scenario S1, P2 will be upgraded to P3 to allow only efficient WuPs to be placed on the market)
- B1 (voluntary) for the residential sector and B2 (mandatory) for the non-residential sector are introduced to target building schemes, taking into account the differences between sectors.
- B4 is introduced to certify the use of alternative waters.

As B1 and B2 are introduced in the policy mix, some overlapping effects occur and two variations can be modelled, giving a range of potential water savings. Thus, between 16 and 26% of water savings could be expected by 2025, and between 23 and 30% by 2050.

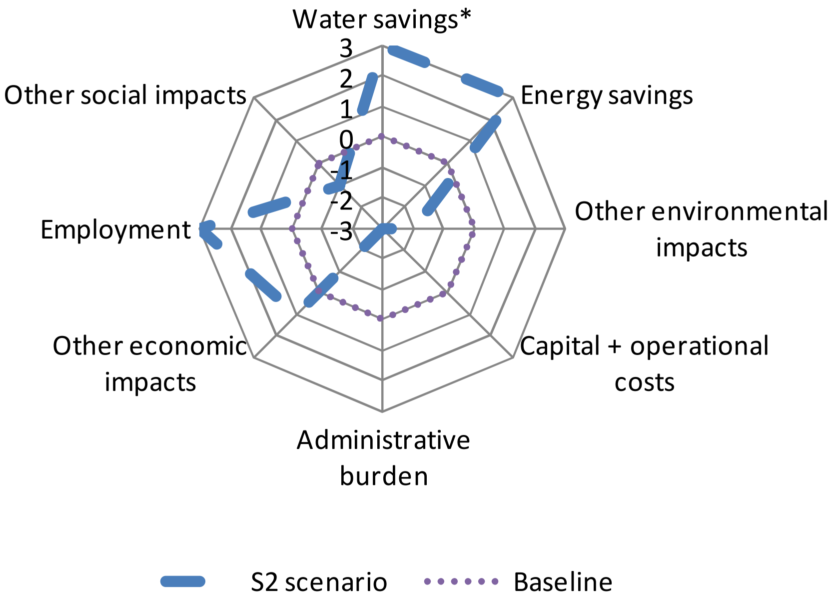

Figure 2 - Graphical assessment of impacts for the S2 scenario (positive values indicate a beneficial impact, negative values indicate a negative impact)

- Monitoring and evaluation:

Possible monitoring and evaluation indicators are proposed to address the specific objectives of this impact assessment. It notably includes the public water supply per year at national level, the water use by residential buildings per year at national level, the water use by non-residential buildings per year at national level, the number (or percentage) of people that are aware of the existence of water-efficient products and water-efficient buildings or the number (or percentage) of new buildings that use water recycling/harvesting technologies.

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Chapter 1: Problem Definition

1.1 Introduction

Water scarcity and droughts (WS&D) increasingly affect many regions of Europe[3], with climate change and population growth predicted to still worsen the issue. In recognition of the acuteness of the WS&D issues in the European Union (EU), the European Commission (EC) adopted a Communication (2007) which provides a fundamental and well-developed first set of policy options for future action. This communication indicates that at least 20% of water is wasted due to inefficiency and estimates that in some regions, up to 30% of the volume of water consumed in buildings could be saved.

Water is used by all sectors of society and the economy (Figure 3), as well as by the environment. The energy sectors returns most of the abstracted water to a water body, while in other sectors it is not the case. The public water supply represents 21% of the total water use, and buildings account for the major use.

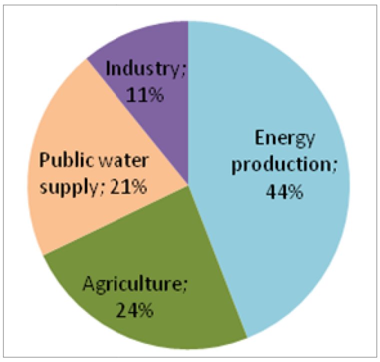

Figure 3 - Water abstraction per sector in the EU (%)

The EC is exploring the ways in which the EU can address WS&D with the Blueprint[4] expected to be released end of 2012, as a milestone and contribution to the Resource Efficiency Roadmap[5]. With increasing population and urbanisation in the EU, and predicted impacts of climate change, increasing resource efficiency is indeed a key to reducing our pressure on ecosystems.

This report presents the identified impacts that would result from implementing selected policies in the building sector, with the aim to reduce pressure on water bodies. Other sectors such as water use in agriculture[6] or leakage in distribution networks are addressed in complementary studies[7] commissioned by the EC within the framework of the Blueprint to Safeguard Europe's Water.

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3 EEA, 2009, Water resources across Europe — confronting water scarcity and drought

4 The Blueprint to Safeguard Europe's Water will be the EU policy response to ensure good quality water in sufficient quantities for all legitimate uses at a 2050 time horizon. More information available at : www.ec.europa.eu/environment/water/blueprint/index_en.htm

5 Under the Europe 2020 strategy, pushing the EU to become a smart, sustainable and inclusive economy. More information available at : www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0571:FIN:EN:PDF

6 BIO Intelligence Service, 2012, Water saving potential in agriculture in Europe: finding from existing studies and applications to case studies. Available at : www.ec.europa.eu/environment/water/quantity/pdf/BIO_Water%20savings%20in%20agiculture_Final%20report.pdf

7 More information : www.ec.europa.eu/environment/water/quantity/water_efficiency.htm

The main objective of the initiative related to improving the water efficiency in buildings is to reduce the water use in buildings, to promote water savings, and stop the wastage as well as to improve synergies among the initiatives across the EU and to facilitate the comparability of the building's performance. In addition, water savings will lead to direct reductions in energy use and thus GHG emissions by households (energy used for pumping, treating, and most importantly heating the water).

1.2 Water use in the building sector

The building sector includes the residential buildings and the non-residential buildings that are connected to the municipal water supply (Industrial and agricultural facilities are out of the scope of this study). More than 165 million buildings exist in the EU[8], with more than 99% of the buildings (in number) being residential.

In 2008, the construction sector had around 3.3 million enterprises that together generated value added of EUR 604,400 million and employed 15 million persons[9]. It accounted for 9.1% of non-financial business economy value added in 2007[9]. The construction of buildings contributed around one third of the sector's value added and employment in the EU-27.

1.2.1 Residential and non-residential buildings

The residential water use represents 72% of the total water use in buildings, and 28% for non-residential buildings. [10]

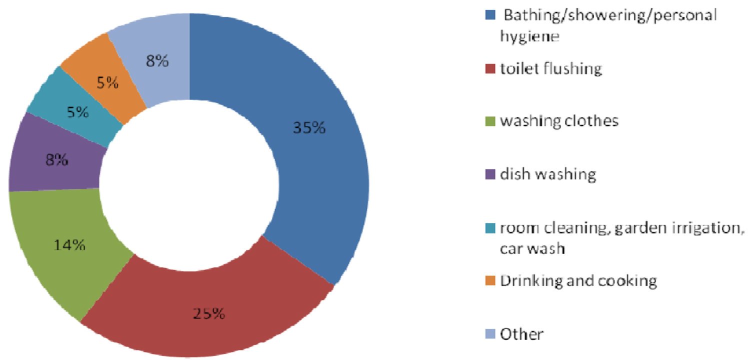

Figure 4 - Residential water use in the EU[11]

[8] JRC, 2011, Development of European Ecolabel and Green public procurement criteria for Office Buildings, Market and economic analysis, draft report

[9] Eurostat, Key figures on European Business, 2011 edition, available from: http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-ET-11-001/EN/KS-ET-11-001-EN.PDF

[10] EUREAU Statistics Overview on Water and Wastewater in Europe 2008 (Edition 2009)

[11] JRC, Ecotapware, Task 2: Economic and market analysis and Task 3: User behaviour, 2011, First Interim Report, Draft.

Residential buildings include single-family house (53%), multi-family buildings (less than 8 floors, 37%) and high-rise buildings (9 floors and higher, 10%)[12]. As seen in Figure 4, the majority of water used in residential buildings is for: personal washing (showers and baths, accounting for about 35% of the use), toilet flushing (25%), washing clothes (14%), dish washing (8%), drinking and cooking (5%), room cleaning, garden irrigation and car wash (5%) and other uses (8%). The water use in residential buildings depends mainly on the number of people residing there. While ranging from 2.1 for Sweden to 3.1 for Ireland, a household occupancy rate of 2.5 persons is considered as average for the EU[13]. Current water use in the EU is around 160 L/person/day in residential buildings (see Figure 6). Significantly lower residential water use of about 120L/person/day or even lower - as currently achieved in Belgium with around 100L/cap/year[14] - are observed in some Member States (MS), indicating some reduction capacity for other EU regions.

Hot water use is identified as a key issue from the building sector as it directly relates to the energy consumption of building. Heating water represents around 22% of household energy use in the UK[15].

Statistics and figures are more often available for the residential sector than for the non-residential one as national studies are often carried out for the residential buildings, in order to study population, households, and demographic trends. In the non-residential sector, different types of buildings use different amounts of water and water use depends mainly on the living surface area (number of square meters) of the building. Most buildings (e.g. in the food and drink sector, retail, education, health and social work, recreation, culture and sport, public administration and defence, etc.) mostly use water for WC and urinals (70- 95% of the use[11]) as shown in Figure 5. In hotels, however, the situation is similar to the residential sector. Given similar water use patterns, hotels and households could then be addressed by common potential measures with regard to water efficiency, as suggested by a stakeholder. The majority of the water used in the non-residential sector is used by office buildings. .

[12] 2005 data, the percentages reflect the distribution of the residential building stock in the EU-25, Source: JRC, 2008, Environmental Improvement Potentials of Residential Buildings (IMPRO-building) Note however that statistics about building stocks in the EU are not considered of very good quality according to the Impact Assessment for the Energy Performance of Buildings Directive.

[13] Based from UN, Economic Commission for Europe Statistical Division, Trends in Europe and North America 2001

[14] Aquawal, Paper in response to the stakeholder consultation.

[15] BERR, 2008, Energy consumption in the UK: overall data tables

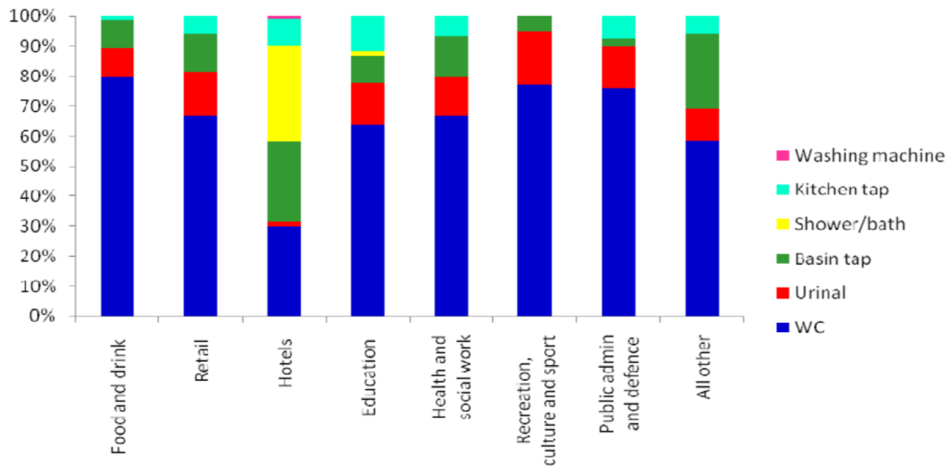

Figure 5 - Non-residential water use per type of sector in the UK[16]

There is less evidence on the hot water use in non-residential buildings. In UK for example[17], heating water accounted for 19% in the energy consumed in the hotel and catering sector, followed by 16% for sports and leisure and 11% in both education and health.

1.2.2 New, to be refurbished, and existing buildings

No "typical" building exists, especially in relation to water use. For the purposes of this study, buildings are categorised into three categories: new, to be refurbished, and existing buildings.

New buildings are those that are still in a planning or design stage. Refurbished/to be renovated buildings usually refer to buildings that are undergoing "major renovation" as defined in Directive 2010/31[18]. However, in comparison to the energy performance of a building, which very much depends on the building characteristics (e.g. type of heating, insulation) the water performance of buildings depends on specific and localised features (e.g. climate, efficiency of the products). Therefore, the refurbished/renovated criteria would be more relevant when directly linked to the renovation of the bathroom and/or kitchen (or other water installations) of a house/flat. Such criteria were underlined in discussions by several stakeholders from the real estate sector. In the UK, renovation periods of 7 years for bathrooms and 12 years for kitchens are usually observed[19].

Based on expert feedback, a 40-year lifetime for buildings is assumed, resulting in about 2.5% of building stock per year being considered new or to be renovated in the EU (as it will be used in

[16] JRC (2010) Scoping document Identification of suitable water-using product groups for the development of EU Ecolabel and GPP criteria

[17] Department of Energy and Climate change, 2009, Energy consumption in the United Kingdom, Service sector data tables.

[18] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the Energy Performance of Buildings (recast). Art .2 'major renovation' means the renovation of a building where: (a) the total cost of the renovation relating to the building envelope or the technical building systems is higher than 25 % of the value of the building, excluding the value of the land upon which the building is situated; or (b) more than 25 % of the surface of the building envelope undergoes renovation;

[19] From CIPHE, (BN DW TAPS: Briefing Note, relating to projections of internal tap water consumption)

the baseline, see section 1.7). Existing buildings are the buildings in use and where major renovation or refurbishment are not planned. This lifetime period is used when modelling scenarios (see baseline scenario in section 1.7) and forecasting potential water savings. This corresponds to a rather conservative approach, as investments in real estate are expected to become scarcer in the next years due to the economic crisis and the lack of public funds.

In comparison, other initiatives[20] adopt a more dynamic approach, accounting 30 years for residential and public buildings, and a calculation period of 20 years for commercial, non-residential buildings. With regard to a 2050 time horizon, assuming a 20, 30 or 40-year lifetime for buildings does not impact the potential water savings as the whole stock of EU buildings will be renovated by 2050. However, with shorter lifetime periods, the water savings would accumulate quicker (see more explanation in section 4.2.1). Some of the modifications to be made in a building are best included at the design scale, thus it must be taken into account when planning or proposing modifications. When planning new buildings, ensuring that the pipe system allows separating potable water, grey water and recycled water is relatively easy, while installing new pipes in an existing building may be technically impossible. Similarly, for changing specific water-using products (WuPs) such as toilets, the changes require relatively high efforts compared to changing a showerhead, or even a washing machine.

1.2.3 Initiatives regarding water use in the building sector

Many initiatives are currently in place in the EU and beyond to improve the environmental performance of the building sector which also target water consumption. Initiatives about green buildings, which aim to label a building according to certain certification criteria, include in the UK the BREEAM scheme, in Germany the DGNB, in France HQE, and beyond the EU, LEED (in USA and Canada) and Green Star (Australia).

Regulations are also in place in several MS and national Governments use public procurement to enhance the environmental performance of buildings (in the non-residential sector a high share of the buildings are generally owned or used by the Governments[21]). Through green public procurement, a minimum share of the public buildings (determined by the Government) will be certified. In this regard, the fact that a building is publicly or privately owned may influence the number of buildings that are being certified. The private sector may also make green procurements, but this will impact a lower number of buildings, compared to the public sector. Green buildings generally target a range of environmental sectors, including energy issues, but also water issues (see Annex 2 for further details). In the energy performance, the EU has implemented the Energy Performance of Buildings Directive (initially adopted in 2002, recast in 2010).

The initiatives targeting buildings generally include a wide range of actions such as monitoring leakages more closely, installing high-performance water-using products, reusing or harvesting

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[20] Commission delegated regulation (EU) No 244/2012 of 16 January 2012. Available at : www.eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ%3AL%3A2012%3A081%3A0018%3A0036%3AEN%3APDF

[21] According to the SCI-Network project, the public sector is responsible for 40% of EU construction activities.

water, etc. In addition, there are currently initiatives, at the EU level, focussing on developing criteria about water performance of buildings that could be used for an Ecolabel, Green Public Procurement (GPP) and/or Ecodesign in the sector of water use in buildings and/or water-using products. These initiatives lead the way to promote resource-efficient practices. As another implementation tool, existing instruments such as energy labelling and the Energy Performance of Buildings Directive (EPBD) could be widened to include water efficiency.

A mapping of the different available schemes in the EU is presented in Annex 2 and this analysis identifies three levels of improvement: horizontal / macro level, product level, and at the building level.

1.3 Challenges in water use in buildings

The issue of water management is both local and seasonal and links to water quality issues. Indeed, water is both less available and more used in the summer, and even more so in Southern Europe, both an area of low rainfalls and high tourism. Other EU areas are also water scarce due to low rainfalls and because the demand for water exceeds the supply (e.g. South-Eastern UK). Water quantity and quality are closely linked as more water used, e.g. in buildings, will result in more wastewater being released.

Furthermore, most uses of water are related to energy consumption. Before arriving in the public supply system, water is pumped and purified. In the building, before being used, water is heated where relevant, and pumped to higher levels in buildings. Lastly, once it has been used wastewater is pumped and treated. However, increasing only the water efficiency of a building is not sufficient to reduce these impacts, the total amount of water used must be reduced (if a more efficient device (e.g. a showerhead) is used for a longer time, the total water used could be higher than a less efficient device used for less time), or the number of cycles that the water is used must be increased (as this will reduce the pumping step, usually requires less treatment, etc.).

Lastly, water is a resource that should not be wasted, both for "ethical" reasons, for ensuring that ecosystems continue functioning, and support human activities, and for economic reasons, as water is needed to sustain many sectors (for cooling power plants, for agriculture, for cleaning purposes everywhere), and reductions in energy and other resources occur by reducing water uses (see previous paragraph). Water used inefficiently in buildings becomes lost, whether in the building itself through leaks (in that case it can even cause damages to the building), or by becoming wastewater.

From these considerations, the main aim of any policy targeting a better water quantity management in the EU is to reduce pressure on water bodies, especially in water scarce areas and at specific times of the year (i.e. reducing peak consumption), while ensuring a safe water quality. However, reducing water use in buildings will also contribute to reducing global energy and financial costs, through reducing the need for pumping, heating and treating water. Such knock-on effect will be relevant throughout the EU and targets all building types. In order to reach this goal two types of measures are available: reducing water use or reusing water.

Finally, targeting buildings means targeting all EU citizens, through their usage of water, and may result in savings in other areas at the same time, by raising awareness on the issue of water quantities and its tight links to other areas, improving sustainability in general.

1.4 Type of measures to reduce pressure on water bodies

While initiatives have been taken to increase the water performance of buildings (see section 1.2.3), progress in uptake of the measures is still low. This is linked to a low awareness of water quantity issues, with water considered an abundant good, and prices generally not reflecting its value. This leads to low attention given to water wastage, including through leaks, leaving taps open, or choosing inefficient WuPs or buildings because of low awareness.

The first type of measures will address the reduction of the water use. In buildings, this will go through improving behaviours, improving the efficiency of WuPs or improving the performance of buildings. Behaviour is important as several flushes of toilets or longer showers will have important impacts on the amounts of water used in buildings, including when efficient WuPs are used.

The second type of measures will address the use of alternative sources of water, including harvesting rainwater or recycling wastewater. This reduces potable water consumption, but requires technically that piping networks are separated and that the water is used only for adapted uses, for instance for toilet flushing or gardening.

1.5 Affected parties

Building constructors will be affected by the implementation of policies, as they will have to innovate to increase water efficiency of the buildings, especially if minimum requirements are set through a legally binding measure. However, in the case of voluntary public procurements by the government, de facto a constructor will have to provide buildings that meet the requirements to enter that market. The design and construction costs may be increased compared to a less efficient building. This may impact the future owners, who would pay a higher price when buying the building/flat, but well-planned and properly-designed installations are generally much more cost-efficient than complementary installations that have to be introduced during refurbishment and, over the life-cycle of the building the occupiers would pay less for their consumption.

Another party that will be impacted is the WuP manufacturing sector. Similarly, innovations will be required to increase water efficiency, depending on the level of requirement. Innovation however also allows entering new markets, and may provide jobs.

The owners of the buildings will be affected, as they may have to improve buildings when being refurbished, or when changing the WuPs in the buildings. Tenants will also play a role in changing certain types of WuPs (e.g. dishwashers, washing machines). The distribution of costs between tenant and owners is important to take into account, as the owner will make most investments, while the tenant will gain the benefits of reduced water bills. In the EU, about 50% of residential buildings in the EU are owner-occupied (40.3% in Germany to 71% in the UK[22]).

The population at large will tend to improve behaviour and make more informed choices in terms of the water efficiency of the products and buildings it uses, if better information is provided both about the (local) situation and the possibilities for improvement. A study[23] prepared for the Consumer Council for Water (UK) showed that three quarters of customers are already doing something to reduce their water use. Based on the results from the EC public consultation (see Annex 4), awareness-raising campaigns are most likely to be accepted by the EU population, compared to other potential water measures.

Water companies will also be affected as a reduced water use will impact infrastructure and adjustments may be needed to ensure safe and sufficient water supply and sanitation systems. Moreover, the water industry is a key actor to promote water-efficiency and thereby stimulate competition as acknowledged by several stakeholders.

Lastly, if certification systems are put in place and/or harvesting/recycling systems promoted, auditors, verifiers and plumbers will benefit from water-efficient schemes. Indeed verifications of compliance for labels or requirements will be needed and plumbers will be in charge of installing WuPs or water harvesting/recycling systems.

1.6 Drivers of water use

An important driver of water use in buildings is the behaviour of its inhabitants. As shown above, the main water uses are linked to toilets and personal hygiene (in all types of buildings), thus several flushes of toilets or longer showers will have important impacts on the amounts of water used in buildings. The use of efficient water devices plays a role in reducing this usage, for instance by choosing dual flushes or by reducing the water flow in showers. Using alternative water sources such as non-potable water sources (rainwater or grey water) is another solution to reducing pressure on water bodies. The quality of such water must be in line with its use, for instance it can be used for toilet flushing or gardening. It is important to note, however, that installation of a water-saving device by itself will reduce the water use to a certain extent, but the consumer behaviour plays an important role in achieving its desired potential.

1.7 How will the problem evolve? (Baseline Scenario)

In order to gauge the scale of water savings that potential policy options might bring in each of the MS, a model of water use was constructed (as further described in Annex 1). The starting

[22] See www.eracobuild.eu/fileadmin/documents/Final_Report_Erabuild_Susren_050208.pdf

[23] DJS Research 2011, Annual Tacking Survey 2010. Consumer Council for Water.

point for the baseline scenario is the current patterns of water use in buildings across the EU 27[24] and the water use is then modelled to a 2050 time horizon.

These consumption patterns include the effects of the different levels of WuP efficiency and any cultural/behavioural differences that exist between countries. These current water use patterns also implicitly include the effects of any water efficiency policies that are already in place.

Five countries, France, Italy, Germany, Spain and the UK account for 49% of total municipal water demand, but this is to be expected as 41% of the EU-27 population resides in these countries. Figure 6 shows the residential water use per capital in the different MS, based on JRC data. As highlighted by several stakeholders during the consultation, gathering clear information about water use in buildings in the different MS is a difficult task. These figures should be considered with caution - in particular for Latvian and Italian water uses, which seem not realistic. For Italy, the relatively high water use per capita could be partly explained by the very low price elasticity of the water demand (as seen in Figure 7, Italy has a particularly low price elasticity). In the Baltic MS, after the collapse of the Soviet Union, the drinking water consumption has dropped below 120 L/d/cap[25] due to the installation of water meters, decreasing population and recession of industry (which could explain the Latvian, but also partly Lithuanian and Estonian figures). While the JRC data may not fully reflect the reality, finding data from other sources to complement the analysis would introduce the risk of using data that include different water uses in the definition (e.g. not only residential water use) and/or apply to other years and would not be consistent with the used dataset.

Having established current water consumption patterns, the following step is to develop an understanding of how water use patterns are expected to change in the future without policy changes at EU level (thereby defining the baseline scenario), in order to be able to compare the water consumption in the baseline against the impacts of a range of policy options.

The key factors that are likely to influence water use patterns in the future are:

- The number of buildings and building occupants[26] (linked to population projections[27])
- Changes in the demand for water services (e.g.an increase in the typical number of showers taken)
- Changes in the efficiency of water using products (including typical efficiency expectations in the future and typical lifetime of WuPs)

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[24] This information is provided in the JRC report "Identification of suitable water-using product groups for the development of EU Ecolabel and GPP criteria: Scoping Document, Aurélien Genty, Andreas Uihlein and Oliver Wolf, March 2010

[25] T. Juhna, 2006, Report on trends in Eastern European countries - Example of the Baltic states. FP6 TECHNEAU report. Available at : http://www.techneau.org/fileadmin/files/Publications/Publications/Deliverables/D1.1.3.pdf

[26] For the domestic sector the typical number of occupants per household will also have a secondary impact especially for some activities that are primarily communal (e.g. cooking). Water use per capita is likely to be higher were household size is lower.

[27] The model is based on water use per capita. No assumptions need to be made on the number of buildings or the occupancy rate. The evolution is directly linked to population projections.

- Behavioural changes in response to greater awareness/desire to make water savings (e.g., not leaving taps running, mending leaks, taking shorter showers)
- Behavioural changes in response to more exposure to climate change effects (i.e. water scarcity and droughts), leading to a higher demand for water (e.g. gardening, pool)
- Spread of voluntary measures to "green" buildings
- Requirements implemented at national or EU levels (e.g. GPP on HQE buildings in France, extended coverage of water-metering in the UK, etc.).

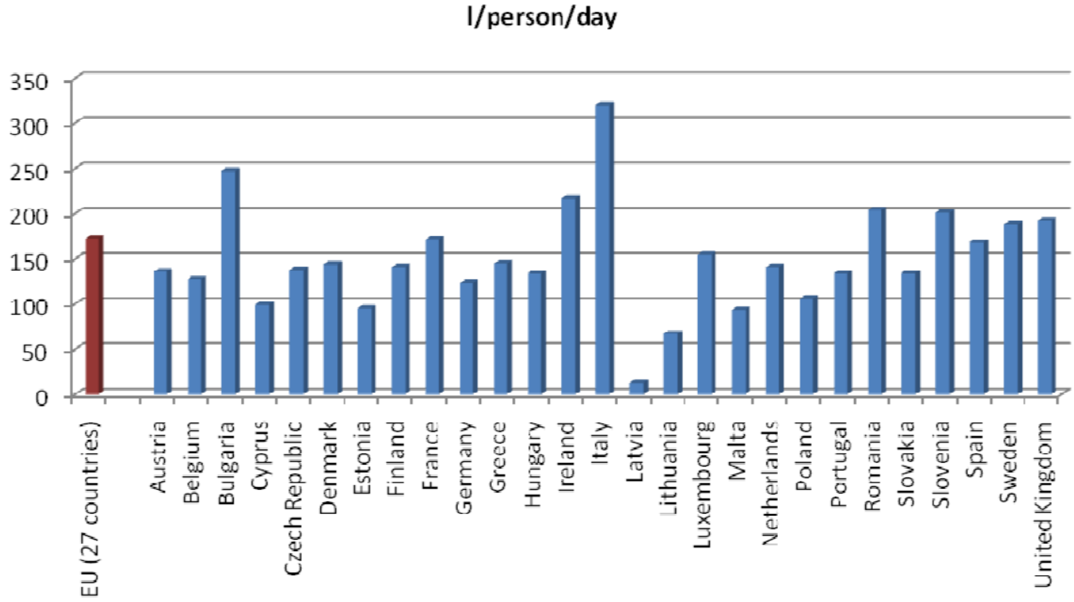

Figure 6 - Residential water use in the EU and MS[28]

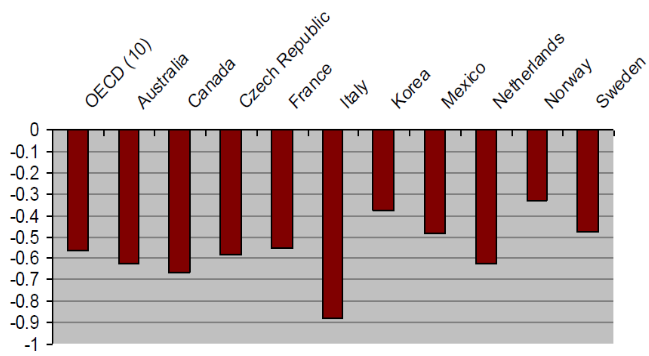

Figure 7 - Price elasticity of water demand[29]

[28] JRC, Ecotapware, Task 2: Economic and market analysis and Task 3: User behaviour, 2011, First Interim Report, Draft. The very low value for Latvia seems to be an outlier, which can probably be attributed to statistical inconsistencies.

[29] OECD, 2009, Determinants of Residential Water Demand in OECD Countries, presentation by Q. Grafton.

In a first approach taking into account a simple population growth but no other changes in water use patterns, the current water use at EU level of 40,000 Mm^3 in 2010 is expected to rise to 42,600 Mm^3 in 2050. However, in order to provide a valid baseline against which to assess the effect of potential policy options, other factors listed above should be taken into account. After consultation with experts from the water and building sectors and further validation with stakeholders, the projections of the baseline scenario include:

- At horizontal (overall) level: 1% of water savings until 2025 and 1.5% of water savings from 2026 to 2050 for all types of buildings.
- At product-level: 15% of savings for residential buildings and 30% of savings for non-residential buildings, with an uptake of 5% for existing buildings and 10% in new buildings
- At building level: 25% of savings for residential buildings and 40% of savings for non-residential buildings until 2025 (and respectively 10% and 12%, from 2026 to 2050), with an uptake of 0.1% for existing buildings and 1% in new buildings until 2025.
- The direct potential savings (independent from the uptake rate) are further described in section 4.2.1 where the impacts on water use are investigated.
- The potential changes in water demand induced by climate change have not been modelled as no data on the impacts of CC on demand for buildings at EU level were found and given the uncertainty and the geographic heterogeneity of the changes induced by climate change.

Figure 8 shows the total water use in buildings in the EU until 2050 and highlights a 5% decrease in the baseline scenario (from 40,000 Mm^3 in 2010 to around 38,700 Mm^3 in 2050). Compared to the first EC study on the water performance of buildings (2007) where a 2-3% decrease was forecast after 20 years, a more robust model was developed here and a stronger stakeholders' involvement was organised to back up the analysis.

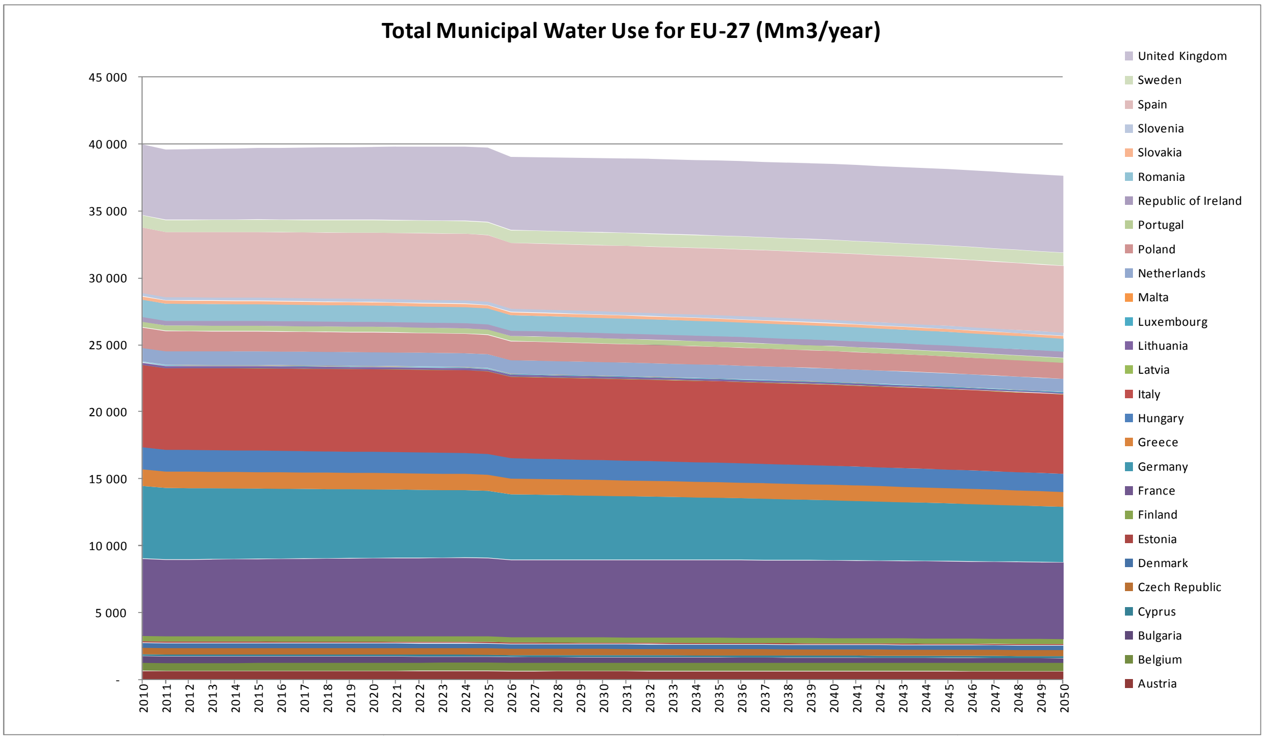

Figure 8 - Water use in buildings in the EU until 2050 – baseline scenario

1.8 Link to other EU actions and EU right to act

Water scarcity, droughts, floods and water quality problems affect most European river basins, many of which are transboundary. Even though the challenges related to water are mostly felt on the regional or even local level, similar problems occur in different regions throughout Europe and EU wide initiatives could create an opportunity for finding common solutions.

Recent studies show that competing demands for scarce water resources may lead to an estimated 40% global water supply shortage by 2030. Climate change is affecting all MS, and river basins will have to face reduced water availability in different parts of the EU, even if Southern MS are the most impacted already and will continue to be.

Therefore, to achieve water resources protection and sustainable water management, a more sustained effort is necessary by all decision-makers, users and stakeholders at all levels.

All sectors need to contribute to water saving efforts in the EU and as identified in the introduction; the option to explore a policy for improving the water performance and water use in buildings is in the framework of the Blueprint to be released end of 2012. The Water Framework Directive (WFD) includes in its purposes the "[promotion of] sustainable water use based on a long-term protection of available water resources". Daughter Directives are also important for the use of water in buildings, including the Drinking water Directive and the

Wastewater Directive. The Resource Efficiency Roadmap[30] reaffirms the requirement of the WFD and includes milestones regarding water, including "good status – quality, quantity and use – of waters attained in all EU river basins in 2015".

The EU policies listed show the involvement of the EU in water quantity issues and ways to deal with them at EU level, however there is no EU wide initiative as regards water efficiency in buildings. Several initiatives in certain MS have been identified that show that national actions are already in place (raising awareness, requiring efficient WuPs and as voluntary "green" building schemes) and taking increasing importance. However, for the moment, while moves towards a common building scheme are said to be occurring, no scheme seems to be achievable in the short term. Efforts to implement an eco-label for buildings also show difficulties for the moment.

Geographic patterns show, illustrating the impacts of WS&D mainly in Southern MS and specific river basins, in which areas actions are clearly required and may be implemented by local or national authorities alone. A specific river basin approach – possibly based on EU-wide common indicators - is preferred by several stakeholders as some EU regions (e.g. BE, DE) already show a low water use per capita. However, at the global level, reduced water use will be beneficial throughout the EU, through the knock-on effect on energy, financial cost reductions and reduced pollution by reducing wastewater. If a policy is implemented, it is thus important to ensure that local specificities are taken into account.

Water is a common resource, with many river basins being shared among several MS. Therefore, water management is not a marginal issue; nor is it limited to a few Member States. The transboundary characteristics of water and the challenges that lie ahead require a holistic and integrated approach that can best be tackled on the European level. There are little incentives for some to become more water efficient (especially those upstream) if other MS do not pursue a similar objective. Additionally, while efforts and initiatives have been progressing about water quality thanks to the WFD, overall insufficient progress has been achieved by the MS regarding water quantity management since the adoption of the WS&D policy. Initiatives at MS level are increasing, but are not harmonised and are fragmented across the EU.

Buildings are often regarded as a local matter, with buildings being stationary. However, seeing the importance of the construction sector in the internal EU market, EU action would have added value compared to isolated efforts by each MS. In order to reduce obstacles in the internal market, EU action would be required so that technical requirements are harmonised, at building level, but also at product level. Manufacturers of WuPs generally sell their products in more than one MS, and would benefit from similar technical requirements across the EU. Similarly, with a common scheme on water efficiency in buildings, constructors that work throughout the EU will only be required to implement one scheme. Also for small and medium sized companies working in the EU this may be beneficial as a new market will emerge with opportunities. A targeted EU action would thus foster new action and complement MS initiatives.

[30] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2011) 571 Final, Roadmap to a Resource Efficient Europe, 20 September 2011, available from http://ec.europa.eu/environment/resource_efficiency/pdf/com2011_571.pdf

Based on the outcomes from the EC public consultation, potential EU measures to address water efficiency in buildings are usually perceived as important and useful by the EU citizens - as shown in Figure 9, although the regional specificities should be properly addressed. On the whole, there is support for EU-level action.

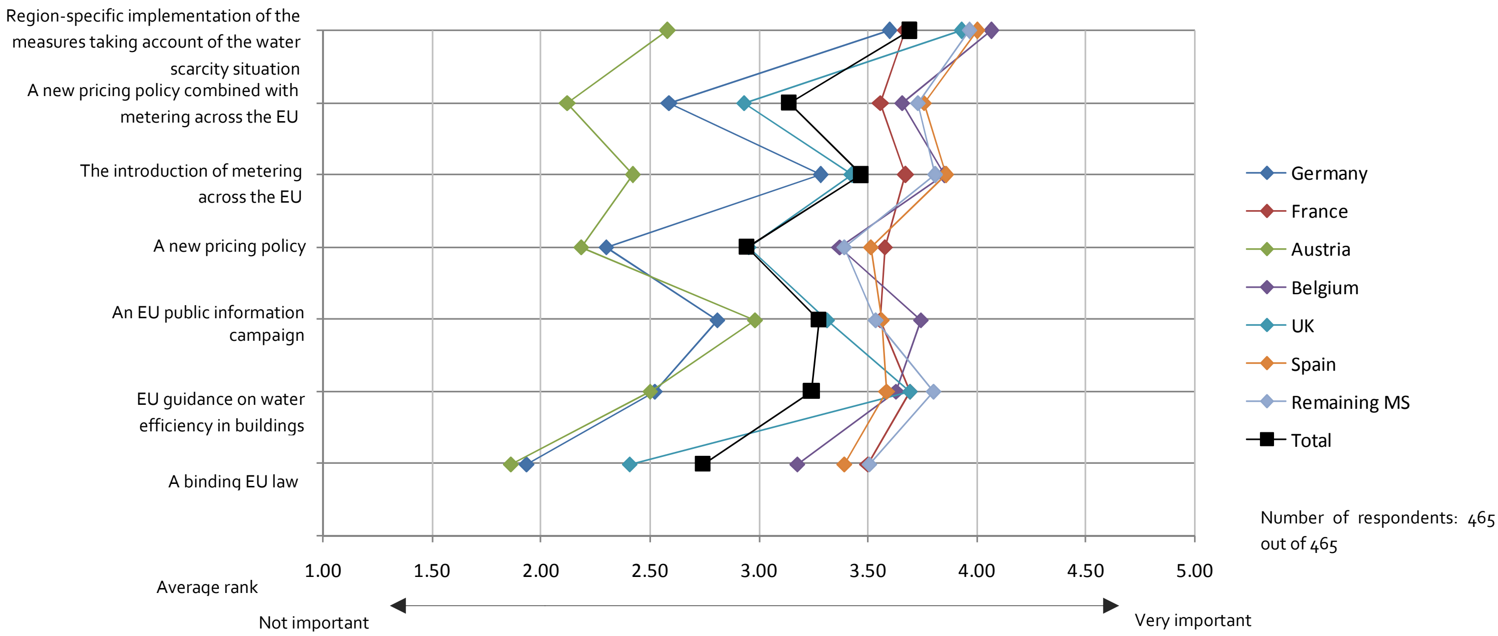

Figure 9 - Results by MS to the question 'Considering future EU action on water efficiency in buildings, which measures would you consider useful?'

Chapter 2: Objectives

This chapter defines the objectives that the EU aims to achieve through improved water performance of buildings. These objectives would necessarily build on the water-related objectives of the EU, including the WFD and daughter Directives. These will serve as the basis against which the performance of different policy options will be measured, e.g. reduced water consumption in buildings, while ensuring that other dimensions of EU policies are not affected negatively (employment, level playing field for companies, etc.).

2.1 Main objectives

The main objectives of the implementation of the proposed policy options for improving water performance of buildings are to achieve the following goals:

- Reduce the negative impacts of the over-abstraction of water on the environment and ecosystems,
- Improve efficiency of resources use (water, but also energy embedded in water use).

2.2 Specific objectives

More specifically the goals that the policy is meant to achieve are to:

- Improve water efficiency in buildings,
- Increase water savings in water scarce areas and seasons,
- Improve the behaviour of water users to encourage responsible water use,
- Increase reuse of water where relevant, and
- Foster energy savings by reducing water pumping, heating and treatment requirements.

2.3 Operational objectives

The study assesses whether implementing the proposed policy options will:

- Reduce the amount of water used in buildings,
- Reduce environmental impacts linked to water use (energy, treatment, etc.),
- Allow MS to adapt the requirements to the water availability in their own country,
- Promote synergies between initiatives to reach higher water savings, and

- Consider the savings at different scales (household/enterprise, building, town, region, national, EU levels).

  In addition, the policy option should:

- Be proportionate to the goals sought,
- Consider the context of different MS,
- Harmonise the requirements between MS,
- Ensure the administrative and financial burdens on the EU, MS authorities and enterprises are not too high,
- Balance the costs and administrative burdens between the EU, the MS and the enterprises, as well as across the EU-27, and
- Take into account impacts outside the EU.

Chapter 3: Description of the policy options

3.1 Identification and selection of the main policy options

Existing initiatives on the water performance of buildings in the EU-27 and beyond were screened in order to set a comprehensive mapping of potential schemes. This overview resulted in the identification of 24 potential policy options.

A preliminary assessment of those options was conducted, based on several criteria:

- Technical feasibility
- Potential for water savings
- EU applicability
- Potential risks
- Costs of investments

This enabled to filter out the options which represent low potential and define 3 policy levels: Horizontal Policies, Product, and Building level policies, on which the detailed assessment is focussed.

Table 4 - List of policy options

Horizontal Policies	Product-level Policies	Building-level Policies
Water metering / smart-metering (H1)	Voluntary Labelling (P1)	Voluntary water performance rating/auditing of buildings (B1)
Water pricing and cost strategy (H2)	Mandatory Labelling (P2)	Mandatory water performance rating/auditing of buildings (B2)
Awareness raising and education (H3)	Minimum water efficiency requirements for water-using products (P3)	Minimum water performance requirements of buildings (B3)
		Certification scheme for water reuse and harvesting (B4)

Regarding the Product and Building level options, different policy instruments are further investigated based on progressively stricter implementing measures: voluntary schemes, mandatory schemes, and minimum requirements. The influence of accompanying those measures by information and education campaigns as well as financial incentives is also investigated. The good dissemination is key to ensuring the success of financial incentive schemes, thus the option looks at implementing financial measures as well as information campaigns. The following section describes the policy levels and related options (listed in Table 4) with their main advantages and issues, and the next chapter assesses the impacts of each policy level, per policy instrument.

3.2 Horizontal Policies (H)

3.2.1 Water metering / smart-metering (H1)

Water metering in buildings provides information to the user in terms of how much water their household consumes. The consumer is then likely to become more engaged in monitoring its water use, leading to more efficient water use, but also more active involvement in the identification of leaks. The metering of water use is in place in many EU Member States (such as DE, FR, ES, PT, and BE) but is inconsistently applied (e.g. hot water metering for each dwelling and cold water metering for the whole building). Water metering is reported to be also strongly linked to water pricing discussions that recently took place in AT, BG, BE, EE, ES, NL, SE and UK, or that are still under development (CY, CZ, IE, RO, and SK)[31]. In the UK, metering is already implemented in certain regions (around 37% of the England and Wales territory in 2009-2010), and work is under way to meter water in more regions (up to 50% by 2014, 90% in water-stressed areas[32]). Ireland is expected to install meters in the country in a near future. Research shows that 57% of customers support metering as being the fairest basis to charge (to avoid that two identical homes pay the same whereas their occupancy rates differ) and 77% of customers would be happy to be charged for the water used as measured.

Water-metering could face technical constraints as individual dwellings and related piping may not allow the installation of individual meters at the suitable points of entry. Based on the outcomes from the EC public consultation, 15% of respondents have a shared water-meter (see Annex 4).

The implementation of smart water meters, which collect real-time water use information, is also shown to help customers address their water uses and help water businesses manage their network more efficiently, by detecting leakages or any other abnormal use efficiently. From the EC public consultation on water efficiency in buildings, 6% of respondents currently use smart water-meters (see Annex 4). Given the related costs, the implementation of smart-metering could be restricted to water-stressed areas, as pinpointed by several stakeholders.

[31] Third Follow-up Report to the Communication on water scarcity and droughts in the European Union, 2011 Report from the Commission to the European Parliament and the Council.

[32] Ofwat, 2009, Future water and sewerage charges 2010-2015: final determinations

Table 5 - Advantages and Issues with water metering / smart-metering (H1)

Advantages	Raises consumer awareness Fair pricing can be implemented, based on actual consumption and efforts by consumers
Issues	Costs of implementing meters in areas where they are not used May induce change in tariff scheme

3.2.2 Water pricing and cost strategy (H2)

Water prices are often estimated to be too low compared to the actual value of water. The WFD requires water to be better priced to reflect its true costs (Art. 9: water-pricing policies provide adequate incentives for users to use water resources efficiently [...]).

A transparent debate on water pricing in urban services is favoured by water associations. Water is usually considered to have a low price elasticity (see Figure 10). Still, the price of water between different European cities in €/m^3 for an annual consumption of 200 m^3 shows significant variations : the highest price for water is 4.54 €/m^3 in Copenhagen, compared to 0.83 €/m^3 in Rome[33].

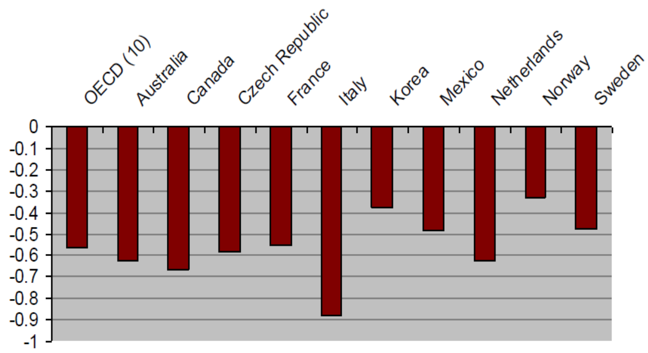

Figure 10 - Price elasticity of water demand[34]

At national level, some price differences are also observed, as highlighted by AEAS, the Spanish water association. That is mainly explained by the availability, quality and proximity of water resources in these places, and the various processes necessary for collection, purification and water purification in each area and / or service.

In Sardinia[35], the urban lifestyle adopted by the residents (3,600 people) has led to considerable and growing water consumption (110 m^3 per capita in 2000, 187 m^3 in 2005), in spite of increasing water prices for drinking water (€ 1.06/m^3 in 2000, € 2.12/ m^3 in 2005)[35]. Pricing policies may be

[33] International Water Association 2008 data on 2007 to check

[34] OECD, 2009, Determinants of Residential Water Demand in OECD Countries, presentation by Q. Grafton.

[35] Corsale, A. , 2011, Environmental conflicts and sustainable water policies in the Mediterranean Region. The case of Sardinia. University of Cagliari, Italy

difficult to organise in places where there is a large high seasonal concentration of tourist activities.

When analysing the outcomes from the EC public consultation on water efficiency in buildings (Annex 4), the number of respondents that believed water to be priced too low was higher than those who felt it to be too high. In Spain and Belgium over a third of respondents felt that water was under-priced, perhaps reflecting an increasing awareness of water scarcity within parts of these countries. The two MS that did not follow this trend were the UK and Austria which could be due to a range of factors including perceived water availability, customer satisfaction with water utilities and the extent to which water services are privatised.

An option is to adapt water tariffs by raising the price of water (possibly including block tariffs to ensure access to water at a fair price for legitimate uses and manage the risk of water poverty). From the EC public consultation, over two thirds of respondents would be willing to save more water if the price was to increase (Annex 4). This would provide a price signal to push consumers to reduce their water use and influence the return on investment for installing devices. Alternatively, pricing policies could be based on other measures than the volume of water used. Customers generally pay utility companies on a volume basis. This may be a disincentive to utility companies to promote reductions in water use. The need to change to an economic model where a service, advising on how to reduce water consumptions (including better monitoring and performance advice) is now recognised by many water utility companies. If such model is implemented, reduction in water uses benefits both the consumer and the water company. It is important to note that reduced water use may not necessarily lead to reduced costs for water, as fixed costs (related to the infrastructure) are an important part of the price paid by consumers. This aspect is currently further investigated in the UK with the "Combining Water and Energy Efficiency" project, in which the Energy Saving Trusts - a non-profit organisation jointly funded by the British Government and the private sector - offers water efficiency advice and customer engagement programmes via telephone calls, mail, organisation of events and home visits[36].

Besides, pricing policies are a way to encourage the use of efficient WuP, the demand for green buildings, the setting-up of metering systems or water reuse/recycling schemes, etc. Pricing policies can be used as an accompanying measure for any of the policy options assessed, since it could provide a price signal to water users and reduce the return on investment time. They allow for flexibility, but provide less certainty about the uptake.

[36] Combining Water and energy Efficiency, 2011, Energy Saving Trust and Waterwise.

Table 6 - Advantages and Issues with water pricing (H2)

Advantages	Provide price signals and influence the return on investment Financial incentives enable more flexibility in decision and may foster quicker uptake of water-efficient schemes.
Issues	Price elasticity of water is low, impacts on different social categories must be taken into account Moving to a new economic model entails challenges Negative rebound effects must be anticipated as much as possible. (e.g. fixed costs)

3.2.3 Awareness raising and education (H3)

Awareness-raising and education is very important for water use, as the sum of the uses of each individual is a part of the pressure put on water resources. Measures to increase awareness raising and education are acknowledged as important by all stakeholders. It may target a wide public, to change behaviours in all types of buildings (homes, office, factory, etc.) both nationally and abroad. Awareness-raising and educational campaigns may be:

- disseminated through different channels: flyers sent to households, phone calls, signs in public bathrooms, web-based communication; through initial or occupational education, or public campaigns;
- targeted to different types of public, with differing interests, motivations, and approaches to policy issues: general public, potential users, children, environmental groups, regulators and/or regulating agencies, home owners associations, educational institutions, political leaders, business/academic/community leaders, etc.
- highlighting different aspects: improving consumption habits and disseminating best practices, explaining the benefits of water-efficient products/retrofits or of water reuse/recycling, improving leak detection, informing about green building schemes, etc.
- implemented by a wide range of stakeholders, including the State, local authorities, companies, etc. Commercial stakeholders could be shown the impact of water efficiency on business costs[37].

The types of channels/messages need to be adapted to the types of buildings: tips on how to reduce the water bill will be useful for dwellings, while e.g. in offices or shopping malls messages

[37]UNEP. Water Conservation: A Guide to Promoting Public Awareness. Available at: www.unep.org/training/programmes/Instructor Version/Part_2/Activities/Interest_Groups/Public_Awareness/Supplemental/Water_Conservation_A_Guide_to_Promoting_Public_Awareness.pdf [Accessed on 14/09/2011]

in the bathrooms to raise awareness on the quantity of water used for washing hands will be more relevant.

The private sector could be involved in such campaigns, as is currently experienced in the UK for energy savings. With the Green Deal, the Department of energy and climate change is now considering the possibility to involve big retailing companies in the "information market" because these companies are in direct contact with the consumers, have large amounts of data on consumer behaviour and have the capacity to run massive campaigns to promote more environmentally-friendly behaviours. However, such campaigns may raise the issue of independence of the information provided by the companies.

Campaigns for water savings are already in place in many countries, and many school programmes include educational messages linked to water. In particular, in Australia, education was consistently named as the major influence for improving water conservation awareness[38]. The focus of education campaigns is most commonly aimed at individual behaviour change, which requires a large target. It also takes time to change behaviours[39]. Such campaigns in the long run seem to be effective in reducing water use. Germany for example started water saving campaigns in school in the 80's and 90's and only nowadays a real impact can be measured.

A broad multi-modal communication approach to conservation messaging may be more effective in changing behaviour in the long run than short sharply focused messages[40]. Also, stating clearly the goals of the water conservation measures is shown to be more effective than general messages. There is no consensus today on the most efficient channel for disseminating information on water conservation. Certain sources suggest including water conservation messages in the water bill whereas others mention TV as the best dissemination channel[40]. Based on the results from the EC public consultation (see Annex 4), awareness-raising campaigns are most likely to be accepted by the EU population, compared to other potential EU measures to foster water efficiency.

Examples of messages sent through awareness-raising campaigns:

- Shortening shower time from 8 to 3 minutes can save about 63 % of water[41].
- Turning off the tap while brushing your teeth in the morning and at bedtime can save up to 30 L of water per day, which equals about 900 L a month.
- Detecting and fixing a leak could save up to 200,000 L/yr/household[42], etc.

As a stand-alone measure, awareness raising carries great potential for water savings. Yet, it is also a crucial tool for a successful implementation of other water efficiency measures. For

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[38] www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-south-east-water

[39] Jeffrey P. & Gearey M. (Unknown), Societal responses to water conservation policy instruments: a literature review and some comments on emerging theory. Prepared for the EPSRC funded network on 'Water Conservation & Recycling'. Cranfield University.

[40] www.waterrf.org/ProjectsReports/ExecutiveSummaryLibrary/4012_Executive_Summary.pdf

[41] www.terrapass.com/blog/posts/get-out-of-the-shower

[42] www.watergy.org/resources/tipsheets/home.php

instance, stakeholders report that in some regions of Belgium, little awareness on EPBD has contributed to the low acceptance of the Directive[43].

In the EU, the European Water Partnership (EWP) is currently creating an online exchange platform Aquawareness (www.aquawareness.eu). Amongst other information on sustainable water management, this platform will compile and present information on awareness raising campaigns. In particular, its mentions the European Water Awareness Program, which aims to introduce a water saving and water efficient culture among political decision makers, key stakeholders and inhabitants within Europe through an improved access to information[44].

Table 7 - Advantages and Issues with awareness-raising (H3)

Advantages	The issues of water-efficiency and water scarcity can benefit from EU scale campaigns. Many lessons from the energy efficiency sector can be adapted and campaigns on environmental awareness can target several areas, including but not limited to water use.
Issues	It is difficult to predict direct impacts of such measures, as it depends on uptake, level of participation, public targeted and messages delivered. Awareness-raising may take a long time before delivering results (e.g. school campaigns)

3.2.4 Summary Table

Table 8 identifies which policy would be more relevant/feasible for different building types. The "+" identify options comparatively more relevant/feasible, with "+++" more relevant/feasible than "+". Policy options H1 and H3 seem more promising, especially when targeted at new or to be renovated buildings. Indeed metering may be difficult to install in existing buildings for technical or costs reasons; and awareness-raising may be even more important in those buildings, as it was identified for energy that residents of new buildings use more energy because they feel since it is more efficient they do not need to be as careful as in less efficient buildings. With regard to (H2), more coordination at water utilities and consumer organisations is needed in order to ensure an efficient and accepted water pricing strategy. Results of a water pricing policy will largely depend on the price setting chosen.

43 UIPI, Paper in response to the Stakeholder Consultation

44 www.ewp.eu/activities/water-awareness/

Table 8 - Summary table for horizontal policies

Horizontal Policies	Residential			Non-residential		
	Existing	To be renovated	New	Existing	To be renovated	New
H1 – Water Metering	++	+++	+++	++	+++	+++
H2 – Water Pricing and Cost Strategy	+	+	+	+	+	+
H3 – Awareness Raising and Education	++	+++	+++	++	+++	+++

3.3 Product-level policies (P)

Water-using Products (WuP) are products that use water to fulfil their intended basic function. WuP include toilets, urinals, showers, taps, washing machines, dishwashers and air conditioning. An increasing number of WuPs present on the market offer improved water efficiency compared to conventional products, such as dual flush toilets, faucet aerators, water-saving showerheads or washing machines. For example, a water-efficient washing machine may use only one-third of the water used by a conventional model. Likewise, a dual flush toilet can save 30[45] to 170[46] L/property per day[47].

Fixtures attached to the building (e.g. toilets) may be differentiated from fixtures that may be changed by a resident (e.g. showerheads), as the difficulty for changing them, costs, and lifecycle impacts will be different. Additionally, whether the products use hot or cold water (and whether they heat the water) has impacts on their energy use and CO_2 emissions; and consumers will choose products whose efficiency is mostly linked to water (e.g. a tap, showerhead, toilet), or to other criteria (e.g. for a washing machine, its washing efficiency and energy use).

Additionally, whether the requirement applies to products placed on the market, fostering that the devices are bought when they need to be changed (end of their lifecycle) has different impacts than if the devices are required to be changed at a certain date in all buildings for instance.

Currently, it is estimated that 394.1 million of toilets are installed in the EU (including 5.1% for public toilets and 77.3% for the domestic sector)[48]. More than 50% are equipped with dual flush

[45] www.waterwise.org.uk/images/site/Policy/evidence_base/evidence%20base%20for%20large-scale%20water%20efficiency%20in%20homes%20-%20phase%20ii%20interim%20report.pdf

[46] www.environment.gov.au/settlements/publications/government/pubs/water-efficiency-guide.pdf

[47] Note that the pressure in the water system may reduce the efficiency of the WuP, and could be an important parameter to include in the standards determining whether WuP are efficient.

[48] susproc.jrc.ec.europa.eu/toilets/docs/1st%20draft_Technical_background_report_oct11.pdf

and about 85% are manually operated. It appears that the most common unit for domestic market is a 6/4-litre dual flush (full flush/reduced flush). In the non-domestic market, single flush systems of 4 and 3.5 litres are more common.

3.3.1 Voluntary Labelling (P1)

Product labelling better informs the consumers of the water performance of a device and allows the comparison with other products, fostering consumer's choice. An example of such voluntary labelling in the EU is the eco-label, for which work is under way to define relevant criteria for taps and showerheads. The uptake rates and penetration in the market of the products can be enhanced by voluntary labelling, but does not necessarily mean that the efficient products will be increasingly bought. Two types of labelling schemes may be implemented, endorsement labelling, such as the eco-label, where the information given is whether or not the product meets the standard; or comparative labelling, which involves a scale, with products performing better/worse than others. A voluntary water-efficient labelling would allow a more significant improvement in product quality than the CE marking, as acknowledged by several stakeholders.

In Australia, the WELS Standard AS/NZS6400:2005 Water-efficient products rating and labelling[49] requires products to meet a certain water efficiency standard to obtain the label, with e.g. 25% of water savings generated for showers. Standards exist for tap equipment, flow controllers, toilets, etc. Another example, is the Energy star label in the USA, mainly implemented for energy saving purposes, but which considers a current Water factor for washing machines <7.5 gal/cycle/ft^3 (around 1,000 L/cycle/m^3) to be reduced in 2011 to 6.55 gal/cycle/ft^3 (around 875 L/cycle/m^3). In the UK, the Bathroom Manufacturer Association (BMA) Water Efficient Product label has up to now been awarded to 28 brands of water using products[50] while ANQIP developed its national water-efficient label in Portugal (see Annex 2).

Table 9 - Advantages and Issues with voluntary product labelling (P1)

Advantages	Information of the consumer Let the consumer choose according to its preferences and needs
Issues	Possibly only already performing products would use the label Uncertainty in the predicted water savings is high

3.3.2 Mandatory Labelling (P2)

A mandatory labelling could be envisaged so that full comparison is ensured in the market stock. For some of the energy-using products, mandatory labelling is already in place (ratings from A to F). A similar label for water could be an option. In that case, all products would be labelled, while in the case of voluntary labelling only some products will be concerned.

49 www.waterrating.gov.au/products/index.html

50 The Water Efficient Product Labelling Scheme, available at www.water-efficiencylabel.org.uk/

Table 10 - Advantages and Issues with mandatory product labelling (P2)

Advantages	All products labelled. Let the consumer choose according to its preferences and needs.
Issues	Costs linked to labelling Common scheme for labelling to implement Uncertainty in the predicted water savings is high

3.3.3 Minimum water efficiency requirements for water-using products (P3)

Water-efficiency mandatory requirements for different types of WuP could apply to products that will be placed on the market in the future, with the purpose of progressively removing the most inefficient products. The efficiency of WuPs is already considered in existing or developing national standards and could be streamlined at EU level and possibly expanded to further categories of WuPs. This would ensure that the least performing products are not available on the market anymore. Examples of standards and future requirements that are being developed are presented in Table 1 below. Ecodesign requirements for household dishwashers and washing machines are already implemented at EU level, through Commission Regulations (EU) No 1015/2010 and No 1016/2010 of 10 November 2010 implementing Directive 2009/125/EC of the European Parliament and of the Council. As toilets (25%) and bathing (35%) are consuming more water in the residential sector than dishwashers (8%) and washing machines (14%) – see Figure 4, focusing on water-efficient tapware, showerheads and toilets is more relevant, as established in the working plan for 2009-2011 under the Ecodesign Directive (and also identified in the selection of policy options, see Annex 3).

Table 11 - Overview of standardisation schemes

Coverage	Framework	Requirements
EU	Ecodesign Directive	Eco-label, GPP preparatory studies for potential requirements for certain categories of WuP (showerheads and taps) - ongoing work by JRC. Ecodesign requirements for dishwashers and washing machines
	Implemented standardisation	Standards for sanitary tapware (not specifically targeting water efficiency): EN 1111, EN 1112, EN 1113, EN 200, EN 816, EN 817, EN 1286, EN 1287
USA	Energy Policy Act (Epact) 1992	Water-efficiency Standards for commercial and residential toilets, for residential bathroom faucets and showerheads.

Coverage	Framework	Requirements
	Energy Independence and Security Act of 2007	Standards for residential dishwashers[51]: - Standard models (around 60 to 75 cm-wide): Water factor (WF) ≤ 28.6L/cycle - Compact models (around 45cm-wide): WF ≤ 19.8 L/cycle

Table 12 - Advantages and Issues with minimum water requirements for WuPs (P3)

Advantages	Future savings can be predicted Ecodesign Directive can be used to implement minimum performance requirements Progressive approach possible, targeting some WuP first, and requiring the changes only when needed
Issues	Need to consider the innovative potential left to the industry Higher costs for the end-users (such costs may in the longer-term be reduced due to innovations being spread), for manufacturers to innovate and to the administration to ensure full compliance.

3.3.4 Summary Table

Toilets and showerheads are the WuPs to be addressed in priority, given their high shares in the residential (where toilets and showerheads represent 45% of the water use) and non-residential (where toilets and urinals represent 80% of the water use) water use patterns.

More generally, product level policies are expected to achieve better outcomes when accompanied by informative and financial measures and when more stringent regulation is adopted (from voluntary to mandatory labelling and then minimum requirements).

[51] As of January 1, 2010: Standard models: WF ≤ 6.5 gallons/cycle ; Compact models: WF ≤ 4.5 gallons/cycle

Table 13 - Summary table for product-level policies

Product level policies		Taps		Showerheads		Toilets		Dishwashers		Washing Machines	
		Res.	Non-R.	Res.	Non-R.	Res	Non-R.	Res.	Non-R.	Res.	Non-R.
P1 – Voluntary Labelling	P1	+	(+)	++	+	++	+++	+	(+)	+	(+)
	P1 + inf. camp.	++	+	+++	++	+++	+++	+	+	+	+
	P1 + inf. camp. + fin. inc.	+++	++	+++	+++	+++	+++	++	++	++	++
P2 – Mandatory Labelling	P2	++	+	+++	++	+++	+++	+	+	+	+
	P2 + inf. camp.	++	+	+++	++	+++	+++	+	+	+	+
	P2 + inf. camp. + fin. inc.	+++	++	+++	+++	+++	+++	++	++	++	++
P3 - Minimum requirements	P3	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	P3 + inf. camp.	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
	P3 + inf. camp.+ fin. inc.	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++

Legend: Res = residential buildings, Non-R = non-residential buildings, inf. camp.= information campaigns, fin. inc = financial incentives. The "+" identify options comparatively more relevant/feasible, with "+++" more relevant/feasible than "+", and in brackets (), when the WuP is not that relevant for the sector.

3.4 Building-level policies (B)

Similar to the options identified on minimum water requirements for WuPs, this option introduces a minimum water performance requirement at the building level. This performance may be measured compared to the per capita use of the building (most relevant for residential buildings), per square meter (most relevant for non-residential buildings), or according to other indicators. Considering the building level allows a better understanding of the whole system's water use and may be more relevant to target those areas with most potential in a given building or geographic area. This scale leaves flexibility in the implementation of water efficient measures to comply with the requirement and foster synergies throughout the building.

The auditing of a building, without labelling scheme, already provides information that can be used as awareness raising, by providing information on how much water is used. Rating then adds the information on whether the standard is met, or comparing buildings together (depending on the labelling scheme).

3.4.1 Voluntary water performance rating/auditing of buildings (B1)

Rating and auditing are tools that allow communicating about a performance against defined standards and comparing performances. The building owner can rate the building (self-rating), or a third party can conduct an audit of the way the building was rated, for objectivity purposes. Rating will provide a grade or notation to the building, while auditing will ensure that the data communicated by the building owner are exact.

The implementation of this policy option would provide a European rating or audit scheme, such as the eco-label being discussed, that would include a number of indicators or requirements that a building would have to fulfil, concerning water performance, but possibly also covering other environmental issues. The scheme could be mandatory (option B3) or voluntary (option B2, e.g. the eco-label). Many options are available for the indicators to be included in the scheme, including calculated or measured indicators, total water use, water use per square meter, number of water efficient devices, etc.

Many initiatives involving voluntary labelling are already in place at national level. Examples of existing schemes include HQE (France), BREEAM (UK), LEED (US), NABERS (Australia) and DGNB (Germany) (see Annex 2). Initiatives are in place to harmonise or investigate potential compatible links and could be further promoted to build a common European scheme[52]. Such scheme would bring a European added value, by implementing the same basic improvement requirements throughout the EU. This scheme could build on the methodology and lessons learnt from well-established schemes, for example related to energy, of which scale and indicators could be adapted for water savings purposes. The indicators could be chosen at EU level, to harmonise the rating throughout the EU, with national scales (or river basin scales),

[52] Deutsche Bank Research, 2010, Green buildings A niche becomes mainstream

which would depend on the building stock (new vs. old buildings, types of buildings) and water scarcity issues in the country.

The aim of rating/audit schemes is to primarily inform buyers or renters of the performance of buildings, so that they can choose more efficient buildings. A building owner would also have to take such schemes in consideration when renovating/refurbishing his buildings. For the buyer/renter, the information may be interesting as it might reduce their water and energy costs, or environmentally responsible buyers or renters may choose the building for its performances. For companies, renting or constructing labelled buildings is a way to show their environmental responsibility and enhance their image.

Rating or auditing alone will not lead to enhanced water performance as it only provides information on the current state of the building. This information then needs to be analysed to identify the areas in which improvements can be made and potential savings would then depend on the tenant or owner's willingness to integrate improvement options. With efficient information campaigns, the demand for buildings with a good WPB rating may lead to incentives to upgrade buildings. Currently demand for green buildings is considered low[53]. The rating/audit scheme would then need to be included in a continuous improvement process, informed by the rating/audit scheme in order to deliver improved water performances. The implementation of voluntary schemes can also be supported by green public procurements, leading to de facto minimum requirements to enter that market (see option B4).

Table 14 - Advantages and Issues with voluntary water performance rating/auditing of buildings (B1)

Advantages	A robust and transparent informative scheme can be set up and harmonised at EU scale. Such a policy option will foster awareness raising.
Issues	No commitment to actual improvement is ensured through only water rating. It is then difficult to measure its direct impacts in terms of water savings Voluntary schemes risk being only implemented by the already "best in class" Rating schemes are generally based on the potential of the building to deliver savings, without ensuring that this potential is reached (behaviour issue)

3.4.2 Mandatory water performance rating/auditing of buildings (B2)

Instead of a voluntary scheme, a similar scheme could be implemented as a mandatory measure. This would follow the example of the energy performance rating of buildings[54], from A to G[55] that

[53] SuperBuildings project, deliverable D.3.1.

[54] information communicated to all new buyers or renters

[55] For an A rating the building must consume <50 kWh/m3/year, for B, between 51 and 90, for C between 91 and 150, for D between 151 and 230, for E between 231 and 330, for F between 331 and 451 and G is above 451 kWh/m3/year.

is in place in France within the implementation of the Energy Performance of Building Directive (EPBD). Such scheme could be extended to integrate data on water consumption.

Table 15 - Advantages and Issues with mandatory water performance rating/auditing of buildings (B2)

Advantages	A robust and transparent informative scheme can be set up and harmonised at EU scale. All buildings are considered and rated Such a policy option will foster awareness raising.
Issues	No commitment to actual improvement is ensured through only water rating. It is then difficult to measure its direct impacts in terms of water savings Rating schemes are generally based on the potential of the building to deliver savings, without ensuring that this potential is reached (behaviour issue)

3.4.3 Minimum water performance requirements of buildings (B3)

The aim of minimum performance requirements is to set a threshold below which it is considered that a building is not efficient "enough". This policy would result in banning the worst water-performing buildings. It differs from the water rating/auditing approach which encourages water-efficient buildings to be certified and to set the example, with unknown uptake rates (a building owner/constructor can choose to enter the scheme or not, and then to use the data to improve or not). These minimum requirements are still flexible as they allow constructors or owners to choose higher standards that must apply. It thus improves water performance of buildings directly. A definition of the water performance of buildings, linked to number of occupants, square meters, or other factors would be required, and the setting of a target for minimum performance. This target could be adapted for different countries or river basins, depending on the local situations, according to a common system that rates each country/river basin.

In the case of green public procurement that requires a voluntary standard to be met (e.g. the French government decided to have 20% of its new buildings certified HQE), a de facto minimum requirement applies, as to enter the market of governmental buildings, certified buildings must be constructed. Green public procurements in buildings may be quite efficient, since the SCI-Network project reports that the public sector is responsible for 40% of EU construction activity.

Minimum requirements can be difficult to set, as a relevant threshold must be found. It requires a good knowledge of current performance and identification of a timeframe and improvement possibilities. They also in general apply more easily for new buildings than existing ones. While new buildings will add to the total water use of the area (unless the new buildings replaces an existing building), implementing minimum requirements means that the new buildings will use less water than they would have if built with other standards.

Table 16 - Advantages and Issues with minimum water requirements of buildings (B3)

Advantages	Minimum performance is ensured and directly results in less water used compared to the baseline scenario
Issues	Difficulties to achieve a standard at EU level, differentiations depending on climatic zones could be suggested Monitoring the compliance of such policy option can lead to administrative burden Difficult to implement on existing buildings

3.4.4 Certification scheme for water reuse and harvesting (B4)

Through water reuse and harvesting, non-potable water sources can substitute potable water for specific uses in buildings, where the lower water quality does not affect consumer's health (e.g. toilet flushing or gardening). Water reuse relates to collecting and reusing grey water[56], i.e. wastewater generated from domestic activities such as laundry, dishwashing, and bathing. Water harvesting relates to rainwater that can be collected and stored from roofs, impermeable surfaces and tanks. While these options are interesting to use water more than once and reduce pressure on water bodies, the implementation of the scheme may lead to negative energy/treatment/CO_2 impacts. Water reuse and harvesting also encompass a number of environmental and sanitary risks that call for suitable controls from national health and environment authorities. Regulations are already in place in certain MS, more or less stringent (e.g. in France limited possibilities exist, while in Belgium it encourages further these systems).

The benefits of rainwater harvesting are related to the local conditions, i.e. amount of rainfall locally. The harvesting will also offer only as much water as is stored, possibly not being best fitted to deal with peak demand. For both systems, the scale at which it should be implemented must be considered, as for isolated buildings a building-system may be useful, while in urban areas a community-system may be better fitted. Indeed, in the UK, the grey water yield of an average house (about 92 L/person/day) is far sufficient to meet its non-potable water demand of 52 L/person/day. On the contrary, with a grey water yield of about 4 L/employee/day, offices require conventional water supply to meet their non-potable water demand of 9.5 L/employee/day). Thus systems that combine the yields of different types of buildings and redistribute them could be most relevant in urban areas.

Rainwater harvesting and grey water recycling are likely to be increasingly used in new buildings under construction, following their success in a growing number of commercial and residential development projects. For example, in Berlin, rainwater utilisation systems were successfully introduced as part of a large-scale urban re-development, the DaimlerChrysler Potsdamer Platz[57]. Rainwater falling on the rooftops (32,000 m^2) of 19 buildings is collected in a 3,500 m^3

[56] "Grey" water must be distinguished from "black" water, which contains human waste.

[57] UNEP, Rainwater Harvesting And Utilisation: Environmentally Sound Approach for Sustainable Urban Water Management: An Introductory Guide for Decision-Makers. Newsletter and Technical Publication. Available at: www.unep.or.jp/ietc/publications/urban/urbanenv-2/9.asp[Accessed on 01/09/2011]

tank. In the EU, Germany is leading the way in encouraging the widespread utilisation of rainwater catchment systems both for domestic supply and commercial purposes. About 50,000 new systems are installed each year, in addition to the 500.000 existing ones (figures are from German manufacturers, for 2001). The EU industry is approaching the installation of 100,000 units per year[58]. From the EC public consultation, the vast majority of respondents indicated that they would be willing to use recycled water for household purposes. Only 12 in the case of greywater reuse and 2 with regard to rainwater harvesting ruled out the use of these resources (out of respectively 323 and 366 respondents). However, it should be noted that a large number of respondents did not express opinion on this issue.

In Tokyo, more than 750 private and public buildings have introduced rainwater collection and utilisation systems. Regarding grey water reuse, in Spain, some local authorities now require new buildings to have water reuse systems installed as part of a strategy to deal with water shortages[59].

Voluntary certification schemes to implement water reuse/harvesting schemes would allow for a better uptake of the systems, reducing sanitary risks and ensuring, from an architectural point of view, that the system is adapted to the building and area. However, a voluntary scheme would leave the door open to non-labelled systems that may be less efficient. A mandatory certification scheme could ensure that the systems meet specifications that are defined by the label, therefore providing better information to the consumer. The option to implement minimum requirements seems however to be most interesting to ensure that sanitary risks and architectural issues are well taken into account and the systems deliver their full potential. In that case, only authorised systems could be put on the market, and possibly only be installed by certified plumbers.

The good dissemination of related financial incentive schemes is also a key element to ensure the uptake of such alternative water schemes. In the USA, architecture, engineering and construction firms and home builders are increasingly making themselves the knowledge source regarding rebates, incentives and grants for water conservation on behalf of their clients. For example, Rain-Bird, a US manufacturer of high-efficient sprinkler systems, provides the link to a dozen state incentive programmes for water-related rebates. In the past, the construction company HDR Architecture was able to convince its client Banner Bank to install a massive storage tank for rainwater harvesting, thanks largely to a 60% grant from the US EPA. HDR found out about the grant programme through a Google search.

[58] www.ukrha.org/rwh/faq/25

59 Domènech, L. and Saurí, D. (2010). Socio-technical transitions in water scarcity contexts: Public acceptance of grey water reuse technologies in the Metropolitan Area of Barcelona. Resources, Conservation and Recycling. 55: 53-62. ec.europa.eu/environment/integration/research/newsalert/pdf/218na4.pdf

Table 17 - Advantages and Issues with a certification scheme for water reuse and harvesting (B4)

Advantages	The use of lower water quality for non-potable uses offers some relief on water abstraction (alternative water sources are used). No or less drinking water is wasted Could be designed at an early stage for new construction plans
Issues	Such policy option needs to be accompanied by targeted campaigns on public perception and education as misuses and sanitary issues may appear Difficult to integrate such systems in existing buildings (technical issues) These systems require standards to be followed, for treatment issues, making sure that pipes are separated, etc.

3.5 Summary Table

Table 18 - Overall summary table

Building Level		Residential buildings			Non-residential buildings		
		Existing	To be renovated	New	Existing	To be renovated	New
B1 – Voluntary Rating	B1	(+)	+	+	+	++	++
	B1 + inf. camp.	+	++	++	+	+++	+++
	B1 + inf. camp.+ fin. inc.	+	++	++	+	+++	+++
B2 –Mandatory Rating	B2	+	++	++	++	+++	+++
	B2 + inf. camp.	+	++	++	++	+++	+++
	B2 + inf. camp.+ fin. inc.	+	++	++	++	+++	+++
B3 –Minimum requirements	B3	-	+	++	-	+	++
	B3 + inf. camp.	-	+	++	-	+	++
	B3 + inf. camp.+ fin. inc.	-	+	++	-	+	++
B4 - Certification scheme for water reuse and rainwater harvesting	B4	-	(+)	+	-	(+)	+
	B4 + inf. camp.	-	(+)	+	-	(+)	+
	B4 + inf. camp.+ fin. inc.	-	(+)	+++	-	(+)	+++

Legend: inf. camp. = information campaigns, fin. inc = financial incentives. The "+" identify options comparatively more relevant/feasible, with "+++" more relevant/feasible than "+", (+) possibly relevant and "-" showing irrelevant options.

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Chapter 4: Impact assessment of selected policy options

4.1 Identification of main impacts

In this section, the analysis focuses on the main impacts that are identified in the table below.

Table 19 - Categories of impacts

Environmental impacts	Economic impacts	Social impacts
Water use	Tenant / Owner distribution of costs	Public behaviour and acceptance
Energy consumption and carbon emissions	Capital costs	Employment
Wastewater generation and supply issues	Operation and Maintenance costs	Sanitary and health issues
	Administrative and Enforcement costs (including red tape[60])	
	Potential side costs (including assets / infrastructure lifespan)	

The impacts are analysed and discussed comparatively to the baseline scenario (see section 1.7) where no EU action is implemented and all estimations provided are additional to that baseline.

For water and energy uses as well as economic impacts, the impacts were quantified based on the existing information collected from the literature and further adjusted after feedbacks from experts/stakeholders.

For the remaining categories of impacts, a qualitative assessment is provided. Given the low availability of quantitative data, data gaps, and difficulty to compare data from several sources, extrapolation would have produced irrelevant data at EU level, it was indeed not possible to quantify and/or monetise the impacts for all categories.

[60] Administrative burden

4.2 Environmental impacts

4.2.1 Water use

All the policy options are aimed at saving water, and/or reducing the pressure on water bodies (and thus reducing i.e. groundwater depletion), but each of them will lead to lower or higher reductions in water uses. Water saved may be used by ecosystems and help reach the "good status of waters" that is the aim of the WFD, or be used for other human needs (drinking water, etc.) where water availability is sufficient for ecosystem uses.

For each selected policy option (except H2), the potential water savings were quantified by considering the water saving potential (%) compared to an inefficient building and the estimated uptake (%) of the implementing measure. Both figures are the key input data to a model that enables to compute and forecast the overall water savings by 2025 and 2050, compared to the baseline scenario. These entries were estimated from the literature review (with the implementation of similar schemes in MS or in third countries) and further adjusted and validated after discussions with experts and stakeholders. The model outputs must then be taken with caution, as they reflect an assessment using several sources and may be higher if consumers are taking more actions to reduce their water use, or lower in the opposite case.

It is important to highlight that the estimations of potential water savings for the different policy options are calculated when computing a 40-year lifetime period for all types of buildings (see Figures 7, 8 and 9). This reflects a conservative approach. Shorter lifetime periods (between 20 and 30 years) could have also been envisaged for the quantification of water quantities (see section 1.2.2). With regard to a 2050 time horizon, the total water savings compared to the baseline scenario remain unchanged as the whole stock of buildings would have been replaced. However, for a mid-term perspective (2025), the water savings would have been higher when considering a shorter lifetime periods as more water-efficient buildings would have been introduced in the market in 2025 (new or refurbished buildings).

- Horizontal Level Policy (H)
    - Water metering (H1)

In the UK, water metering is estimated to be able to achieve average water saving of 10-15% per household (35-52 L/d assuming 147.8 per capita consumption and a 2.36 occupancy rate). Higher reduction of 17% has been observed at Wessex Water[61]. Further water savings could be obtained with the introduction of "smart" metering and structured tariffs, for example rising block and seasonal tariffs[62] (see also H2). The "Fairness on taps" coalition of organisations (2011) estimated average water savings of 25 L/cap/day with metering[63]. A study undertaken in Spain[64] shows that

[61] Wessex Water, 2011, Towards sustainable water charging – summary of interim findings

[62] www.environment-agency.gov.uk/research/library/publications/40731.aspx

[63] Fairness on Tap, 2011, Making the case for Metering.

[64] Cobacho, R. Low flow device in Spain ? How efficient are they in fact ?An accurate way of calculation. Institute for Water Technology. Polytechnic University of Valencia. Spain

10% of water savings can be gained with metering via a better localisation of water leakage in the building, leaving the possibility for the landlord as well as for the tenant to directly address the problem. 10% of the residential buildings water consumption in Spanish cities represents 9,760 Mm^3/year. These results seem to be consistent with what has been observed in Austin (Texas) where sub-metered apartments use 15.3% less water than multi-family buildings in 2008[63].

There is evidence from the UK that there is an instant drop in consumption of some 10%[65] when meters have been being installed. In Hamburg, Germany, domestic water consumption for metered apartments (112 L/capita/day) was 18%[66] lower than for unmetered apartments (137 L/capita/day) in 1992.

Based on this evidence and further feedbacks from experts, the assumption is that 10% of water is saved for about 25% of the EU population (which does not have full implementation of water meters yet, in line with the outcomes from the public consultation). This improvement in efficiency however occurs only once, once the metering has been put in place.

- Water pricing and cost strategy (H2)

Uncontrolled water use may be explained by a general low valuation of water. Pricing could take into account externalities so that water is no longer taken for granted by consumers.

Reduced water use could be achieved if water is to be better priced in some Member States. In the EU water tariffs range from 0.962 €/m^3 in Portugal to 5.24€/m^3 in Denmark[67]. A Spanish awareness-raising initiative launched in Alcobendas aimed at reducing 15-20% of the total domestic water consumption through the introduction of water saving mechanisms including pricing in 5,000 houses (1/6 of the total), 10 public buildings, 30 hotels, bars and restaurants[68]. Based on international evidence, a 8-14%[69] range for water reduction was attributable to shifting from non-incremental Block Tariffs to Incremental Block Tariff (IBT) charging, with however an acknowledged uncertainty.

However, social constraints and differences in income levels make it difficult to compare costs, which cannot be influenced much by the EU. The risk for an increase in water-poverty was raised by several stakeholders.

The use of flat rates in buildings may lead to a lack of responsible consumption behaviours. Billing according to real consumptions (for hot water as well as cold water) would enable potential water savings as consumers would have an economic incentive to save water.

Depending on the prices of water, whether block tariffs are implemented etc. water could be saved, but it is unclear what amounts could be saved through that lever.

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[65] Lis Stedman: Motivations for metering, Water 21, The Magazine of the International Water Association, April 2006, p. 26-28

[66] Trinkwasserversorgung in Deutschland, DIW-Wochenbericht 39/1993

[67] JRC, Ecotapware, Task 2: Economic and market analysis and Task 3: User behaviour, 2011, First Interim Report, Draft.

[68] www.panda.org/downloads/europe/pricing2.pdf

[69] WWF-UK, 2007, Waste Not, Want Not Sustainable Water Tariffs

▷ Awareness Raising and Education (H3)

Behavioural issues may reduce the efficiency of most water saving policy measures. An exception is self-regulating washing machines which adapt the amount of water to the weight of clothes loaded into the machine (probably the only WuP which adapts to human behaviour). In most cases, a lower (more efficient) shower flow may be compensated by a longer shower. Likewise, people might feel the need for double flushing in low flush toilets and for cleaning them more frequently. Water efficiency measures would therefore benefit from being accompanied by a communication campaign.

Broad water efficiency campaigns at EU level could improve consumer behaviour, by ensuring that people use the double-flush system, reduce their time under the shower, etc. Overall, everyday life behaviours at the individual scale have great potential in saving water. In Denmark, a campaign targeting unnecessary consumption and habits alone was estimated to allow a reduction in water consumption by up to 15%[70].

From the Australian experience, awareness-raising about household retrofit and audit services (including installation of water efficient appliances such as showerheads, flow regulators and toilet flush controls and minor leak repair) may contribute to greater household water savings when compared to water saving campaigns focused on buildings with minimal requirements (cutting household's water use to under 150 litres per person per day), and monthly water statements (a document sent to households each month to advise of their recent water consumption and water saving information)[71]. Yet, some experiences show that awareness raising campaigns sometimes failed in reducing water use, although they may have raised awareness of a certain share of population. In the UK, an assessment of the effectiveness of promotional campaigns on water-use behaviour[72] showed that there was sometimes no significant evidence of any change in behaviour.

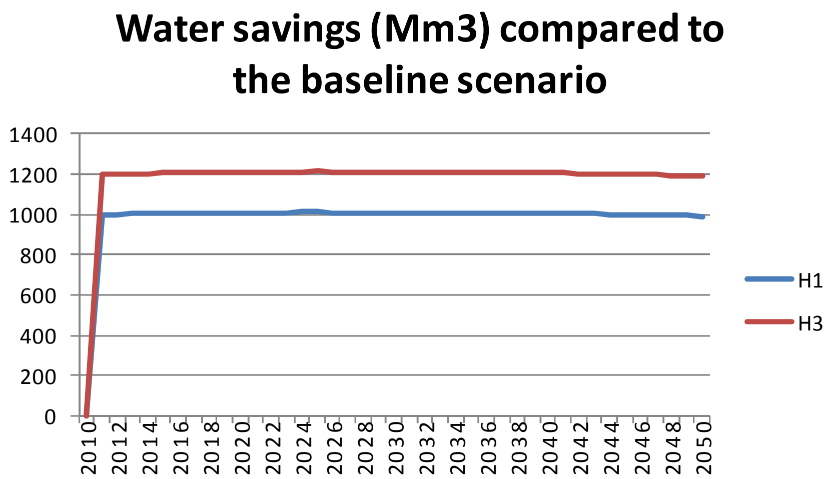
Based on this evidence and further adjustments from experts, it is assumed that 3% of water will be saved at EU level with stand-alone awareness-raising and education campaigns.

Water savings induced by the implementation of (separate) horizontal policies are illustrated in Figure 11.

[70] www.amsmiljo.dk/pdf/Vandbesparelser% 5B1% 5D.pdf and www.amsmiljo.dk/om.html

[71] www.watergy.org/resources/tipsheets/home.php and www.watergy.org/resources/tipsheets/municipal.php

[72] www. paginas.fe.up.pt/~mjneves/publicacoes_files/data/es/ponencias/por_autor/pdf/10086.pdf



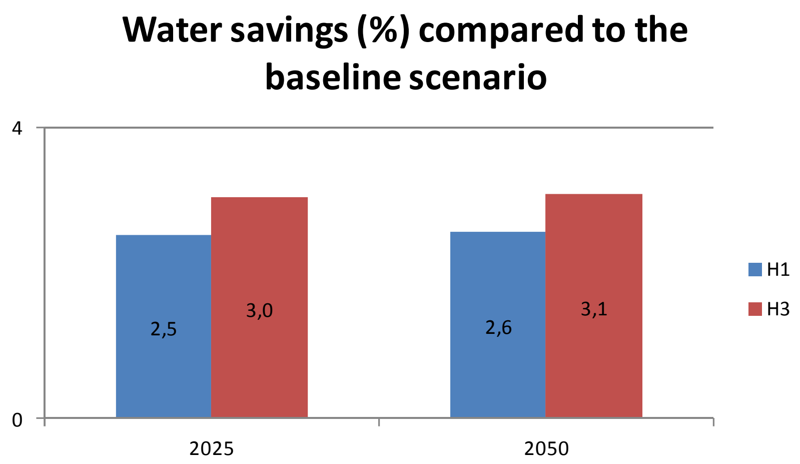


Figure 11 - Water savings with horizontal policies

- Product Level Policy (P)

Several studies assessed water savings from the implementation of water efficiency options at the product level[73,74,75,76]. Table 20 summarises key figures for water savings from the literature review. 65% of all indoor water use occurs through hygiene and flushing[77]. Bathrooms are therefore a major area for water savings. For example, in the UK, a 6 L/min showerhead to replace a 16 L/min existing showerhead, together with a 4.5 L toilet to replace an old 9 L one, could result in annual savings of 67 m^3 water for a household with a standard occupancy of 2.4 (persons) [78]. Waterless (composting) toilets have not been considered as a potential water-efficient option in this study as it currently represents a niche market. Even if the uptake of such

[73] www.watergy.org/resources/tipsheets/home.php and www.watergy.org/resources/tipsheets/municipal.php

[74] www.melbourne.vic.gov.au/Environment/SavingWater/Documents/water_turning_blue.pdf

[75] Defra, Science Report –- Greenhouse gas emissions of water supply and demand management options

[76] Waterwise, 2011, Results from water efficiency projects in the evidence base Phase II report

[77] www.bolius.dk/alt-om/vand/artikel/reducer-din-vandregning/

[78] UK Environment Agency, Quantifying the energy and carbon effects of water saving – Summary report.

toilets may start to rise in the coming years, they are not expected to be representative for the EU stock of buildings. Indeed, such toilets are currently used as an alternative to flush toilets in situations where there is no suitable water supply or waste treatment facility available, such as in national parks. In addition, the social implications (e.g. public acceptance) may stand as a relevant barrier to the development of this market.

Based on JRC data[79], more than 50% of WCs in EU are equipped with dual flush and about 85% are manually operated and it appears that the most common unit for domestic market is a 6/4 L dual flush (full flush/reduced flush). In the non-domestic market, single flush systems of 4 /2.5 L/flush are more common. In the future, according to stakeholders, the 4/2.5 dual flush will be hard to further reduce[80]. Besides, South East Water - water utility in the UK - showed that users do not usually like the partial flush (of 3L) compared to the full flush (4L), leading to an actual average flush volume of 4.25 L (because of double flushing).

Table 20 - Potential water savings at product level

WuP	Water savings
Low flush toilets	Use of 3 to 4.5 [81,]L/flush instead of 6 to 12L/flush; Water saving of 30[84] to 170[81] L/property per day In Australia, 22% of water savings from efficient toilets and urinal compared to conventional ones (in the WELS context)[82].
Water-saving showerhead	Use of 6[73] to 7[78]L/min instead of about 25 (6L/min instead of 16 in the UK[83]) Water saving of 25.2 L/property/per day[84] Water saving of 8%[74] compared to total household water consumption.
AAA rated dishwasher	Water saving of 5 000L/yr[73] Water saving of 0.2%[74] compared to total household water consumption
AAA rated front-loading washing machine	Water saving of 90L compared to conventional top loaders, i.e. about 16 000L per family per yr[73]. Water saving from 0.9%[73] compared to total household water

[79] JRC, 2011, Technical Background report, available at http://susproc.jrc.ec.europa.eu/toilets/docs/1st%20draft_Technical_background_report_oct11.pdf

[80] CIPHE, Paper in response to the Stakeholder Consultation

[81] www.environment.gov.au/settlements/publications/government/pubs/water-efficiency-guide.pdf

[82] www.waterrating.gov.au/products/index.html

[83] UK Environment Agency, Quantifying the energy and carbon effects of water saving – Summary report.

[84] www.waterwise.org.uk/images/site/Policy/evidence_base/evidence%20base%20for%20large-scale%20water%20efficiency%20in%20homes%20-%20phase%20ii%20interim%20report.pdf

WuP	Water savings
	consumption. By 2021 in Australia, 34% of water savings from efficient washing machines compared to conventional ones (in the WELS context) [77]
Faucet aerator	Water savings between 12 and 65L/day at home; reduced flow up to 50% in municipalities[85] Water saving of 7 to 11.6%[86] compared to total household water consumption.

Influence of the type of buildings

Potential water savings depend on the type of buildings considered. As regards non-residential buildings, in the USA, water savings are shown to be greater for offices and schools than for restaurants (about 40% greater), and much lower for laundries, hospitals and healthcare facilities (for each, about 6% of the water savings from both offices and schools), since offices, schools and restaurants are high water users[87]. Residential buildings are likely to integrate more WuPs, as showers or washing machines are less often found in non-residential buildings (apart from hotels).

Additionally, from the figures given in the introduction, 70 to 95% of the use of water in the non-residential sector is for WC and urinals, thus the changing of such products would result in a high percentage of water savings relative to that type of building. Based on the increased efficiency of toilets: from 6-12/6 L to 6/4L flush (40% improvement), and 80% of water used by toilets, **savings of about 30% are taken as assumption for non-residential buildings**.

In residential buildings, as the highest use results from toilets and showerheads (about 25 and 20% resp., excluding baths) an increased efficiency in those two types of WuPs is considered (same 40% for toilets and 30% improvement for showers). In that case, **savings of about 15% are taken as an assumption**.

Evidently, the introduction of efficient toilets and urinals in new buildings is the easiest to target. In buildings being refurbished, the toilets and urinals can also be changed, with a few more efforts, and in existing buildings, such toilets and urinals can also be introduced, but with quite some work and costs involved, including in terms of resources and energy, to produce the new toilets/urinals and get rid of the old ones. In sum, implementing WuP would reduce the share of water used mostly in non-residential buildings, especially offices and schools, with an easier implementation for new than for existing buildings, and would also include benefits for the residential buildings, where many WuPs can be found, again with an easier implementation for new than for existing buildings.

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[85] www.watergy.org/resources/tipsheets/home.php

[86] Defra, Science Report –- Greenhouse gas emissions of water supply and demand management options

[87] EPA, WaterSense program. Available at: www.epa.gov/WaterSense/about_us/what_is_ws.html [Accessed on 01/09/2011]

In the UK uptake rates between 6% and 22% in general housing[88], in a programme involving awareness-raising. Hypotheses within this rate are used for the calculations made below.

- Voluntary Labelling (P1)

Efficient WuP already exist on the market, and options targeting them can thus be relatively easily implemented. The implementation of a voluntary labelling scheme, such as an eco-label is expected to accelerate the market penetration of these products, by providing supplementary information.

As highlighted by some stakeholders, WuP (as many other products) must respect the standards set by CEN (e.g. for sanitary reasons). Where a product labelling approach based on water using criteria is introduced, it is important that the CEN standards are still respected.

As discussed with experts, the assumption is a 10% uptake in existing buildings and 20% uptake in new buildings.

Influence of information campaigns/awareness-raising schemes

Such campaigns are likely to have a high impact on the uptake rate, as customers who are not aware of the scheme will not be incentivised to buy more efficient products. This is particularly important for voluntary labelling schemes, as not all products will be labelled. This will however depend on the level of choice the customers have: tenants will be less able to change toilets than showerheads and employees will have low impacts on the WuP installed in their offices.

In Australia, significant water savings were reported in 2011 within the frame of the WaterSmart Behaviour Change Programme[89], which aimed to raise household awareness about water-efficient devices.

As discussed with experts, the assumption is a 15% uptake in existing buildings and 35% uptake in new buildings.

Influence of financial incentives added to the information campaign

Authorities may choose to directly invest in replacement schemes to ensure rapid uptake of water-efficient technologies. In 1985, the city of New York began an ambitious plan to improve water performance in the city. The city offered landlords 290 million dollars' worth of grants (currently equivalent to 200 million Euros) as an incentive to update plumbing systems with low-flow toilets, showerheads and faucets. Between 1994 and 1997, the city of New York replaced 1.3 million inefficient toilets saving an estimated 265 to 303 million L/d. In some of the participating buildings, water use has decreased by up to 37%. Complementary financial incentive programmes are still anticipated in New York to help achieve a reduction in consumption by approximately 60 million gallons per day (around 227 000 m^3/d) over the next 20 years[90].

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[88] www.waterwise.org.uk/images/site/Policy/evidence_base/evidence%20base%20for%20large-scale%20water%20efficiency%20in%20homes%20-%20phase%20ii%20interim%20report.pdf

[89] www.water.vic.gov.au/saving/home/watersmart

[90] Alliance Environmental LLC, Experience and Future Prospect

This example shows that even without explicit labelling scheme, incentivizing the use of WuP can lead to water savings. In combination with a voluntary labelling scheme that helps customers identify the products that are most efficient, the uptake for the measure is estimated to be even higher than with no accompanying measure or only awareness-raising measures.

As discussed with experts, the assumption is a 20% uptake in existing buildings and 50% uptake in new buildings.

▷ Mandatory Labelling (P2)

It is unclear to what extent mandatory labelling will further lead to water savings, compared to voluntary labelling because the information provided is similar. However, as all products would be labelled, the influence of information campaigns would be reduced, through the fact that customers will more easily identify a label on all products than on a few products only.

The results in terms of water savings is thus expected to be very similar for P2 as a stand-alone measure (and results of adding an information campaign would not lead to big differences) to P1 with information campaigns. It is expected to be slightly higher due to the incentive provided to companies to green their image, thereby proposing more efficient products. Similarly, the addition of financial incentives will increase the uptake by a similar rate than for P1.

As discussed with experts, hypothesis are:

- a 15% uptake in existing buildings and 35% uptake in new buildings for P2 (stand-alone) as for P1 with info.
- a 18% uptake in existing buildings and 45% uptake in new buildings for P2 with info (slightly higher uptakes rates than P1 with info).
- a 22% uptake in existing buildings and 50% uptake in new buildings for P2 with financial incentives (slightly higher uptake rates than P1 with financial incentives)

▷ Minimum Requirements (P3)

The implementation of minimum requirements will speed up the market penetration of WuP, by banning the most inefficient products, increasing their uptake rate. The speed of the market penetration will depend on the timing at which the minimum requirements are introduced. However, uptake rates are expected to be higher than for P1 and P2. As discussed with experts, it is assumed a 15% uptake in existing buildings and 100% uptake in new buildings.

While less efficient products would be banned, awareness-raising campaigns and financial incentive schemes would still allow to increase the water saved, by letting customers choose products that are even more efficient than those minimum rates. The water saved through these accompanying measures was not calculated, as it depends on the WuP efficiency, but would be higher than in the case of P3 as a stand-alone measure.

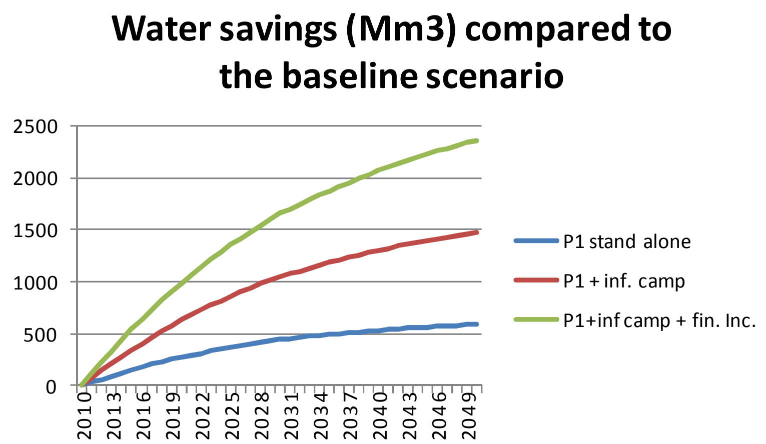
Table 21 - Potential water savings for product-level policies

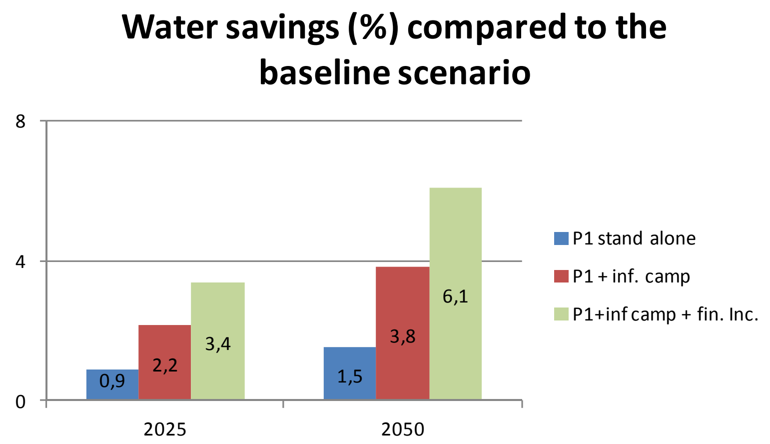
Product Level Policies			Residential building : 15% savings			Non-residential building: 30% savings			Additional water savings by 2025 (%)	Additional water savings by 2050 (%)*
			New	TBR	Existing	New	TBR	Existing		
P1 – Voluntary Labelling	P1	Building Uptake (%)	20	20	10	20	20	10	0.9	1.5
		Savings (%)	3	3	1.5	6	6	3		
	P1 + inf. camp.	Building Uptake (%)	35	35	15	35	35	15	2.2	3.8
		Savings (%)	5.25	5.25	2.25	10.5	10.5	4.5		
	P1 + inf. camp.+ fin. inc.	Building Uptake (%)	50	50	20	50	50	20	3.4	6.1
		Savings (%)	7.5	7.5	3	15	15	6		
P2 – Mandatory Labelling	P2	Building Uptake (%)	35	35	15	35	35	15	2.2	3.8
		Savings (%)	5.25	5.25	2.25	10.5	10.5	4.5		
	P2 + inf. camp.	Building Uptake (%)	45	45	18	45	45	18	3.0	5.3
		Savings (%)	6.75	6.75	2.7	13.5	13.5	5.4		
	P2 + inf. camp.+ fin. inc.	Building Uptake (%)	50	50	22	50	50	22	3.5	6.1
		Savings (%)	7.5	7.5	3.3	15	15	6.6		
P3 - Minimum requirements	P3	Building Uptake (%)	100	100	15	100	100	15	6.2	13.7
		Savings (%)	15	15	2.25	30	30	4.5		
	P3 + inf. camp.	Building Uptake (%)	100	100	>15	100	100	>15	>6.2	>13.7
		Savings (%)	15	15	>2.25	30	30	>4.5		
	P3 + inf. camp.+ fin. inc.	Building Uptake (%)	100	100	>15	100	100	>15	>6.2	>13.7
		Savings (%)	15	15	>2.25	30	30	>4.5		

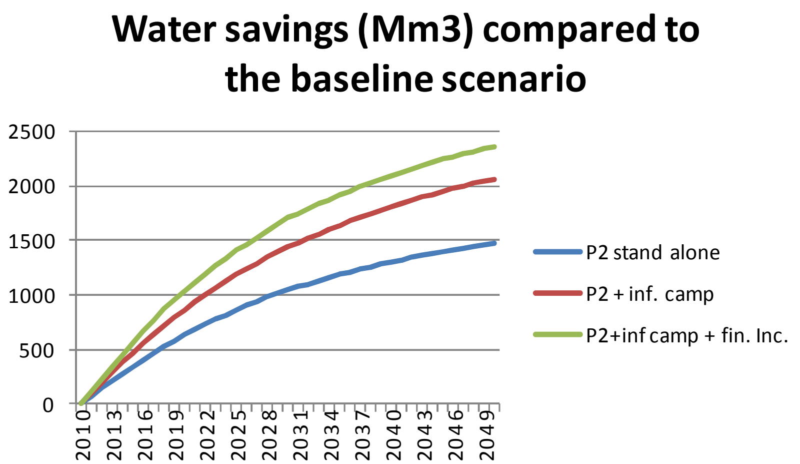
(*) compared to the baseline, based on the model outputs

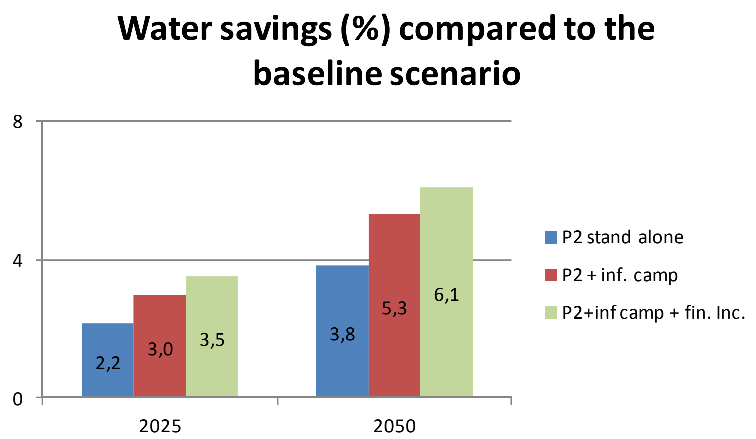
Legend: Info c. = information campaigns, fin. inc = financial incentives.

Water savings induced by the implementation of product-level policies are illustrated in Figure 12.


Water savings (Mm3) compared to the baseline scenario
2500
2000
1500
1000
500
0
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
2043
2046
2049
P1 stand alone
P1 + inf. camp
P1+inf camp + fin. Inc.


Water savings (%) compared to the baseline scenario
8
4
0
0,9
2,2
3,4
1,5
3,8
6,1
2025
2050
P1 stand alone
P1 + inf. camp
P1+inf camp + fin. Inc.


Water savings (Mm3) compared to the baseline scenario
2500
2000
1500
1000
500
0
2010
2013
2016
2019
2022
2025
2028
2031
2034
2037
2040
2043
2046
2049
P2 stand alone
P2 + inf. camp
P2+inf camp + fin. Inc.


Water savings (%) compared to the baseline scenario
8
4
0
2,2
3,0
3,5
3,8
5,3
6,1
2025
2050
P2 stand alone
P2 + inf. camp
P2+inf camp + fin. Inc.

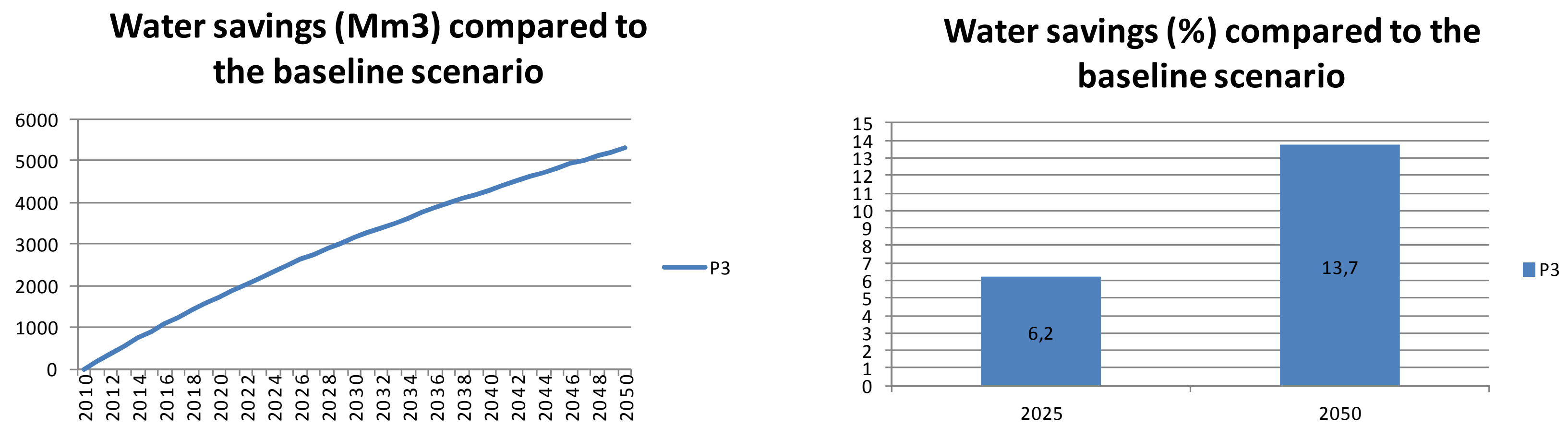


Figure 12 - Water savings with the implementation of P1, P2 and P3.

- Building Level Policy(B)

It is important to notice that the quantification of water savings induced by the implementation of building-level policies that is presented in this section cannot directly be added to the water savings quantified for the product-level policies. Indeed, as presented in Annex 2, building schemes encourage the installation of water-efficient products and potential water savings for B1/B2/B3 already (partly) cover the water savings induced by horizontal or product-level actions.

- Voluntary rating/auditing for WPB (B1)

Water is addressed in several national green building (voluntary) certification programmes and while it may account for only a small part of the overall assessment, there are points or credits to be earned by targeting water use reduction and increasing water efficiency.

Within the HQE programme in France, the reduction of water use can vary from 5 to 45%. By 2010, 535 buildings or operations (part of a building) have been certified[91]. Since 2008, the State aims to have 20% of its new constructions certified HQE or HPE[92].

The Pacific Northwest National Laboratory (PNNL) researchers estimated that water savings from the widespread use of green building schemes in the USA could offset the annual water use of more than 500 000 people (0.16% of the US population) by 2015, and 1.9 million people (0.6% of the US population) by 2030 (assuming an average use of 33 600 gal/cap/yr - around 127 m^3/cap/yr).

The WaterSense Commercial and Institutional Certification Programme in the USA foresee a potential 40% reduction in water use in the USA, with[93]:

- Office buildings: 43,338,240 gal/yr[94] (around 164,000 m^3/yr)
- Schools: 37,798,766 gal/yr (around 143,000 m^3/yr)
- Restaurants: 15,640,869 gal/yr (around 59,000 m^3/yr)
- Laundries: 4,887,771 gal/yr (around 18,500 m^3/yr)
- Healthcare facilities: 4,887,771 gal/yr (around 18,500 m^3/yr)
- Hospitals: 3,258,514 gal/yr (around 12,000 m^3/yr)

Likewise, the NABERS scheme in Australia has been shown to save around 220,000 m^3 of water per year for a 1 star-certified non-residential building (e.g. retail centres, hospitals and schools) [95].

The number of certifications in the UK from the BREEAM programme evolved from about 500 certifications in 2004 to about 3 000 certification in 2009 for commercial buildings[96]. BREEAM

[91] Certivea webpage, www.certivea.fr/ressource/data/presse/Communiqu-de-Presse-Janvier-20_45.pdf

[92] High Energetic Performance, label from the Code of Construction and Housing that inspired the HQE

[93] Building Design + Construction, 2009, Green Buildings + Water Performance

[94] 1 US gallon is equivalent to around 3.79 L

[95] Clark, M. (2008) Conference and NABERS Overview. BENCHMARK Conference, 8 May 2008, Sydney, Australia. Available at: www.abgr.com.au/page.aspx?cid=638&site=1 [Accessed online 28032011]

[96] Deutsche Bank Research, 2010, Green buildings A niche becomes mainstream

has also rated more than 100 000 residential buildings in total[96]. Based on these numbers, an assumption is made that each year 500 commercial buildings and 15 000 residential buildings are rated in the UK. Extrapolated to the EU-27, that would represent a 1% uptake per year in commercial buildings, and a 0.05 %uptake per year in residential buildings.

In case a European voluntary scheme, such as an eco-label, is implemented, the numbers could be raised to a 1.5% uptake in commercial buildings and 0.15% uptake in residential buildings, as for the moment schemes exist only in the UK, Germany and France and even considering that the German scheme is currently spreading in Benelux and Eastern countries.

Based on the HQE numbers of 5-45% water saved, an estimate of 25% of water saving potential is taken as assumption for the residential sector and 40% for the commercial sector (in line with the WaterSense programme in the USA). The water savings would thus be 0.6% for all non-residential buildings and 0.0375% for residential buildings.

Influence of information campaigns

Again, for voluntary labelling the influence of information campaigns is very important, so that people are aware of what the label means. For residential buildings it may influence the choices of tenants, and for commercial buildings, in the case of companies that wish to show their environmental responsibility, the label must be known to ensure that their image is indeed recognised as green. Additionally, the information campaign may build trust about the scheme.

In Florida, the 2008 Green Building Public Awareness Campaign Plan increased the actual implementation of energy-efficiency and water-conservation strategies by 10% by 2010[97].

The assumption is that the water savings would thus increase to reach 0.8% for all non-residential buildings and 0.055% for residential buildings.

As a different type of initiative, in the UK, water savings of 11 L/d per household were observed after the distribution of self-auditing packs. This saving is just over 3% of total household water use. Whether this level of water saving can be sustained in the future is unknown[98]. Such auditing packs are between a voluntary rating initiative and an awareness-raising initiative, but could be useful in improving water performances of buildings. Similarly, providing information on the potential water use of a building, based on the products and systems installed and an average consumption rate, compared with the real consumption of the building could make people aware of their water use and result in further water savings, through avoiding negative rebound effects of consumption compared to the theoretical performance of the building.

Influence of financial incentives

Similarly, by using financial incentives the use of voluntary labelling and thus the reduction in water used will be increased by financial incentives, such as tax abatement for companies that construct or lease green buildings, etc.

It is assumed that the water savings would be 1.2% for all non-residential buildings and 0.075% for residential buildings compared to the baseline.

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[97] www.dca.state.fl.us/FBC/workgroups/Workgroup_Greenbuildings/GBW_PAC_Plan_1-25-08.htm

[98] UK Environment Agency, Quantifying the energy and carbon effects of water saving – Summary report.

▷ Mandatory rating/auditing for WPB (B2)

Instead of a voluntary rating, a mandatory rating could be implemented, as in the case of the EPBD. As in the case of products, the move to a mandatory rating is expected to increase the awareness of the public more easily than for voluntary labelling. However, as seen in the case of the EPBD, information campaigns may be required to ensure that the public understands the meaning of the scheme. Additionally, negative publicity has decreased public trust in the scheme, resulting in reduced benefits from the scheme than expected.

The results in terms of water savings is thus expected to be very similar to B2 (25% for residential and non-residential buildings) but the uptake rates of improved buildings will be increased.

While the labelling is mandatory, it does not mean that all buildings will improve their water efficiency (those that do not will only be rated with low grades). Hypotheses are:

- 2% uptake for improvement in existing buildings and 5% uptake for improvement in new buildings for B2 (stand-alone).
- 4% uptake for improvement in existing buildings and 10% uptake for improvement in new buildings for B2 with info.
- 8% uptake for improvement in existing buildings and 20% uptake for improvement in new buildings for B2 with financial incentives.

▷ Minimum Requirements for WPB (B3)

Minimum requirements would be implemented for new and to be renovated buildings, targeting only a small part of the buildings in the EU, but reducing the water used compared to constructing buildings that are lower performers. In addition, while the improvement may seem low since it targets a low number of buildings, it will increase in time with more buildings being built or refurbished, bringing higher benefits in the longer-term.

In that case the assumption is an uptake of 100% by new and to be renovated buildings of the potential water saved for residential and non-residential buildings. However, as the minimum requirements would have to be set at a reasonable threshold, in order to not strongly affect the current stock, 10% water savings are foreseen for all buildings.

▷ Certification scheme for rainwater harvesting and grey water recycling (B4)

Water reuse and rainwater harvesting do not reduce the amount of water used every day by households. Yet, they carry significant potentials for reduced pressure on ecosystems by reducing the abstraction of freshwater from surface and groundwater sources (i.e. freshwaters). Rainwater harvesting could save 20 to 50% of the total potable water use in a standard home, whereas grey water recycling could save 5 to 35%, as seen in the UK experience[99]. The environmental benefits and drawbacks of rainwater harvesting and grey water recycling highly depend on the type of building considered (e.g. existing vs. new building, demand share for non-potable water); its location (low, medium or high rainfall zone), and the system installed (e.g.

[99] Defra, Science Report - Greenhouse gas emissions of water supply and demand management options

direct feed[100] vs. header tank[101] for rainwater harvesting; or e.g. small and large membrane-bioreactors, short-retention systems, small biological systems vs. multimedia filters for grey water reuse).

The potential grey water yield highly varies between average households, hotels, schools or offices and is not always adapted to the daily water demand of these buildings[102]. For instance, in the UK, the grey water yield of an average house (about 92 L/person/day) is more than sufficient to meet its non-potable water demand of 52 L/person/day. On the contrary, with a grey water yield of about 4 L/employee/day, offices require conventional water supply to meet their non-potable water demand of 9.5L/employee/day). Thus, the water saved in each type of building will be different. In the USA[103], up to 95% of water could be reused in offices and about 75% in schools, commercial centres and stadiums. In comparison only up to 50% water reuse was observed in residential areas. Water savings from rainwater harvesting and grey water recycling are particularly interesting in areas at risk of water shortages but also present a number of other environmental benefits (such as for irrigation purposes in Cyprus).

So, as assumption, 20% reduction in residential buildings and 40% in non-residential buildings will be considered (if connected to a general supply, grey water can be mostly used for toilets which account for 80% of use).

The systems are expected to be introduced voluntarily in buildings, with the help of a voluntary, or mandatory labelling, or minimum requirements for putting the systems on the market and/or installing them. The uptake is expected to be slightly higher when implemented with minimum requirements than with mandatory or voluntary labelling, mainly because of the trust that would build from implementation of the systems, through which people would be more likely to implement the systems. Additionally, the systems are much more likely to be implemented in new buildings, as the technical difficulties to change the pipes in an existing building to implement the system would be quite complicated, and even more so if a community-scale system is implemented.

The assumption taken is thus to have a 2% uptake of such systems in existing buildings and a 20% uptake in new buildings.

These hypotheses lead to 0.8% water saved in existing non-residential buildings, 0.4% in existing residential buildings, 8% in new non-residential buildings, and 4% in new residential buildings. That would represent around 800 Mm^3 of savings per year at EU level. With slightly higher rates when going from voluntary labelling to minimum requirements and when adding awareness-raising campaigns and financial incentives, more savings could be foreseen, although it is difficult to directly measure their impacts.

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[100] In a direct feed system, 100 per cent of the water for the non-potable end uses connected to the rainwater system is pumped from the rainwater tank.

[101] In a header tank system, only 20 – 40 per cent of non-potable demands met by harvested rainwater are pumped and the rest is supplied without additional energy use and carbon emissions above those for mains supply.

[102] Defra, Energy and carbon implications of rainwater harvesting and grey water recycling

[103] Edward A. Clerico, Alliance Environmental LLC, Experience and Future Prospect

Table 22 - Potential water savings for building-level policies

Building Level Policies			Residential building : 25% savings			Non-residential building: 40% savings			Additional water Savings by 2025 (%)*#	Additional water Savings by 2050 (%)*#
			New	TBR	Existing	New	TBR	Existing		
B1 – Voluntary Rating/auditing	B1	Building Uptake (%)	0.15	0.15	0.15	1.5	1.5	1.5	1	2.9
		Savings (%)	0.0375	0.0375	0.0375	0.6	0.6	0.6		
	B1 + inf. camp.	Building Uptake (%)	0.22	0.22	0.22	2	2	2	2.5	6.9
		Savings (%)	0.055	0.055	0.055	0.8	0.8	0.8		
	B1 + inf. camp. + fin. inc.	Building Uptake (%)	0.3	0.3	0.3	3	3	3	4.1	9
		Savings (%)	0.075	0.075	0.075	1.2	1.2	1.2		
B2 – Mandatory Rating/auditing	B2	Building Uptake (%)	5	5	2	5	5	2	4.1	8
		Savings (%)	1.25	1.25	0.5	2	2	0.8		
	B2 + inf. camp.	Building Uptake (%)	10	10	4	10	10	4	7.8	8
		Savings (%)	2.5	2.5	1	4	4	1.6		
	B2 + inf. camp. + fin. inc.	Building Uptake (%)	20	20	8	20	20	8	11.1	8
		Savings (%)	5	5	2	8	8	3.2		

Building Level Policies			Residential building : 25% savings			Non-residential building: 40% savings			Additional water Savings by 2025 (%)*#	Additional water Savings by 2050 (%)*#
			New	TBR	Existing	New	TBR	Existing		
B3 - Minimum requirements	B3	Building Uptake (%)	100	100	5	100	100	10	10	8
		Savings (%) [a]	10	10	1.25	10	10	2.5		
	B3 + inf. camp.	Building Uptake (%)	100	100	5	100	100	10	>10	>8
		Savings (%) [a]	>10	>10	>1.25	>10	>10	>2.5		
	B3 + inf. camp. + fin. inc.	Building Uptake (%)	100	100	5	100	100	10	>10	>8
		Savings (%) [a]	>10	>10	>1.25	>10	>10	>2.5		
B4 - Rainwater Harvesting and Reuse	B4		Residential building : 20% savings			Non-residential building: 40% savings				
		Building Uptake (%)	20	20	2	20	20	2	0.62	5.2
		Savings (%)	4	4	0.4	8	8	0.8		

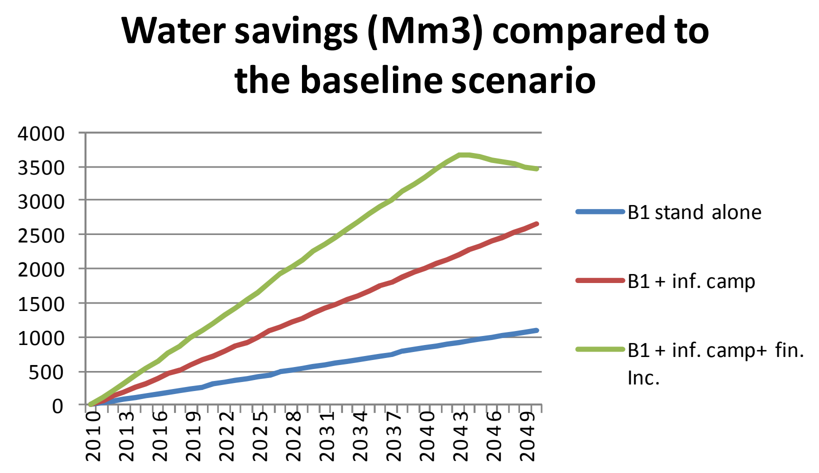
(*) compared to the baseline, based on the model outputs.

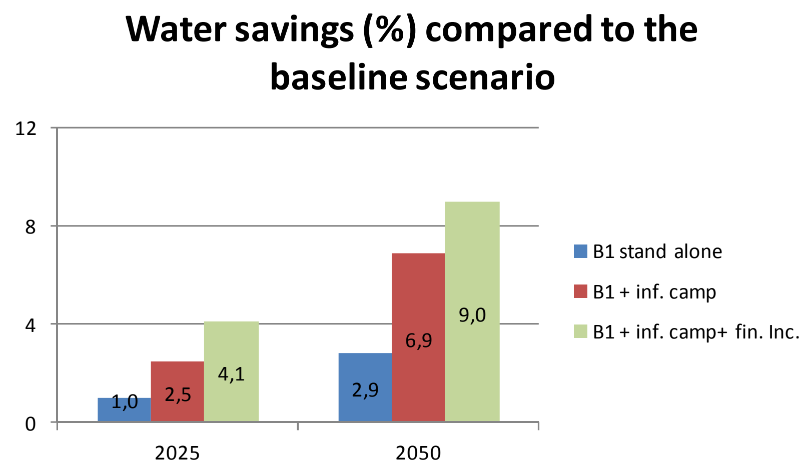
(#) Potential water savings for B1/B2/B3 already (partly) cover the water savings induced by product-level actions, and cannot be directly summed with the water savings that were quantified for P1/P2/P3.

(a) Minimum requirements would have to be set at a reasonable threshold, in order to not strongly affect the current stock, thus 10% water savings are foreseen for all buildings.

Legend: inf. camp. = information campaigns, fin. inc = financial incentives.

Water savings induced by the implementation of building-level policies are illustrated in Figure 13.





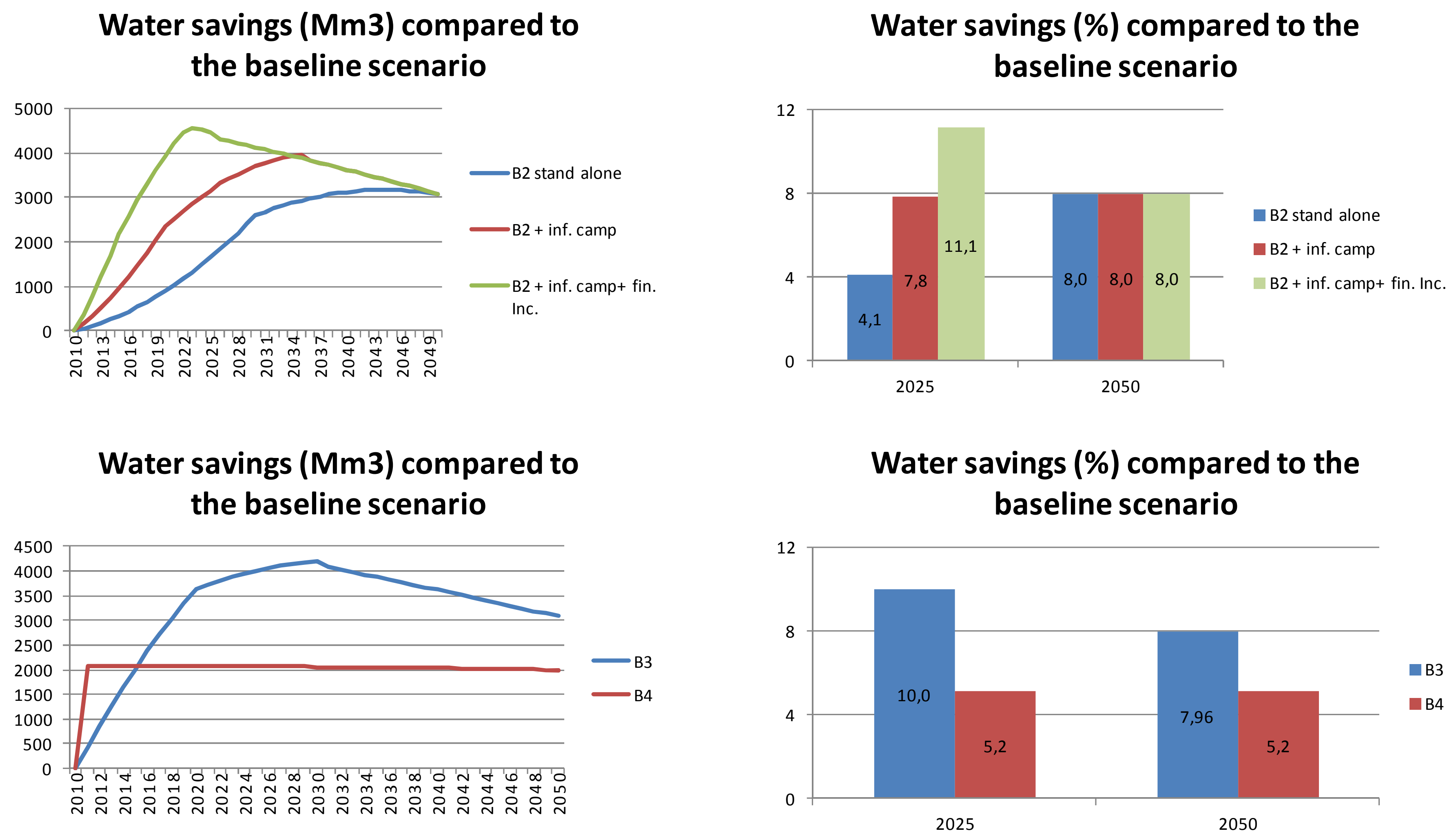


Figure 13 - Water savings with the implementation of building-level policies.

4.2.2 Energy consumption and carbon emissions

Energy is embedded in the water used in buildings, through the energy required to pump the water from a water body, pump it to the required floor of the building, and (where relevant) to heat the water; but also for treatment after use. Reducing water use would thus reduce the energy needs and GHG emissions.

According to the Waterwise programme[104]:

- 0.747 tCO2eq is saved per ML of water saved (when no specific distinction between hot or cold)
- 8 tCO2eq are saved per ML of hot water saved
- 44,000 kWh of energy is saved per ML of hot water saved

In households (i.e. residential buildings), 90-96%[105,106]of GHG emissions from water use actually come from water heating. Heating water is also considered as a strong energy consumer in the USA (with 15%-30% of the household energy demand)[107], in line with the 22% reduction observed in UK[108]. Thus, water- efficient retrofit devices that save hot water (e.g. tap aerators, low flow shower heads) can save more CO_2 than cold water retrofits (such as dual flush WC retrofits)[105]. Yet, in the UK, the current framework for reducing water use in new homes (principally the Code for Sustainable Homes) considers hot and cold water uses to be equivalent.

CO_2 emissions can considerably vary depending on the heating system used (gas, oil, electric system, LPG, solid energy source have different CO_2 factors[109]). Thus, the total GHG emissions associated with the end uses of water was found to be around 2,100kg CO_2eq per household per year for a continuous energisation gas storage hot water service compared to around 7,100 kg CO_2eq per household per year for an off-peak energisation electric storage hot water service. More attention is generally set on the energy savings that can be achieved through reduced water consumption. The United Nations Framework Convention on Climate Change (UNFCCC) is currently working on a methodology targeting demand-side energy efficiency activities for installation of water saving devices from a Clean Development Mechanism (CDM, i.e. one of the Kyoto mechanisms) perspective.

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[104] www.waterwise.org.uk

[105] UK Environment Agency, Quantifying the energy and carbon effects of water saving – Summary report.

[106] Flower, D.J. M; Mitchell, V.G. and Codner, G.P. ; Urban Water Systems: Drivers of Climate Change?, Institute for Sustainable Water Resources & eWater CRC, Department of Civil Engineering, Monash University, Victoria; Available at: www.hidro.ufcg.edu.br/twiki/pub/ChuvaNet/13thInternationalConferenceonRainwaterCatchmentSystems/Flower.pdf

[107] Around 4% of the US electricity production is actually dedicated to the supply, transport, heating and treatment of water and wastewater (it reaches 19% for California only).

[108] BERR, 2008, Energy consumption in the UK: overall data tables

[109] Defra (2008), "Greenhouse gas (GHG) conversion factors for company reporting". Available at: www.defra.gov.uk/environment/business/envrp/conversion-factors.htm, accessed 13/11/08

Box 1 - UNFCCC approach[110]

The following equations are used to determine energy savings per low-flow device (e.g. showerhead, bathroom faucet, and kitchen faucets):

$$ES_y = \Delta W_y \times \Delta T \times C_p$$

$$\Delta T = T_{out,\ measured} - T_{in,\ measured}$$

$$\Delta W_y = (W_{BL,\ calculated} - W_{P,\ measured}) / Days_{monitoring} \times 365$$

$$W_{BL,\ calculated} = FR_{BL,\ calculated} \times W_{P,\ measured} / FR_{P,\ measured}$$

Where:

y Each year of the crediting period

ES_y Energy savings in year y (MWh)

ΔW_y Difference between annual heated water flow through project low-flow device and baseline device (litres per year)

ΔT Annual average difference in water temperature between water entering the water heating unit used to heat water and the water exiting the low-flow device (°C)

$T_{out,\ measured}$ Annual average temperature of water exiting project low-flow device (per paragraph 15) (°C)

$T_{in,\ measured}$ Annual average temperature of water entering water heating device (per paragraph 15) (°C)

C_p Specific heat capacity of water (4.186 kJ/L)

$Days_{monitoring}$ Number of days during which the value of $W_{P,\ measured}$ is determined (days)

$W_{BL,\ calculated}$ Calculated amount of heated water that would flow through the baseline faucet during the number of days equal to $Days_{monitoring}$ (litres)

$W_{P,\ measured}$ Measured amount of heated water that flows through the project low-flow device during the number of days equal to $Days_{monitoring}$ (litres)

$FR_{BL,\ calculated}$ Measured flow rate of baseline device (litres/minute)

$FR_{P,\ measured}$ Measured flow rate of low-flow device (litres/minute)

[110] More information at : http://cdm.unfccc.int/filestorage/6/o/I/6oIAK9SVCJRXPL7DBOQ5GNZ481HT32/eb62_repano9.pdf?t=WTh8bTNyaDNwfDD5KqkCnpFTHYm4hfyhz6lC

- Horizontal Level Policy(H)
  - Water metering (H1)

Moving to full water metering across England and Wales could potentially reduce annual emissions by 1.1 to 1.6 million tCO_2eq/yr from current levels[111]. Moreover, achieving full household water metering could deliver a significant emission reduction, equivalent to 27-40% of the Carbon Reduction Commitment (CRC) target. Indeed, the Government's CRC is a new emissions trading scheme covering large organisations in the public and private sectors including water companies and it aims to deliver emissions reductions of 4 million tCO_2eq/yr by 2020. The CRC targets business and public sector organisations which are significant energy users but do not currently participate in other emission trading schemes or climate change agreements.

As it is expected that the use phase of water meters will be predominant in their Life-cycle Assessment, carbon emissions related to the manufacturing of such devices and their installation are to be considered neglected compared to the savings induced by the reduction of water use.

  - Water pricing and cost strategy (H2)

Changing the water prices and cost strategy will lead to energy savings and emission reductions directly linked to the amounts of water saved, and especially of hot water saved.

  - Awareness Raising and Education (H3)

Raising awareness will lead to energy savings and emission reductions directly linked to the amounts of water saved, and especially of hot water saved.

- Product Level Policy (P)

In addition to the reduction in GHG emissions due to water savings, the manufacture, installation and operation of water efficient products generally present decreasing average incremental carbon costs (AICC) compared to conventional products, except for the installation of new white goods in existing homes. The Waterwise programme concludes to a range of between 0.031 and 0.187 kgCO2eq/property/day of carbon emissions saving as a result of the water efficiency retrofitting projects (considering a UK carbon factor). The main difference in carbon cost between these options can be attributed to product manufacturing, which involves high emissions.

In new residential (luxurious) buildings, the observed trend to install fancy showering systems with higher flow rates may actually lead to more hot water use. As most of the GHG emissions come from water heating, and despite the potential use of water-efficient devices such as dual flush toilets, the CO_2 emissions from water use in new luxurious houses are not significantly lower than in existing houses.

Table 23 summarises average incremental carbon costs resulting from the setting of different WuPs, based on a Defra study[112].

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[111] Defra – The Greenhouse Gas Implications of Future Water Resources Options

[112] Defra, Science Report –- Greenhouse gas emissions of water supply and demand management options

Table 23 - Average incremental carbon costs resulting from the setting of different WuPs

Water-efficient products	Existing homes	New homes
Toilets	Decrease of AICC by 7% for displacement devices (e.g. cistern) and 1% for low flush toilets[113]	Reductions of AICC of 8%[114]
Shower, bath and taps	Decrease of AICC by 1-7% in existing home (because of carbon footprint included as one-off retrofit cost). Increase of AICC for bath due to high one-off retrofit cost for replacement.	Decrease of AICC by 2-12%. Lower emissions also due to less hot water use in the home.
White goods (dishwashers, washing machines)	Increase of AICC by 30% mainly due to one-off retrofit cost and manufacturing cost (this does not take into account the full energy efficiency gains offered by new machines).	Decrease of AICC by 3%

For example, in the UK, a 6 L/min showerhead to replace a 16 L/min existing showerhead, together with a 4.5 L toilet to replace an old 9 L one, could result in annual savings of 67 m^3 water, i.e. 371 kg CO_2 for a household with a standard occupancy of 2.4 (persons) [115]. The same order of magnitude is observed in Portugal, where the implementation of the ANQIP product labelling enabled to save 165 kWh/cap/year (corresponding to 66 kg CO_2 /cap/year) in a municipality of 73,000 inhabitants[116].

In Spain, the average urban household is an apartment of 95 m^2 area, with 3 occupants. The average water consumption of that household is about 330 L/household/d. Based on preliminary assumptions from the Technical University of Valencia (i.e. 10% reduction in the consumption for faucets and showers), annual water savings of 7.2 m^3 for that household (6% reduction in water volume) could be foreseen, including 2.4 m^3 for hot water. Assuming that water is pumped to a 5th floor-flat from a private open reservoir (and not directly from the network pipes), the pumping energy saved per year due to those water savings is around 0.3 kWh whereas thermal energy savings are assessed to 125 kWh, each year. Therefore, mechanical energy (i.e. for transport) that is saved due to water-saving actions is significantly lower than the thermal energy (i.e. for heating)[117]; and special attention to heating and cooling systems is recommended for any

[113] The carbon cost of low flush toilet is relatively high due to embedded carbon costs in manufacture. Net emission are however still negative

[114] The carbon footprint ignores the "sunk" carbon costs because the devices are installed in every home not for water efficiency purposes

[115] UK Environment Agency, Quantifying the energy and carbon effects of water saving – Summary report.

[116] ANQIP, Paper in response to the Stakeholder Consultation.

[117] Communication with Technical University of Valencia

potential WPB policy development. As water boilers are addressed within the EPBD, some policy coordination could be fostered.

Whatever the type of policy instrument used to implement the product level policies, i.e. Voluntary Labelling (P1), Mandatory Labelling (P2), or Minimum Requirements (P3), the energy and emission savings will be linked to the water saved, and especially the hot water saved. According to the assumption of introducing efficient toilets in non-residential buildings and both toilets and showerheads in residential buildings, the energy and carbon costs of non-residential buildings would be higher, because of the manufacturing and implementation of new toilets, with few reductions in carbon costs as it is cold water; while in residential buildings the savings from the shower would better balance the costs. However, another issue is raised with faucet aerators and showerheads, as water is cooled more rapidly in the presence of pressurised air. Hence, a reduction in water use can be offset by the need to raise the temperature of the water. A measurement of the temperature profile should be included in any minimum water performance criteria.

Accompanying these policy instruments by awareness-raising and financial incentives is expected to introduce the devices more rapidly, and could focus on the energy-water nexus, highlighting synergies and fostering global approaches, in order to increase behavioural changes that will bring both higher water and higher energy savings. Additionally, awareness-raising could couple energy and water savings, through changing behaviours, but information campaigns promoting efficient products and financial incentives would increase the change of devices, increasing the carbon costs (depending on when the devices are changed, i.e. carbon is saved if the device was going to be changed in any case).

As it is expected that the use phase of water-using products will be predominant in their Life-Cycle Assessment, carbon emissions related to the manufacturing of such devices and their installation are to be considered neglected compared to the savings induced by the reduction of water use.

- Building Level Policy
  - Building level WPB approach (B1, B2 and B3)

Adopting a building-level WPB approach (whether through voluntary rating/auditing (B2), mandatory rating/auditing (B3), or minimum requirements (B4)) would enable to ensure side energy savings and make potential synergies with energy performance schemes. In 2008, a General Services Administration survey revealed that the LEED-certified office buildings performed 29% better on energy use than the national and regional averages from a Commercial Buildings Energy consumption Survey[118]. Minimum requirements would gain energy and carbon through the water savings, but also would require modifications in existing buildings that would result in energy and carbon costs; for new buildings a few more carbon costs could be incurred, but are expected to be counterbalanced during the lifecycle of the building.

[118] Building Design + Construction, 2009, Green Buildings + Water Performance, Available at : http://www.lafargenorthamerica.com/BD&C%20White%20Paper%202009.pdf

The energy and carbon saved would be linked both to the water saved and the need to introduce new products and systems. Thus, carbon would be saved in new buildings, and possibly in to be renovated buildings, while the carbon costs would be higher in existing buildings.

Awareness-raising on building approaches could enhance the reduction in energy and carbon costs, by leading to an increased knowledge of e.g. what the theoretical potential of the building is vs. its real consumption. In this respect, surveys conducted within a Life+ pilot project on water and energy[119], launched by Energy Saving Trust and Waterwise, has established that UK consumers were broadly unaware of the issues relating to water efficiency and the energy carbon implications[120], demonstrating the need to raise awareness in this area. In response to this observation, Energy Saving Trust Advisors were to deliver innovative water and energy advice service to householders in the pilot areas of Cardiff, Edinburgh and London.

- Certification Scheme for Rainwater harvesting and grey water recycling (B4)

An integrated approach is needed in order to determine the potential environmental benefits and drawbacks of rainwater harvesting and greywater recycling, compared to using drinking water from the public water supply. These include:

Table 24 - Potential environmental benefits and drawbacks of rainwater harvesting and greywater recycling

	Greywater reuse	Rainwater harvesting
Benefits	In specific cases (such as in new buildings or during major refurbishment, and in combination with other water-efficiency initiatives), reduction of CO_2 production or a lower carbon footprint as a result of less energy consumption	Reduction of CO_2 production or a lower carbon footprint as a result of less energy consumption
Drawbacks	Increased energy consumption and GHG emissions to manufacture, install, operate (e.g. pumping, treatment) and ensure maintenance of the system (incl. additional treatment):	
	Increase of average incremental carbon cost by 20 to 40% based on 30% savings[121] Footprints for the installation of small grey water systems, applicable to the	Increase of average incremental carbon cost by 30 to 60% based on 20% savings[121] Footprints for the installation of the larger systems applicable to non-

[119] www.energysavingtrust.org.uk/About-us/What-we-do/Life-Water-and-Energy-project

[120] The preliminary study in 2009 stated that only 8% of households would make the link between saving water and saving energy.

[121] Defra, Science Report - Greenhouse gas emissions of water supply and demand management options

	Greywater reuse	Rainwater harvesting
	average home, range from 0.5 -2.8 tonnes of CO_2[122]. Other sources mention: 1.0 to 3[123] kWh/m^3 to produce clean water from wastewater compared to 0.48 kWh/m^3 from groundwater with an additional 0.62 to 0.87 kWh/m^3 due to the wastewater treatment[122]	domestic and multi-residential buildings range from 13 to 47 tonnes of CO_2[122]. In the UK, operational energy use for rainwater harvesting systems ranges between 0.6 and 5 kWh/m^3 [124]

Specific systems are more applicable to residential buildings than to offices, such as the low level treatment systems for grey water reuse (e.g. short retention systems). Likewise, different biological and bio-mechanical systems apply to single residential dwellings, commercial buildings or multi-use buildings. These systems have different operational energy and carbon intensities[101]. For grey water reuse, the latter range from 0.6 kWh/m^3 for short-retention to 3.5 kWh/m^3 for small membrane bioreactors. For rainwater harvesting, the latter range from 1.0 kWh/m^3 for direct feed to 1.5 kWh/m^3 for header tank.

Both the retrofitting of household rainwater harvesting and grey water recycling results in increased GHG emissions in existing homes, whereas their installation in new homes, alongside with other water efficiency measures, shows net carbon benefits[124]. Likewise, community-scale systems are shown to be more carbon-efficient than individual households. The impact of grey water use on energy consumption depends of several factors, including embodied factors (e.g. water tank, component replacement and maintenance) and operational factors (the energy intensity of current water supply, wastewater treatment) [125,126]. In this context, grey water reuse presents higher carbon costs than rainwater harvesting, up to one-third higher (0.6 kWh per day for a standard home) [124].

In summary, carbon could be saved if such systems are implemented at an early stage in new buildings, and possibly in to be renovated buildings, while the carbon costs increase in existing buildings, whether residential or not. Grey water reuse presents higher carbon costs than rainwater harvesting. Stakeholders recommend to take these figures with caution and adopt a case by case analysis, based on LCA considerations. In particular, the thermal recovery of grey water to preheat water in an optimised circulation system could lead to energy (and carbon) savings. Also some gravity treatment (such as the Ecoplay grey water system) could reduce the energy requirements of such systems.

[122] Defra, Energy and carbon implications of rainwater harvesting and grey water recycling

[123] German grey water standard (FBR 2005)

[124] Defra, Science Report - Greenhouse gas emissions of water supply and demand management options

[125] Pacific Institute (2010), Overview of grey water reuse: the potential of grey water systems to aid sustainable water management. November 2010. Available at: www.pacinst.org/reports/grey water_overview/grey water_overview.pdf [Accessed on 01/09/2011]

[126] Defra, Energy and carbon implications of rainwater harvesting and grey water recycling

Box - Example for energy saving calculations

A preliminary assessment of energy savings at EU level that are linked to an improved water performance of buildings is proposed.

Based on Spanish water/ energy use figures[127], the energy consumption per stage of the urban water cycle (excluding water end-use) can be assessed to:

- Extraction and water treatment: 1.26 kWh/m^3
- Distribution: 0.17kWh/m^3
- Wastewater treatment: 0.89kWh/m^3
- Over the different stages: 2.32kWh/m^3

If 10% water savings are envisaged in 2025 compared to the baseline (around 4,000 Mm^3 of net savings for the EU - as seen for policy option B4), then 9.3 TWh would be saved. That represents 0.6% of the EU electricity consumption in 2009 of the households and commercial and industrial sectors[128].

4.2.3 Wastewater generation and supply issues

The information presented below is relevant for all policies targeting reduction of water use:

- Impact on sewer flow

Reducing water used in buildings could adversely affect the sewer collection systems and may cause blockages or other operational problems and potentially lead to property flooding. As the most relevant wastewater discharges to drain/sewer come from the toilets, solid movement would be significantly reduced with the lower flush volume that is promoted in water-efficient schemes. It is also likely that the problem will be most apparent in drains taking very little flow, such as those serving either a single property or a few single occupancy properties[129]. If the solids fail to be removed by subsequent flushes, there is a risk of sewer blockage. Such potential issues are underlined by many stakeholders and several studies, but it is unclear to what extent the risk is potential or proven, and how significant it could be. It can be noted however that some cities with reduced consumption have experienced smelling and blockage issues (e.g. Berlin[130]).

Moreover, when the water demand decreases, especially in agglomerations where the number of population decreases and what not anticipated when constructing water networks, water providers may face infrastructure issues as the network would be oversized, leading to technical and financial consequences.

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[127] Hardy, L., Garrido, A. And Juana L., 2012, Evaluation of Spain's Water-Energy Nexus, Water Resources Development, Vol 28, No. 1, 151-170, March 2012

[128] Which correspond to around 1560 TWh, based on JRC data, available at http://ec.europa.eu/dgs/jrc/downloads/jrc_091130_newsrelease_electricity_en.pdf

[129] www.publications.environment-agency.gov.uk/PDF/SCHO0208BNQU-E-E.pdf

[130] Official Berlin portal, Save water for climate change (in German), www.berlin.de/special/immobilien-und-wohnen/ratgeber/906500-893025-wassersparengegendenklimawandel.html

However, some technical solutions exist, e.g. increasing the gradient of the network, or adapting the diameter of the drains. A sufficient flow can be ensured when effluents are collected at the building exit and are only released in the wastewater network when the collected amount reaches a minimum threshold. Besides, the volume of wastewater that reaches the treatment plants, if less water is discharged, may be lower than the design volume of the plant. In that case, the plant would then operate inefficiently. Indirect effects also include increased sewer retention times with a greater tendency for anaerobic conditions to develop during periods of low flow. That could cause odour problems[131].

However, with new buildings to be constructed, the water amounts could still be sufficient, and as stated above technical solutions exist. In new urban areas, the problem would be less likely to occur.

- Effect on treatment process performance

Reductions in per capita potable water demand could result in a change in the average wastewater content that is received at treatment plants, with increased biological oxygen demand (BOD), Suspended Solids (SS) and ammonia levels. Indeed, due to lower flow, more concentrating effects would be observed in the effluent to be treated. Such changes might have an effect on the performance of treatment processes.

- Supply

Networks designed for lower demands of drinking water may not be capable of fully responding to peak consumption period[132,133]. As this would only apply to newly designed systems, the impact is expected to be low.

4.2.4 Other environmental impacts

- Ability to adapt to climate change

Water demand may increase in the future because of the effects of climate change. Measures targeting the water performance of buildings will contribute to a more sustainable use of water and therefore avoid the over-exploitation and depletion of non-renewable water resources.

In the case of rainwater harvesting, in addition to reducing pressure on water bodies, other environmental benefits include reduced rainwater run-off, and increased 'resilience' to water shortages[126]. Therefore, rainwater harvesting could be identified as a suitable system to address the changes in precipitation patterns that are induced by climate change, with potential storage of water during intense rain events and valuable availability of water amount during droughts.

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[131] Less water to waste: Impact of reductions in water demand on wastewater collection and treatment systems, 2008, Environment Agency.

[132] Kay Chambers, John Creasey and Leith Forbes (2004), 3 - Design and operation of distribution networks. 2004 World Health Organization. Safe Piped Water: Managing Microbial Water Quality in Piped Distribution Systems. Edited by Richard Ainsworth. ISBN: 1 84339 039 6. Published by IWA Publishing, London, UK.].

[133] EUREAU (2011), Working Group Microbiological Quality, Eureau-Commission Position Paper on water re-use and other alternative resources at home: rainwater harvesting and grey water recycling for domestic purposes. July 2011

The environmental impact assessment of these systems is therefore complex and must be site-specific.

- Impact on biodiversity, flora, fauna and landscape

The set of policy measures will be ensure water availability in the water bodies and thereby contribute to protect water-dependent ecosystems and biodiversity.

- Sustainable consumption and production

The policy options contribute to sustainable production and consumption by promoting products and buildings that help reduce water use and increase efficiency.

- International environmental impacts

The proposed policy measures contribute to a responsible use of water resources that is specifically important for shared river basins.

4.3 Economic impacts

In addition to these environmental benefits, the large scale implementation of the policy options can result in costs, but also financial advantages by reducing the water and energy bills.

4.3.1 Tenant / Owner distribution of costs

There may be a misalignment between owner costs and tenant benefits. Under usual leasing arrangements, landlords pay the capital costs of efficiency measures while many of the benefits of green buildings apply to the user of the property. The implementation of the EPBD has generated high costs for property owners without any benefits and thereby some resentment has been observed. However, requirements for water-using products are generally better understood as they have directly visible impacts and involve a cost for both tenant and owner. When investment in water-efficient schemes are made in new buildings, cost compensation could be observed in the rent for the future tenant (compared to a similar building without efficient products) whereas refurbishment does not allow such a rent flexibility if the tenant remains the same.

In order to address this issue, "green leases" could be developed. The landlord and the tenant have to agree on how the positive externality of lower operational costs can be internalised by the landlord. However, legal requirements may slow down the return on investment. German tenancy laws for example currently limit net rent increases in residential buildings due to modernisation work to 11% of the costs[134]. Such a constraint impacts the return on investment that a building owner may expect. In Sweden for example, maintenance and operational costs are normally included in the rent (or paid for by the landlord) as "gross lease"[135], in which case it may be difficult for tenants to see the added value of renting green buildings. Alternatively the tenant may pay a fixed sum to the landlord to cover maintenance and operation. Thus the landlord or the tenant may gain from green building measures.

This misalignment may be most evident in installing products attached to the building, such as toilets, or rainwater harvesting schemes and for certifying buildings, where the compliance costs of certification and additional construction costs will incur to the owner, as well as any administrative burden to prove compliance, and benefit the tenant.

Information programmes are not expected to change the situation, except for making "green" rents better accepted by tenants. Well-organised financial incentives however may counterbalance this imbalance.

4.3.2 Capital costs

- Horizontal Level Policy (H)
  - Water metering (H1)

In 1985, the city of New York began an ambitious plan to install water meters in every residential building. The city paid for most of the costs of installing water meters ranging from $400 to more than $40,000 per building depending on its size (around 280 to 2,800€). By the end of September 2000, more than half a million meters had been installed.

In the UK, a strategy was used to install meters systematically, rather than one-by-one. This has the potential to reduce installation costs by up to 50% (saving £1.5 billion) via economies of scale.

The capital costs of metering are likely to be borne by the owners of buildings, even where a water company installs the meters. The price of an average meter device ranges from 35€ to 350€[136], depending on its properties in terms of maximum flow capacity and accuracy of output data. Since more than one metering device is often needed in a household or dwelling (for instance, a hot water and a cold water one), this may be costly for the owner/inhabitant. In many MS, buying two 100€ meters would actually more than double the annual water bill.

With the assumption that about 25% of the EU population would introduce meters, around 7 billion Euros are foreseen based on the information in the UK.

  - Water pricing and cost strategy (H2)

No specific capital costs are expected.

  - Awareness Raising and Education (H3)

Implementing awareness-raising and education campaigns has a cost, which depends on the public targeted, messages sent through, etc. The campaigns are expected to result in lower costs for customers who reduce their water use through a change in behaviour.

The costs will be borne by the government or other entity paying for the campaign.

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[136] www.omniinstruments.co.uk/products/product/moredetails/multi-jet.id544.html

- Product Level Policy (P)

The changing of products results in costs to owners and/or occupiers of buildings both for buying the device and for installing it (e.g. by a plumber). Building owners will pay for the installation of new fixed fixtures (taps, toilets), while the occupiers (whether owners or renters) may change other types of devices (showerheads, washing machines, dishwashers) and bear those capital costs. Building constructors may also have higher costs from installing efficient WuP in buildings, if the efficient products are more costly than less efficient ones.

Costs will also be incurred to manufacturers who have to develop more efficient products, with positive impacts such as increased innovation. In case of mandatory labelling and minimum requirements, compliance costs for manufacturers will also arise. On the other hand, manufacturers may benefit from higher prices paid by customers that buy more efficient devices.

An Australian study stated that the most frequently mentioned barrier to install efficient appliances in households was financial[137]. According to an economic newspaper from Germany[138], the replacement of existing showerheads, toilets and faucets with more water-efficient ones to achieve 30% water reduction would cost 400€ per flat owner, i.e. more than 10 billion Euros for the whole of Germany. Water savings and costs of implementation will vary greatly depending on the level of use, the specific water savings measures, the plumbing arrangements and the architectural finishes, etc. The Waterwise programme shows a wide variation in the cost of retrofitting, which ranges from 46€ to 270€ per property. This might make the replacement of water-using products by more efficient ones a costly effort for the owner and/or tenant (depending on the type of fixture changed). Another study in Australia[139] estimates a cost of 500€ per household for the installation of a combination of water-efficient appliances, including a AAA showerhead, a drip irrigation system for the garden, flow restrictors and water-efficient front loading washing machines. The cost efficiency of the measure depends on the associated savings and the payback time.

To reduce the cost, in general it is advantageous to make retrofitting as a part of a refurbishment programme[140], or to introduce them directly in new buildings (both for non- and residential buildings).

An Australian survey confirms the impact of financial incentives on the uptake rate of water-efficient products in Sydney[141] in 2005 - 2006: 48% of the respondents said they would be willing to fit water saving devices even if they had to pay for them entirely; 77% expressed their willingness to set these devices if the prices was subsidised by a half; whereas 86% would install these devices if they were free. Financial incentives are generally provided by the State, which would have to bear those costs. Mechanisms where private companies are involved may also be imagined.

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137 www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-central-highlands-water
138 www.economicsnewspaper.com/policy/german/water-consumption-eu-savings-plan-could-cost-billions-of-german-e-18590.html
139 www.melbourne.vic.gov.au/Environment/SavingWater/Documents/water_turning_blue.pdf
140 www.environment.gov.au/settlements/publications/government/pubs/water-efficiency-guide.pdf
141 www.fbe.unsw.edu.au/cf/news/2008/attitudestoconservationandwaterconsumption.pdf

Many mechanisms can introduce financial incentives for increasing the water performance of buildings, with differing costs and results:

- Tax abatements can be used at national level to promote the purchase of water-efficient products. Financial incentives have been tested in the UK, with the Enhanced Capital Allowances (ECA) scheme. The scheme is managed by Defra and enables businesses to claim 100% first year capital allowances (i.e. tax relief) on investments in technologies and products that encourage sustainable water use. Businesses are then able to deduct the whole cost of their investment from their taxable profits of the period during which they make the investment. The objective is to encourage businesses to invest in water-efficient technologies and provide key information to accompany them in their decision process. Indeed, the water-efficient technologies that are supported by the ECA scheme are listed to inform businesses of which efficient fixtures are targeted. It includes washing machines, flow controllers, leakage detection equipment, meters and monitoring equipment, rainwater harvesting equipment, small scale slurry and sludge dewatering equipment, vehicle wash water reclaim units, water efficient industrial cleaning equipment and water management equipment for mechanical seals. The categories and technologies are expected to be reviewed on an annual basis, based on satisfactory methods of certification and identification, proven cost-effectiveness and costs to the UK Government.
- Waterwise favours a tax reduction on water-efficient kits across the EU. A financial mechanism is perceived as an effective way to deliver water-efficiency improvements but it will require both clarity and exposure.
- NYC, in its water saving plan, also offered landlords 290 million dollars' worth of grants (currently equivalent to 200 million Euros) as an incentive to update plumbing systems with low-flow toilets, shower heads and faucets. Between 1994 and 1997, the city of New York replaced 1.3 million inefficient toilets

  The Living Victoria Water Rebate Programme in Australia rewards inhabitants for their efforts to be water efficient around the home, garden and small business by providing rebates on a range of water efficient products and appliances

- Building Level Policy (B)

Implementing labelling or minimum requirements will incur costs while building or refurbishing the building to meet the standards, and for the certifier to verify compliance, but also to set up the scheme against which the building is audited (i.e. determining the standards and thresholds). In case of mandatory labelling and minimum requirements, the constructors will bear compliance costs.

A water audit for a 10-floor office building in the USA would cost around 5 000$ (around 3 560€) according to an American consultancy. Green Star and LEED cost between 4 000 € for buildings smaller than 2 000 m^2 and 24 000 € for 50 000 m^2 and more [142].

Costs will also be incurred by setting up the certification scheme. A large-scale rollout allows for certification schemes to capture economies of scale. However, a one-size-fits-all scheme will not be suitable because different types of commercial and institutional buildings have technologies and operating systems that are specific to their activities. This results in the need to adapt the certification systems and therefore additional costs. Several certification initiatives offer building schemes specific to the building usage, e.g. LEED for home (with 15 water credits to be awarded), LEED for new construction (10 water credits), LEED for commercial interiors (11 water credits), LEED for schools (11 water credits), BREEAM New Construction, BREEAM refurbishment, etc.). Therefore, a certification programme at EU level would require the development of several parallel schemes that each cover particular types of buildings. The setting up of the different schemes would incur higher costs than a single scheme, but as all schemes would be based on a common broad scheme it would still be less costly than fully developing a scheme for each different types of buildings.

Green building may include costs not only for the certification itself but also for planning and construction. The extra cost includes more time for architects and engineers to plan the construction. The cost will decrease over time (as is the trend at present). Studies by USGBC show that LEED-certified buildings cost from 0.66% to 6.8% more in planning and construction, depending on certification level aimed for[143].

Influence of the type of owner

The costs of paying for the certification and modifying/designing the building so that it meets the standards of the certification scheme will be borne by the owner or constructor of the building.

Consequently, green certifications generally tend to be relevant for public authorities, major corporations and owners of real estate with rather long investment horizons. This category of owner may also benefit from communicating their environmental performance through a certification , and result in benefits, worth the costs. For private property or homeowners, the additional costs of achieving better environmental performance and thereby fulfilling a minimum requirement may significantly affect the financial burden.

Impact on the building value

A survey on the UK financial and business services sector showed that tenants would be willing to pay 10% more rent if the building was designed and constructed to increase water efficiency[144]. That is consistent with the fact that green buildings may contribute to economic benefits for the owner with increased occupancy rates (+8%)[145], higher rents (+6%) and higher commercial

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[142] BIO Intelligence Service, 2009, Water Performance of Buildings, DG ENV

[143] Kats, Greg, et al., 2003, The Costs and Financial Benefits of Green Building; A Report to California's Sustainable Building Task Force, California Integrated Waste Management Board.

[144] Deutsche Bank Research, 2010, Green buildings, a niche becomes mainstream.

[145] Fuerst, Franz and Patrick McAllisters, 2009, An investigation of the Effect of Eco-Labelling on Office Occupancy Rates. Real Estate and Planning Working Papers. Reading University.

building values (+35%)[146]. The EU FP7 project SuperBuildings indicate that value of a building increases to up to 10% if assessed as green. For the moment no evidence of increased rents were identified in real cases. According to real estate stakeholders, this information remains questionable and does not reflect the actual market.

- Certification scheme for rainwater harvesting and grey water reuse (B4)

The implementation of rainwater harvesting and grey water recycling induce additional costs[147,148] linked to the manufacture, installation and maintenance of the systems[149], borne by the building owner/constructor. The building and operating costs are likely to decrease with improvements in technology and design in the future. Inserting rainwater harvesting and grey water recycling in existing buildings could be more expensive than including such systems from start in the construction phase due to technical issues. Costs would also be associated with the implementation of certification of systems for recycled/harvested water. The implementation cost for such scheme would be relatively low, by requiring the verification only of the harvesting/reuse system (and thus being quite low compared to the certification costs provided for whole buildings above). Integrating water reuse or harvesting criteria (where feasible) within building certification schemes is financially interesting, since it would lower the overall costs of certification.

Financial incentives can increase the use of these systems, but can be quite costly. For example, in Victoria (Australia), eligible households who purchased and installed a rainwater tank between 1 July 2011 and 30 June 2013 are eligible for a rebate of up to 1,000 AUD (around 760€). Rainwater tanks must have a minimum volume of 2 000 litres and be connected to toilet and/or laundry made at time of installation. The programme also lists non-treatment and treatment grey water systems that are eligible for rebates[150]. Through the Australian National Rainwater and Grey water Initiative, as part of the Water for the Future Initiative, household rebates of $500 (i.e. 370€) for new grey water systems purchased after January 2009 have been offered[151].Financial incentives can also make overall costs for alternative waters more attractive than conventional waters.

[146] Fuerst, Franz and Patrick McAllisters, 2009, New evidence on the Green Building Rent and Price Premium. Real Estate and Planning Working Papers. Reading University

[147] Jeslin Kaduvinal Varghese (2007), Effects of the Implementation of Grey Water Reuse Systems on Construction Cost and Project Schedule. , B-tech, Kerala University, India ; Chair of Advisory Committee: Dr. Charles W. Graham. August 2007. Available at: repository.tamu.edu/bitstream/handle/1969.1/ETD-TAMU-1447/KADUVINAL-VARGHESE-THESIS.pdf?sequence=1 [Accessed on 31/08/2011]

[148] Edward A. Clerico, Alliance Environmental LLC. Experience and Future Prospect

[149] They require large tanks, normally underground, for storing intercepted rainwater, coupled with a treatment unit (filter) and pump, header tank (in loft) and separate pipework.

[150] www.water.vic.gov.au/saving/home/grey water/rebates

[151] Pacific Institute (2010), Overview of grey water reuse: the potential of grey water systems to aid sustainable water management. November 2010. Available at:www.pacinst.org/reports/grey water_overview/grey water_overview.pdf [Accessed on 01/09/2011]

Based on the technical expertise from a real estate association[152], the costs of the installation of efficient WuPs and renovation at building level for the residential sector have been assessed:

- Replace 4 to 5 taps or shower heads: 50 to 200 €
- Replace toilet flushes or toilet equipment: 200 to 2.000 €
- Install a low pressure water system: 500 à 1.000 €
- Replace 1 or 2 WUP in furnished rented homes: 350 to 1.500 €
- Replace bathtubs (with shower, or smaller bathtubs): 1.500 to 5.000 €
- Install water efficient cooling system: 800 à 3.500 €
- Install grey water treatment & distribution system: 10.000 to 30.000 €
- Install rainwater collector & distribution system: 5.000 to 15.000 €
- Install water heater (close to the tap) to prevent cold water waste (cost not evaluated)
- Replace or repair water pipes to prevent leakages in plumbing system 10.000 to 30.000 €.

4.3.3 Operation and Maintenance costs

- Horizontal Level Policy (H)
  - Water metering (H1)

In the UK, the installation of water metering may lead to an increased price of water services to consumers due to the initial and replacement costs[153]. During the lifetime of the meter, water companies will read meters regularly, and get payment from the building occupiers through services on the water bill. In the face of rising energy prices, water metering alone could reduce customers' water and energy bills by between £40 and £160 per year in the UK (around 45 and 182€)[154].

According to a study in Spain[155] 10% of water savings can be gained thanks to metering, which means in residential buildings 9,760 Mm^3/year, i.e. 206 M€/year (considering a 21,100 €/Mm^3 price for water in Spain in 2009). Since the average household is 3 persons, the potential savings in Spanish urban households could be 19€/year/household. This potential economic saving emphasises the importance of accurate metering, and can be used to make a point to consumers who fear that such measures could result in an increase of the price of water.

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[152] UIPI, Paper in response to the Stakeholder consultation

[153] www.ciwem.org.uk/policy-and-international/current-topics/water-management/regulation-for-a-sustainable-water-industry.aspx

[154] The greenhouse gas implications of future water resources Options – Defra www.environment-agency.gov.uk/research/library/publications/40731.aspx

[155] Cobacho, R. Low flow device in Spain ? How efficient are they in fact ?An accurate way of calculation. Institute for Water Technology. Polytechnic University of Valencia. Spain

However, the cost benefits of metering cold/warm water have been questioned in some parts of the EU. Swedish National Board of Housing, Building and Planning investigated[156] the question of individual water metering. They concluded that it is hardly profitable to introduce individual metering of water in view of the cost of water meters (reading, calibration, billing, etc.). However, the profitability of this measure is increased if the measurement is limited to domestic hot water, whose cost is significantly higher due to energy costs.

Based on experience from existing metering projects a rough estimate can be made of the impact of individual metering in all apartment buildings in Sweden on energy and water use:

- Energy costs for heating and hot water would be reduced by the order of 2.4 to 4.8 billion SEK per year (around 550 M€).
- Water costs would decrease by the order of 0.4 to 0.8 billion SEK a year. (45-90 M€)

If the annual costs for operation and maintenance of measurement systems are assumed to be 400 SEK / apartment (around 45€), incl. VAT, and the average investment costs of 7,000 SEK / apartment (around 800€), incl. VAT, the total investment for the country's 2.4 million apartments is in the order of 17 billion SEK (around 2 M€) with a payback time of 4 to 9 years[156]

The benefits in terms of reduced water and energy bills will benefit the occupier, while the costs of installing the meter will be borne by the owner (see capital costs).

- ▷ Water pricing and cost strategy (H2)

Pricing water and changing cost strategies will result in higher costs for consumers that continue to use the same amounts of water (unless under the volumes of a block tariff). Consumers that reduce their water use could have lower bills in the medium-term. Reduced fees gained by water companies may reduce their profits, and mean that prices per litre of water increases to take account of fixed charges (pipeline maintenance, etc.).

- ▷ Awareness raising and education (H3)

Operating and maintenance costs for water companies (in case a leak has to be repaired in the system), building owners or occupiers (in case of leak to their systems, products, or of water damages) and insurances (in case of water damages) may be reduced by a better awareness of water usage, through a better maintenance of pipes and equipment by aware users, thus raising daily operational costs but reducing high costs linked to bigger repairing operations.

Awareness-raising about financial savings thanks to such water conservation measures (e.g. use of alternative waters) are shown to be a key motivating factor for conservation behaviour[157]. Depending on measures (and water prices), the payback time of the investments can be quite high, with substantial financial savings occurring only in the long-run, from a lower use of water and/or energy. In this case, communication campaigns are crucial to inform consumers about these future savings, and encourage them to consider such investments for water

[156] Boverket, Projekt 22101/311/5111, Indiduell Mätning av värme och varmvatten I lägenheter, 2005, Lennart Berndtsson

[157] www.waterrf.org/ProjectsReports/ExecutiveSummaryLibrary/4012_Executive_Summary.pdf

conservation[158]. A significant amount of money can be spent, generally by the State, but often also by NGOs or water companies, on awareness-raising campaigns. For example, California water officials are planning to spend $4 million (around 3 M€) in the coming year to get the message out: conserve water[159].

The benefits in terms of reduced water and energy bills will benefit the tenant, but maintenance costs of bigger repairs will also benefit the owner.

- Product Level Policy (P)

Once efficient WuPs are introduced, after the initial investment cost, the water consumption and consequently the water costs would be reduced. For example, while investment costs will incur (currently simple water saving showerheads cost about £35 (42€), see section on capital costs), in the UK, changing a showerhead and toilet, could result in annual savings for the occupier of 67 m^3 water, that is £225 (270€) for a household with a standard occupancy of 2.4 persons [160].

An Australian study[161] mentions a payback time of about 7 years through savings in the water bill, based on a cost of 500€ per household for the installation of a combination of water-efficient appliances, including a AAA showerhead, a drip irrigation system for the garden, flow restrictors and water-efficient front loading washing machines (all could be introduced by the occupier, whether renting or owning the place, who would then also gain the savings).

Adding to the costs of the water saved, savings in the energy costs will also apply to the occupiers. In the Waterwise programme, the cost of energy saved in the trials range from 1.3 to 44.3 £/property/year (1.5 to 50.3€/property/year)[162].

Calculations for water saving (changing toilet, shower fitting and adjusting behaviour) a normal detached villa in Sweden (2 adults, 2 children) show that 45 m^3 could be saved per year, which results in 675 SEK (77€) for the water (based on 15 SEK/m^3 (1.7€/m^3)) plus about the same amount for heating of the water, thus in total 1,200 SEK/year (136€/year). The investment cost to obtain these savings would be about 2,000 SEK[163] (226€), highlighting a payback time of less than 2 years. These would need to be installed by the owner, and gained by the occupiers, which is likely to be the same person for detached villas.

Depending on the policy instrument used (P1, P2, P3), the costs will be different. Indeed, through voluntary and mandatory labelling schemes, the owners and/or occupiers decide whether to introduce products in their buildings, deciding whether it is cost-effective for them or not. In the case of minimum requirements, the costs will be imposed to customers (i.e. those buying the product, whether constructor, owner or renter), but on the long-term, through the competition

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[158] Csobod E., Grätz M., Szuppinger P., 2009, Overview and analysis of public awareness raising strategies and actions on energy savings. INTENSE Background paper, Public awareness raising strategies and actions on energy savings. Report number: INTENSE/Deliverable 6.1/WP6/Year 2009

[159] www.abclocal.go.com/kabc/story?section=news/state&id=6773657

[160] UK Environment Agency, Quantifying the energy and carbon effects of water saving – Summary report.

[161] www.melbourne.vic.gov.au/Environment/SavingWater/Documents/water_turning_blue.pdf

[162] www.waterwise.org.uk/data/resources/14/evidence-base-for-large-scale-water-efficiency-in-homes-phase-ii-interim-report.pdf

[163] www.viivilla.se/Energi/Spartips/Spara-vatten-med-battre-vanor-och-moderna-armaturer-42576

occurring between manufacturers, the costs – initially higher for efficient WuPs than for traditional ones - are expected to decrease over time.

Awareness-raising campaigns will induce costs to the State, NGOs or water companies. They will help the customers decide whether the products are cost-efficient for them, but are not expected to raise customer's costs.

Financial incentives will have an important impact on financial return on investment, and will thus highly impact the decisions by customers to introduce products or not, but are also costly for the stakeholder providing the incentive, generally the State.

- Building Level Policy (B)
    - Building level approach (B1, B2 and B3)

In terms of return on investment, costs premiums for obtaining a LEED certification in silver or platinum levels are respectively around 2 and 6.5% of the life-cycle costs (LCC) (i.e. costs over the whole lifetime of the buildings, including construction, use, refurbishment and end-of-life), paid by the owner of the building (sometimes initially paid by the constructor, but expected to be regained through sale of the building). The net value of the related savings over 20 years - with a discount rate of 5% - is over 3 times larger than the minimum initial cost of 2% of the LCC[164]. Setting minimum requirements comparable to a silver LEED certification would then be in compliance with adopting a lowest life-cycle cost approach (as promoted in the Ecodesign Directive).

Besides, utility charges, paid by occupiers, which are usually among the most costly expenses for buildings, are considered lower than usual in green buildings. McGrawHill Construction[165] finds overall operating costs to be lower by 8-9% for green buildings compared to conventional ones.

If audits are required to confirm the rating of the building, the costs will be borne by the owner, or by the tenant (if included in the maintenance costs of the building). Water (and energy) bills reductions will benefit the tenant.

At EU level, with regard to the implementation of the Energy Performance in Buildings Directive (EPBD), the Cohesion Fund had dedicated 4.2 billion euro of financial aids mainly for eastern European countries for the 2007-2013 period[166] to increase energy efficiency in the housing sector. Another measure was proposed in the 2010 EPBD recast to extend an existing measure: the VAT reduction for a specific list of services relative to renovation and reparation of private dwellings was to be extended to the whole housing sector. This type of financial incentives could be transposable to a policy aiming to enhance the Water Performance in Buildings, if public finances permit.

Studies show that green buildings (e.g. LEED, BREEAM) obtain better results in terms of higher rent (+3%) plus lower maintenance and operational costs (-8 to -9%, not only related to water

[164] Building Design + Construction, 2009, Green Buildings + Water Performance

[165] McGrawHill Construction, 2006, Green Building Smartmarket Report.

[166] Proposal for a recast of the energy performance of buildings directive (2002/91/EC) Impact Assessment.

aspects). Moreover, the share of rented space occupied (as opposed to non-rented out) was 3.5% higher in green buildings[167].

- Certification scheme for rainwater harvesting and grey water reuse (B4)

The costs for treating wastewater and producing non-potable reuse water is in the range of 1.36€ to 2.04€ per m^3, depending on system size[168]. The operational costs of regular audits to confirm the functioning of the system will be borne by the building owner (to be added to the capital costs), but could possibly be borne by the occupier through the operational costs of the building paid by the tenants depending on the renting agreement. The tenants will benefit from reduced water bills.

EUREAU – the European Federation of National Associations of Water - expressed uncertainties regarding the effect of an expected decrease in water consumption (due to the use of alternative water sources) on drinking water prices. Supply of alternative water sources for non-drinking use, leading to lower drinking water consumption, may increase (drinking water) prices due to the high fixed costs of drinking water supply. In Japan, the economics have been shaped to promote water conservation and reuse. Indeed, the national government has generally subsidized 50% of the capital cost for large scale water reuse facilities, so that the average cost for non-potable reuse water is $0.83/m3 (around 0.6€/$m^3$) whereas potable water supply ranges between $1.08/m3 to $3.99/m3 (0.75 to 2.8 €/$m^3$)[168]. The economics favour water reuse in all cases.

In sum, the installation and life cycle of the implementation of such systems would be costly, but could be counterbalanced by reduced costs of water from the general supply network. Also, the overall cost-efficiency could be enhanced if the systems are installed at a larger scale than a single building (e.g. neighbourhood, residential area, municipalities, etc.). Further investigations are needed to identify best practices on that aspect.

4.3.4 Administrative and enforcement costs

Administrative costs will be associated with the set-up of certification schemes or labels and/or the determination of performance thresholds. Public authorities have to face additional costs, on top of the related administrative burden (e.g. red tape), to control the good enforcement of the labels and building certification schemes and ensure the compliance with potential minimum requirements. Those costs will be higher in case of minimum requirements, than for mandatory labelling, and lower for voluntary labelling (which still involves some control). With regard to the certification for rainwater harvesting and grey water reuse, additional costs with regard to the set and compliance of a health code have also to be envisaged. Moreover, extra-costs related to the training of proper certifiers and auditors have to be considered.

Likewise, any launch of financial incentives will come from public budgets, which will lead to costs, and will need to be administratively monitored in order to check proper implementation.

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[167] Bowman, Richard & Wills, John, 2008, Valuing Green – How green buildings affect property values an getting the valuation method right.

[168] Edward A. Clerico, Alliance Environmental LLC. Experience and Future Prospect

Financial incentives will promote water-efficient products, buildings and certain harvesting and reuse systems, thus balancing the relative prices by promoting environmentally friendly goods.

4.3.5 Potential side costs

To address the possibility of sewer blockages and other operational problems due to lower wastewater volumes, changes in the design of drainage systems can be suggested such as the use of smaller diameter pipes and pipes with steeper gradients. This opens opportunities for new building construction but it would rarely be a cost effective option for existing building areas[169].

However, the current design of drainage systems can still be suitable in spite of a reduced water use per capita when considering the population growth in some MS. In this case, the overall water demand would remain balanced and the current water network could still be used. The lifespan of assets and infrastructure could even be extended.

4.3.6 Other economic impacts

- Impact on investment cycle

Building-level policies may impact on how investments are made in the real estate market. Potential investors may adapt their strategy in terms of favouring green elite buildings with longer returns on investment to expect.

4.4 Social impacts

4.4.1 Public behaviour and acceptance

- Participation and uptake

Public acceptance of water saving initiatives highly varies between types of housing. In the UK, the Waterwise programme[170] shows uptake rates between 6% and 22% in general housing whereas social housing (i.e. dedicated to lower-class population) show significantly higher uptake rates (between 45% and 60%). Yet, once involved in a water-efficiency project, 65% and 78% of customers from respectively general and social housing save water. The uptake of water-efficient devices has been shown to depend on the credibility of the body offering the retrofit and the communication about the new water saving equipment. The high uptake rates noted in social housing areas has mostly been due to the involvement of a housing association in the facilitation, planning and execution of water efficiency retrofitting projects. In Victoria, the WaterSmart Behaviour Change Programme actually engaged 18% of the public invited to take part. The

[169] Less water to waste: Impact of reductions in water demand on wastewater collection and treatment systems, 2008, Environment Agency.

[170] www.waterwise.org.uk/images/site/Policy/evidence_base/evidence%20base%20for%20large-scale%20water%20efficiency%20in%20homes%20-%20phase%20ii%20interim%20report.pdf

Central Highlands Water[171] project showed for example that people with children were more likely to be influenced by marketing communications and a desire to reduce money spent on water. Likewise, the WaterSmart Behaviour Change Programme also showed a greater propensity for the smaller households to make larger reductions in water usage than larger households.

According to the Waterwise programme, only a small proportion of the population accepts to participate and actually commits to water efficiency programmes, which severely limits the water savings achievable. The number of people invited to participate, is higher than the number of people that agree to participate (i.e. uptake rate), which is higher than the number of the households where installation actually takes place and where water savings occur. Projects feedbacks, such as in the City West Water[172] project in Australia, often underline the difficulty to engage target audience and the progressive withdrawals from the project of a share of the population. A 2001 UK assessment of the effectiveness of promotional campaigns on water-use behaviour[173] highlighted the difficulty to engage the public, especially when it does not consider the amount of water as a priority issue due to the absence of noticeable shortages.

The case of renters vs. owners is less clear. Depending on projects, renters are said to be more reluctant and less likely to install water saving appliances[174] or to make significant reductions in their water use compared with owners[175].

While the receptivity of people engaged in programmes is very variable, according to the Waterwise programme, the proportion of customers that save water in the majority of multi-measure projects is rather predictable, and ranges between 65% and 78%[106]. Likewise, the WaterSmart Behaviour Change project showed, in the Barron Water project, that participants ended up significantly changing their behaviour, with about 52%-93%[176] of them taking showers of four minutes or less in duration and 92% washing full loads of clothing in the washing machine[177]. Regarding the installation of water efficient appliances, 41%-69% also had installed water efficient showerheads in their bathrooms. Yet, only 14%-16% installed water flow restrictors[176].

The use of water-efficient schemes could also be perceived as a compromise on the comfort of use and therefore not be well-accepted by the consumers. That could be partly explained by the use of innovative WuPs that did not comply with a multi-criteria performance assessment. Water-efficient showerheads could therefore be associated with customers' dissatisfaction due to pressure issue or to the need to increase the water temperature. As highlighted by the

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[171] www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-central-highlands-water
[172] www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-city-west-water

[173] paginas.fe.up.pt/~mjneves/publicacoes_files/data/es/ponencias/por_autor/pdf/10086.pdf
[174] www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-central-highlands-water
[175] www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-city-west-water
[176] www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-city-west-water
[176]www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-stage-2-yarra-valley-water
[176] www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-city-west-water
[176]www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-south-east-water
[177] www.water.vic.gov.au/saving/home/watersmart/watersmart-program-executive-summary-barwon-water

Ecodesign Directive for energy-related products, the promoted products should not have a direct impact on the consumer behaviour.

- Building level policy (B1, B2 and B3)

A 2010 study from researchers from Maastricht University[178] suggests that the real estate sector is not yet ready to embrace voluntary efforts to set water measurement standards. The low (20-30%) response rate after contacting 688 real estate entities on sustainability performance indicates that environmental management within the property sector is still in the early stages. The green building market is still emerging.

It has to be noted that when learning from experiences of LEED and BREEAM, the higher ratings (Gold, Platinum) a better indoor environment is also obtained which may make these buildings more attractive than conventional or lower rating ones[179].

- Rainwater harvesting and reuse systems (B4)

The use of non-potable water in households (through grey water reuse and rainwater harvesting) is still hampered by population reluctance, mainly related to their perception of sanitary risks and/or disgust reactions. Thus, the terms "treated wastewater" or "recycled water" are avoided in public communications, which rather use terms like new water (e.g. in Singapore, NEWater project) or repurified water (e.g. in San Diego). The public acceptance also depends on the use and source of the grey water. Regarding the use of grey water, according to the CSIRO review[180], the closer the recycled water is to human contact or ingestion, the more people are opposed to using the water. Regarding the source of grey water, the use of a water recycling system where the source and application are located within the household is acceptable to the vast majority of the population as long as they trust the organisation which sets standards for water reuse. However, using recycled water from second party or public sources is less acceptable, although half the population show no concern[181].

Public perceptions and acceptance of water reuse are now recognised as key factors of success for water reuse projects. According to the CSIRO study[180], social marketing or persuasion is ineffective in influencing people to use recycled water. Consumers today require evidence-based information before engaging themselves in a water reuse project. Information provision, including communication about the risks, has been shown to reduce people's concerns about reuse and increased the perceived safety of the projects[182].

[178] Kok, Nils, Piet Eichholz, Rob Bauer, Paulo Peneda, 2010, Environmental Performance: A Global Perspective on Commercial Real Estate, Maastricht University

[179] Bonde, M, Lind, H., Lundström, S. , 2009, Hur värderas energieffektiva och miljöanpassade kommersiella fastigheter? KTH Royal Institute of Technology Sweden

[180] Po M., Kaercher J. and Nancarrow B.E. CSIRO Land and Water (2004), Literature review of factors influencing public perceptions of water reuse.www.clw.csiro.au/awcrrp/stage1files/AWCRRP_1A_Final_23June04.pdf

[181] Jeffrey, P. and Jefferson, B. (2003). Public receptivity regarding in-house water recycling: Results from a UK survey. Wat.Sci.Tech: Water Supply 3(3) 109–116.

[182] Marks, J., Cromar, N., Howard, F., Oemcke, D., & Zadoroznyj, M. (2002a, April). Community experience and perceptions of water reuse. Paper presented at the Enviro 2002 Convention and Exhibition, Melbourne, Australia.

A survey performed in Spain[183] after installing grey water reuse systems in 120 households also showed that the public is particularly sensitive to failures of the system. About a third of the participating households were dissatisfied, because of the unpleasant odour and appearance of the water, system breakdowns and maintenance costs. In order to build trust in these new technologies, the public therefore needs to understand their principles and benefits before their installation. In the Netherlands and Belgium, it seems that problems in distribution systems also hampered the development of this technology.

Education centres have been created to accompany consumers in their uptake of grey water reuse. For example, the Public Utility Board (PUB) of Singapore opened a public education centre in early 2003 to enhance the public understanding of reclaimed water, called 'NEWater', amongst other water-related topics. This centre was complemented by an intensive public education programme on NEWater in the second half of 2002, with advertisements, posters, leaflets, the broadcast of a documentary, as well as the provision of over 1.5 million bottles of NEWater samples. As a result, an overwhelming majority of Singaporeans have expressed their acceptance of NEWater[184].

4.4.2 Employment and business opportunities

- Horizontal Level Policies (H)

The implementation of pieces of the horizontal policies would lead to increased employment through the installation of water meters and would bring business to information campaign stakeholders.

- Product Level Policies (P)

The implementation of product labels and minimum requirements will increase innovation in products, to provide customers with more efficient products. Such innovation may provide a competitive advantage to manufacturers on new and/or international markets. Businesses that do not adapt may however have to close down. The impact is expected to be higher with minimum requirements, but would also be high with mandatory labelling, through increased requirement by businesses to appear either as best in class or to have a range of products (e.g. prices and efficiency differences between products). Depending on the policy option, requirements applying to put products on the market would be harmonised (applying to all, whether European or not), simplifying the work from manufacturers. It will also help consumer choice by providing better information. Minimum requirements will prohibit the placing on the market of inefficient products.

Additionally, administrators would be needed to ensure the good application of the certification schemes and of any accompanying financial schemes, possibly increasing public jobs. Synergies with administrations controlling energy-using products may be fostered.

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183 Domènech, L. and Saurí, D. (2010). Socio-technical transitions in water scarcity contexts: Public acceptance of grey water reuse technologies in the Metropolitan Area of Barcelona. Resources, Conservation and Recycling. 55: 53-62. ec.europa.eu/environment/integration/research/newsalert/pdf/218na4.pdf

184 UNEP (after 2006), Water and wastewater reuse . www.unep.or.jp/ietc/publications/water_sanitation/wastewater_reuse/Booklet-Wastewater_Reuse.pdf

Certification businesses will increase their activity.

- Building Level Policies (B)
  - B1, B2 and B3

The development of water labelling schemes or other standard development will bring employment to green building businesses, through the development of the standard and advice to be given to companies to improve their ratings/meet the standards. However, it will require the education and training of skilled workers. For this purpose, for example Green Plumbers USA proposes that community colleges create a curriculum for "pre-apprentice water auditors". Graduates would be trained to assist professional water auditors, thus expanding the potential workforce and possibly reducing the cost of water audits, and vocational training may also be utilised to train existing workers. It is considered as a new opportunity to create employment[185]. Depending on the policy option, requirements applying to label buildings would be harmonised (applying to all, whether European or not), simplifying the work from constructors and certifiers. It will also help consumer choice by providing better information. Minimum requirements will prohibit the construction of inefficient buildings.

Additionally, administrators would be needed to control the good application of the certification schemes and of any accompanying financial schemes, possibly increasing public jobs. Synergies with administrations controlling the implementation of the EPBD may be fostered.

Certification businesses will increase their activity.

  - Certification for rainwater harvesting and reuse systems (B4)

Rainwater harvesting and grey water reuse schemes are expected to result in the training (in particular with regard to the sanitary risks) and employment of specialised plumbers, and to increase the business of the companies building those systems and of certification businesses.

- Regional effects

If different thresholds are set based on common criteria for implementing labelling schemes or minimum requirements, impacts may differ in different MS. However, these are expected to be in line with the climatic differences, that already impact how business work in different MS.

4.4.3 Sanitary and health issues

Reduced water flows can result in more stagnation in pipes, possibly leading to higher sanitary and health risks, but no evidence of this was found. This would apply to any of the policy level and instrument chosen, that reduces the total amount of wastewater.

The main other sanitary and health issue applies to rainwater harvesting and to grey water reuse (B1). Indeed, sanitary issues are linked especially to installation, maintenance and operation of rainwater harvesting and grey water recycling. Low quality of grey water can result in significant

[185] Kok, Nils, Piet Eichholz, Rob Bauer, Paulo Peneda, 2010, Environmental Performance: A Global Perspective on Commercial Real Estate, Maastricht University

health risks, including infectious diseases. Stored rainwater can be contaminated with *Enterococci*[186].

Likewise, back-wash systems - incorporated in the design of a reuse system and needed as part of maintenance and cleaning requirement - could result in the contamination of drinking water supplies.

Compared to traditional water point of uses, quality issues could also be encountered after the introduction of alternative water supplies because of the stagnation of water in pipes or storage tanks, which encourages biological activity. However, in general the risks associated with these systems are considered low, especially for flushing and gardening uses. Sanitary engineering and preventive medical practices have combined to reach a point where waterborne disease outbreaks of epidemic proportions have been controlled to a great extent. Household rainwater collection systems are becoming more established technology in countries such as Germany[187].

Yet, even where the risk is considered low, public perception of this risk may be an important barrier to the large scale uptake of grey water reuse solutions. For instance, parents may be afraid that when playing in the garden their child opens the recycled water tap which is outdoor for gardening use and drink from it. Actions to control water quality include health codes, procedures for approval of service, regulations governing design and construction specifications, inspections, and operation and maintenance[188].

For example, standards for reusing grey water are set in Spain in the Royal Decree 1620/2007, or standard for rainwater harvesting are set in the UK (BSI 8515:2009) and in France (French Decree August 2008). These standards could be used as a mandatory legal basis for the implementation of grey water reuse. In the UK, the frequency of maintenance stated in the literature ranges between 1[189] and 3[190] years.

In order to limit those risks, the option to implement minimum requirements to introduce systems on the market and ensuring that the systems are installed by certified plumbers would be most interesting. This would increase consumer protection within the EU.

4.4.4 Other social impacts

- Social equity

Water poverty should not result from any water saving policies. Where water prices are increased, it is important to assess the impacts on different social categories. Indeed, low-income

[186] EUREAU (2011), Working Group Microbiological Quality, Eureau-Commission Position Paper on water re-use and other alternative resources at home: rainwater harvesting and grey water recycling for domestic purposes. July 2011
[187] Defra, Science Report –- Greenhouse gas emissions of water supply and demand management options
[188] US EPA, Guidelines for Water Reuse. Chapter 3 Technical Issues In Planning Water Reuse Systems. EPA/625/R-04/108 September 2004. Available at: www.epa.gov/nrmrl/pubs/625r04108/625r04108chap3.pdf [Accessed 23/08/2011].
[189] UK Code of practice BS8515:2009

[190] Roebuck R., et al, 2006, Predicting the hydraulic and life-cycle cost performance of rainwater harvesting systems using a computer based modelling tool. Proceeding of the 4th International Conference on Water Sensitive Urban Design, Apr. 2-7, Melbourne, 699-706.

households tend to be hit hardest by rising water bills, as they proportionately pay more than twice as much for water usage in the home compared to high-income households[191].

- (Access to) Personal data processing

The use of smart-metering could gender issues related to the use of (and related access to) personal data. Water utilities would have to have clear customer policies and controlled procedure to ensure that any abusive exploitation of such data is banned.

- Split of responsibilities for public authorities

In terms of governance, some issues could be raised regarding the distribution of responsibilities for national and/or river basins authorities when ensuring the implementation of metering and pricing measures as well as minimum requirements at product and building levels.

- Access to finance

Stakeholders mentioned that requiring certain standards to be met especially when refurbishing buildings may create issues in terms of financial situation. Many owners in the EU are relatively old people (according to a statement from a stakeholder), and banks may be reluctant to agree to loans, making refurbishment works difficult to finance for owners.

On the other hand, banks may be interested in investing in green buildings either because rents may be higher, or as part of their environmental strategies.

- Synergies with existing schemes and international discussions

ISO standards are currently being discussed to set up a methodology to assess water footprints, which may propose interesting methodological developments. Any scheme (voluntary, mandatory labelling, minimum requirements for products, buildings or reuse/harvesting systems) will need to take into account CEN standards. Existing schemes are presented in the sections describing the policy options, and may be used for streamlining exercises while implementing schemes.

- Environmental responsibility

[191] OECD, 2011, Greening Household Behaviour: The Role of Public Policy

The implementation of the policy options will increase the possibilities for citizens to implement environmental responsibility, including through improving their behaviours relative to water, buying efficient products, living in green buildings, implementing systems to reuse/harvest water. Citizens will also be able to work for companies that either contribute to this by providing innovative products, advising on green buildings, certifying goods, or working in better conditions provided by efficient products and green buildings.

Through awareness raising and information campaigns, but also labelling, citizens are better informed about water issues and have better access to information.

4.5 Synthesis

To assess the policy options, a semi-quantitative approach is adopted, as shown in Table 25. Each of the options is presented in the form of a spider diagram that identifies Water savings, Energy savings, Other environmental impacts, Capital and operational costs, Other economic impacts, Employment and Other social impacts.

The spider diagrams are presented in Figure 14 to Figure 21 and allow a visualisation of the impacts of the different policy options, by aggregating several types of impacts. The level of detail in the analysis is based on the amount and accuracy of information gathered in section 4.

Table 25 - Semi-quantitative score matrix

Score on spider diagram	Quantitative assessment of water savings by 2025	Qualitative assessment	Legend (see summary matrix in section 5.1)
3	>5%	Very beneficial effect	+++
2	Between 2.5 and 5%	Beneficial effect	++
1	<2.5%	Slight beneficial effect	+
0	0	No effect (same as the baseline) or Marginal/Neutral impact	0
-1	(Irrelevant)	Slight negative effect	-
-2	(Irrelevant)	Negative effect	--
0	(Unknown)	Unknown effect	?

4.5.1 Horizontal policies

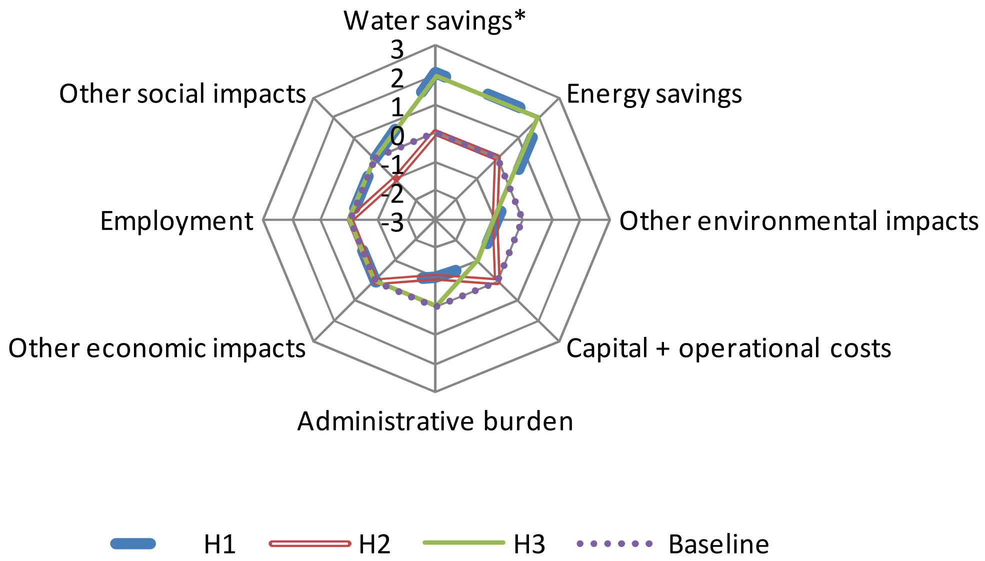


Figure 14 - Graphical assessment of the horizontal policies (includes water metering (H1), water pricing (H2) and awareness-raising and education (H3)).

Water metering (H1) is in place systematically for all buildings and for both hot and cold water in several MS but is still not in place everywhere, and for all types of buildings and all types of water (e.g. hot/cold). There is not sufficient information available to assess how many meters would be needed to cover all buildings in the EU. However, there is evidence from several MS that there is a rapid drop in consumption when meters are installed, and payment per consumption (i.e. based on meter readings) has strong acceptability in the EU. The impact of water metering on water savings is thus assumed to be of some 10%, for about 25% of the EU population. The related energy savings are directly linked to these, as water and energy use are very much linked, for pumping, treating, and more importantly heating the water; and energy use for production and installation of meters is not considered significant in comparison. Other environmental impacts due to lower amounts of wastewater, because of lesser use, include reduced sewer flow which may cause smelling and blockage issues (i.e. a negative impact compared to the baseline, although only anecdotic experience, e.g. in Berlin, currently exists). Works to modify sewers would be very costly and treatment and supply issues may also occur due to reduced wastewater flows. Reducing water usage will be important to cope with the impacts from climate change and ensure maintenance of biodiversity and ecosystem services relying on water. The option also encourages sustainable production and consumption and a responsible use of water resources, which is particularly important for transboundary river basins.

Capital and operational costs are high (i.e. negative impact) because of the costs of manufacturing, installing and monitoring the meters, even if water bills for users will decrease. How costs are shared between owner and tenant has significant impacts on the burdens put on these groups. Under usual leasing arrangements, landlords pay the capital costs of efficiency measures (and meters are likely to be installed by owners) while many of the benefits of green buildings are enjoyed by the user of the property. The administrative burden for public authorities is also high (i.e. negative impact) as there will be a need to verify that metering is implemented. Other economic impacts are similar to the baseline and include the risk that water is priced higher when consumption diminishes, to cover fixed costs from the installations.

The implementation of meters would lead to increased employment through the installation, monitoring and reading of water meters, but is not very different from the baseline as the meters would only be installed once and have a relatively long lifetime.

Water pricing (H2) is an important instrument to take into account externalities so that water supply is no longer taken for granted by consumers. Introducing water pricing that recovers the costs of water services and provides adequate incentives for users to use water resources efficiently is required by the WFD. The impacts of water pricing on water savings very much depends on pricing levels and structure. In the spider diagram and table these impacts are thus similar to the baseline, but could be much higher. Energy savings will similarly be directly linked to water savings, especially for hot water. Other environmental impacts are similar to H1 impacts.

No specific capital costs are expected.

The risk of water poverty needs to be considered and must be taken into account when modifying prices ('Other social impacts' are therefore assessed as negative impacts). Where water prices are increased, it is important to assess the impacts on different social categories. Indeed, low-income households tend to be hit hardest by rising water bills, as they proportionately pay more than twice as much for water usage in the home as high-income households. Administrative burden, Other economic impacts and Employment will not differ from the baseline.

Awareness-raising and education (H3) are very important since, as detailed in the Problem definition (Chapter 1:), consumption by water users is responsible for the majority of the building's water consumption. This option also receives a great support by stakeholders consulted. There is a wide range of estimates available on how much water could be saved by this option, and effectiveness will very much depend on the targeted public, types of messages, etc. Based on available evidence and further expert information, it is assumed that 3% of water will be saved at EU level with stand-alone awareness-raising and education campaigns. Energy savings will be directly linked to water savings, especially for hot water. Other environmental impacts are similar to H1 impacts.

Capital costs for implementing awareness-raising and education campaigns will be borne by the government or other entities paying for the campaign. Other economic impacts may include benefits (i.e. reduced costs), as awareness of consumers in terms of water savings may also help detecting leaks and other issues early, leading to lower repair costs later in time, but as this cannot be quantified it is not considered significantly different from the baseline. No specific administrative burden is foreseen from this option.

The uptake of water-efficient schemes has been shown to depend on the credibility of the body leading the campaign and to the communication about the new water saving schemes. The high uptake rates of efficient WuPs noted in social housing areas has mostly been due to the involvement of a housing association in the facilitation, planning and execution of water efficiency retrofitting projects.

- Comparison

H1 and H3 policy options offer significant potential water and energy savings but induce capital costs (for H1 and H3) and administrative burden (for H1). H2 has not been investigated in full details but the risk linked to water poverty is illustrated in the social impacts.

4.5.2 Product level policies

Several studies have assessed water savings from using more efficient water using products. As use from water using products depends on the type of buildings, the impacts are assessed separately. In non-residential buildings, 70 to 95% of the water is used for WC and urinals, with a potential improvement of 40% in water efficiency; potential savings are thus estimated to reach about 30%. In residential buildings, toilets and showering/bathing are the highest users, amounting to about 45% excluding baths. With improvement rates of about 40% for toilets and 30% for showers, potential savings are estimated to be around 15%. The introduction of efficient toilets and urinals in new buildings is the most obvious measure to consider and easier to implement than in other buildings. In buildings being refurbished, the toilets and urinals can also be changed, with some more efforts and costs. In existing buildings, such toilets and urinals can also be introduced, but with more significant work and costs involved, including in terms of resources and energy, to produce the new toilets/urinals and get rid of the old ones.

The options considered are **P1, voluntary labelling of water using products, P2, mandatory labelling of water using products** and **P3, minimum requirements for water using products**.

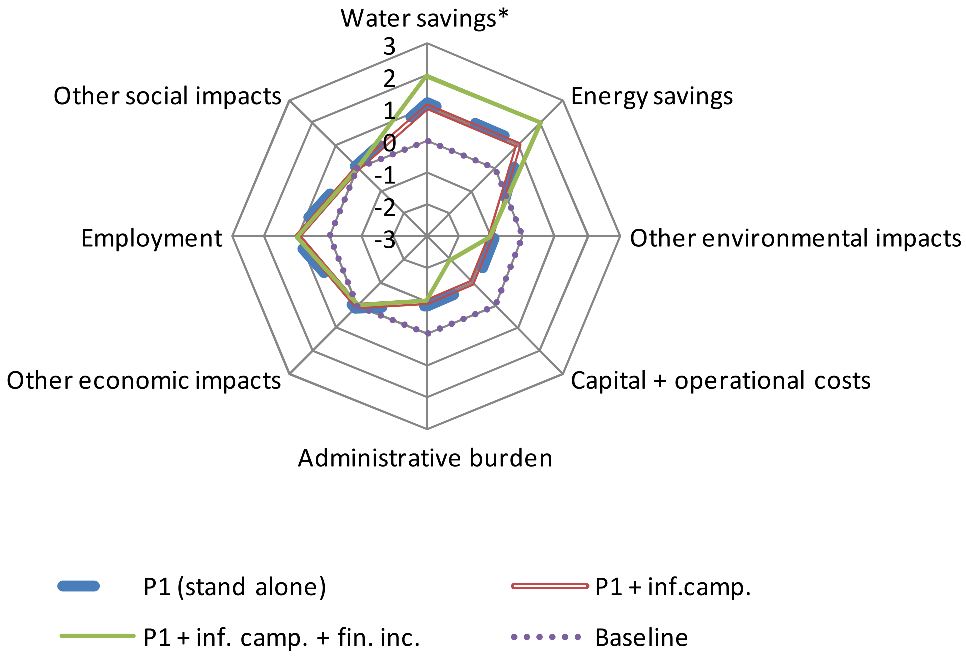


Figure 15 - Graphical assessment of the product-level policies P1 (inf. camp.= information campaigns, fin. inc = financial incentives)

Efficient WuP already exist on the market, and options targeting them can thus be relatively easily implemented. The implementation of a voluntary labelling scheme, such as the eco-label, is expected to accelerate the market penetration of these products, by providing supplementary information. WuP (as many other products) must respect the standards set by CEN (e.g. for sanitary reasons) also when their water efficiency is increased. As discussed with experts, the assumption is a 10% uptake in existing buildings and 20% uptake in new buildings. The rate of uptake is expected to rise by ensuring that consumers are aware of the meaning of labelling. Financial incentives would also increase uptake. Energy savings would occur and would be directly linked to water savings, notably because in residential buildings one of the greatest use of water is showering and the energy costs of constructing and installing showering products is considered insignificant in comparison, based on existing data. Other environmental impacts are similar to H1 impacts.

Capital costs for changing products will occur, at different levels depending on the products (e.g. higher for toilets than for showerheads). How costs are shared between owner and tenant has significant impacts on the burdens put on these groups. Under usual leasing arrangements, landlords pay the capital costs of efficiency measures while many of the benefits of green buildings are enjoyed by the user of the property. This is particularly true for fixed products such as toilets, which tenants may not be able to change. As P1 has no requirement in terms of installation, the costs will depend on uptake and lifecycle of the products (consumers will decide when to change their existing products). Where information campaigns and financial incentives are added as accompanying measures, costs will be higher. Similarly to other options, water bills will be reduced, but water prices may go up (see H1). Administrative burden for public authorities will be higher than in the baseline, due to the need to verify information provided on the labels.

In terms of social impact, implementing product-related policies would foster innovation and increase labelling requirements, thus increasing employment. However, the use of water-efficient schemes could also be perceived by consumers as decreasing the comfort of use and therefore not be well-accepted. The voluntary uptake of water-efficient devices has been shown to depend on the credibility of the body offering the retrofit and the communication about the new water saving equipment. The high uptake rates noted in social housing areas have mostly been due to the involvement of a housing association in the facilitation, planning and execution of water efficiency retrofitting projects. Depending on projects, renters are said to be more reluctant and less likely to install water saving appliances or to make significant reductions in their water use compared with owners.

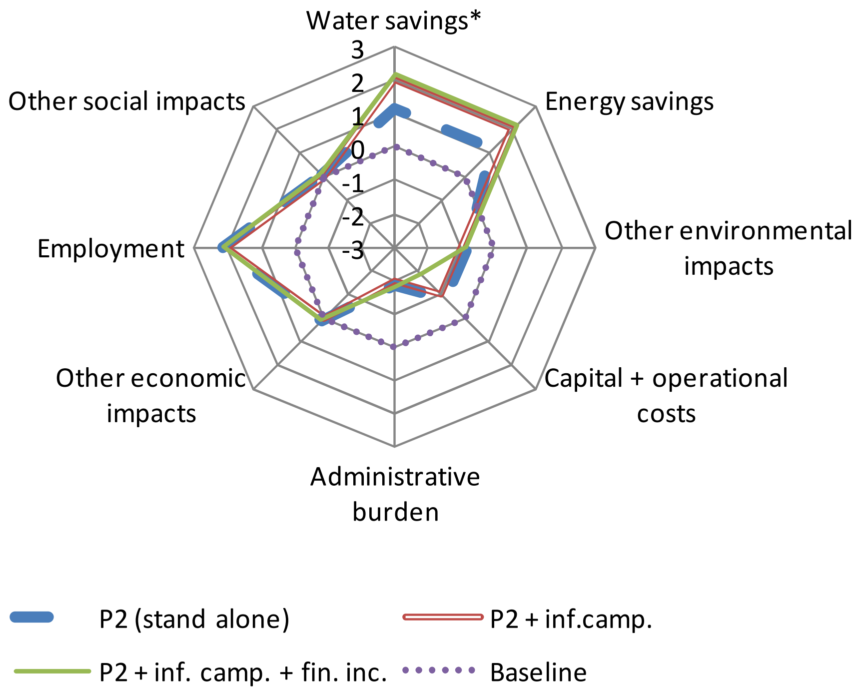


Figure 16 - Graphical assessment of the product-level policies P2 (inf. camp.= information campaigns, fin. inc = financial incentives)

It is unclear to what extent mandatory labelling will further lead to water savings, compared to voluntary labelling, because the information provided to consumers is similar. However, as all products would be labelled, the influence of information campaigns would be reduced, through the fact that customers will more easily identify a label on all products than on a few products only[192]. Energy savings would occur, directly linked to water savings, notably as in residential buildings one of the greatest use of water is showering and the energy costs of constructing and installing showering products is considered insignificant in comparison, based on existing data. Other environmental impacts are similar to H1 impacts.

[192] The difference between P2 and P2+ info c. in the spider diagram is explained because while the difference is low it exceeds the threshold set between scores +2 and +3.

Capital costs for changing products will occur, at different levels depending on the products (e.g. higher for toilets than for showerheads). Owner-tenant cost imbalances are similar to those associated with P1. As P2 has no requirement in terms of installation, the costs will depend on uptake and lifecycle of the products (consumers will decide when to change their existing products). Where information campaigns and financial incentives are added as accompanying measures, costs will be higher. Similarly to other options, water bills will be reduced, but water prices may go up (see H1). As this includes a mandatory scheme, administrative burden to monitor and enforce the mandatory requirements will be high (higher than for P1).

The implementation of mandatory product labels will foster innovation in products, to provide customers with more efficient products. Such innovation may provide a competitive advantage to manufacturers on new and/or international markets. It will also increase employment, particularly in relation to the implementation of labels and the verification of compliance with these labels.

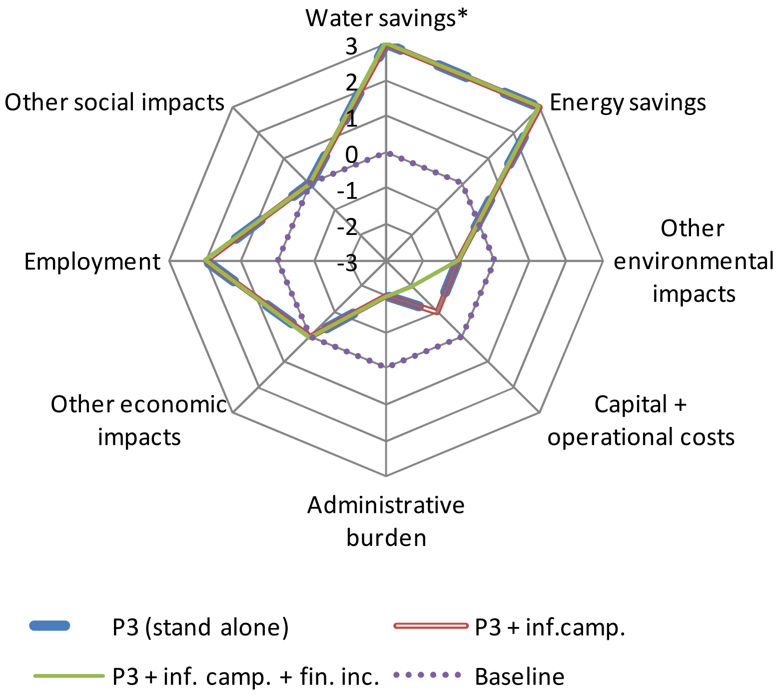


Figure 17 - Graphical assessment of the product-level policies P3 (inf. camp.= information campaigns, fin. inc = financial incentives)

The implementation of minimum requirements will speed up the market penetration of WuP, by banning the most inefficient products and increasing their uptake rate. A 15% uptake in existing buildings and a 100% uptake in new buildings are assumed. This means that the quantity of water saved through these means is higher than with other measures presented earlier. Energy savings would occur, directly linked to water savings, notably as in residential buildings one of the greatest uses of water is showering and the energy costs of constructing and installing these showering products is considered insignificant in comparison, based on existing data. Other environmental impacts are similar to H1 impacts.

Capital costs for changing products will occur, at different levels depending on the products (e.g. higher for toilets than for showerheads). Owner-tenant cost imbalances are similar to those associated with P1. As P3 has no requirement in terms of installation, the costs will depend on uptake and lifecycle of the products (consumers will decide when to change their existing products), but are expected to be higher than today for new buildings as efficient products will probably cost more. Similarly to other options, water bills will be reduced, but water prices may go up (see H1). Where minimum requirements are involved, administrative burden for public authorities to monitor and enforce the obligations will be higher compared to other options.

The implementation of minimum requirements for WuP will foster innovation in products, to provide customers with more efficient products. Such innovation may provide a competitive advantage to manufacturers on new and/or international markets. It will also increase employment, especially because of compliance verification needs.

- Comparison

Policy Options P1, P2 and P3 progressively offer more potential for water and energy savings while fostering employment. Administrative burden for public authorities will increase with a mandatory scheme (P2) and, to a greater extent, with the implementation of minimum requirements (P3).

4.5.3 Building-level policies

Options at building level approach the issue of water use in a more holistic way. The options are **B1: voluntary rating/auditing for WPB, B2, mandatory rating/auditing, B3, minimum requirements** and **B4 certification scheme for rainwater harvesting and grey water recycling**.

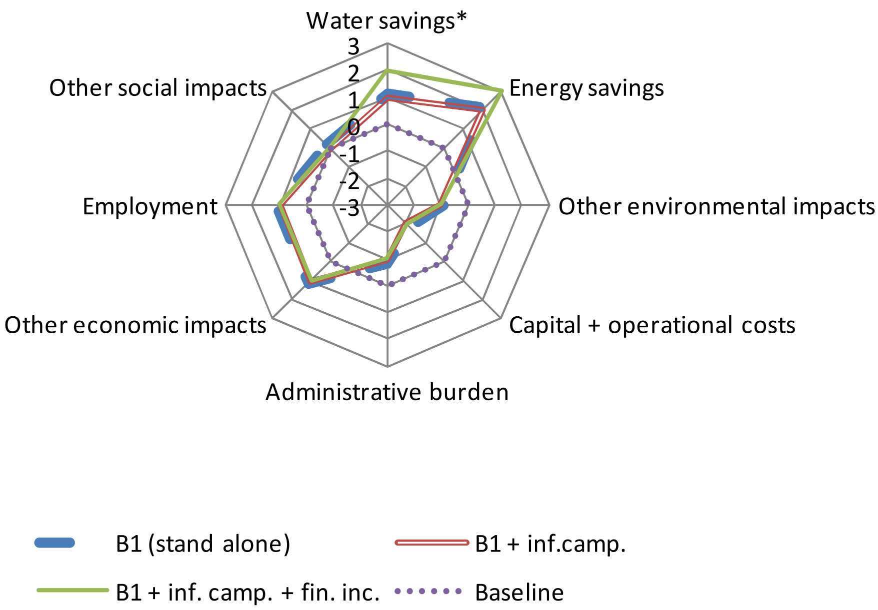


Figure 18 - Graphical assessment of the building-level policies B1 (inf. camp.= information campaigns, fin. inc = financial incentives)

Water is addressed in several national green building (voluntary) certification programmes and while it may account for only a small part of the overall assessment, there are points or credits to be earned by targeting water use reduction and increasing water efficiency. Based on a recent survey on uptake whose results have been extrapolated to a potential EU-wide scheme, a 1.5% uptake in commercial buildings and a 0.15% uptake in residential buildings are expected. A 25% water saving potential is assumed for the residential sector and a 40% water saving potential for the commercial sector (in line with existing evidence). For voluntary labelling, the influence of information campaigns is very important, so that people are aware of what the label means, and could increase the uptake. Financial incentives would also increase uptake. The energy and carbon saved would be linked both to the water saved and the need to introduce new products and systems; these two aspects are high mostly in existing buildings, while having these installations from the construction stage reduces the energy needs compared to later installation. Thus, energy and carbon would be saved in new buildings, and possibly in to be renovated buildings, while the carbon costs would be higher in existing buildings. Information campaigns on these schemes would increase the savings, making consumers aware of the links between water and energy and subsequent impacts on their energy bills. Other environmental impacts are similar to H1 impacts.

Building-level policies will incur costs to respect the standards and to receive a certification. On the other hand, the value of buildings may be raised, even if no consensus exists on the magnitude of this effect. The option may be more attractive to non-residential buildings owned by private companies, as a way to green their image. Owner-tenant cost imbalances also apply (see H1) as the owner may buy new green flats or houses without necessarily recovering a higher rent (similar to building value, no consensus exists on a potential increase). Similarly to other options, water bills will be reduced, but water prices may go up (see H1). The administrative burden would be higher than in the baseline to verify compliance of buildings with the schemes. Other economic impacts are positive as private companies may green their image and buildings may have a better attractiveness in these cases. Indeed, in terms of public acceptance and uptake, the real estate sector is not yet ready to embrace voluntary efforts to set water measurement standards[193]. Still, when learning from experiences of LEED and BREEAM, higher certification ratings (Gold, Platinum) may make (commercial) buildings more attractive than conventional or lower rating ones[194]. Employment is increased in this option through increased need for certification workforce and advice to owners.

[193] Kok, Nils, Piet Eichholz, Rob Bauer, Paulo Peneda, 2010, Environmental Performance: A Global Perspective on Commercial Real Estate, Maastricht University

[194] Bonde, M, Lind, H., Lundström, S. , 2009, Hur värderas energieffektiva och miljöanpassade kommersiella fastigheter? KTH Royal Institute of Technology Sweden

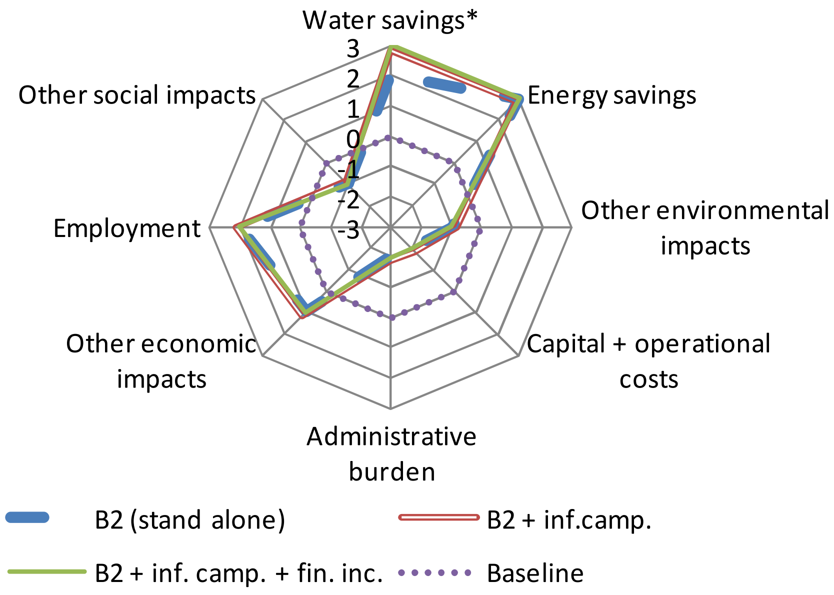


Figure 19 - Graphical assessment of the building-level policies B2 (inf. camp.= information campaigns, fin. inc = financial incentives)

Instead of a voluntary rating, a mandatory rating could be implemented, as in the case of the EPBD. The results in terms of water savings is thus expected to be very similar to B1 (25% for residential and non-residential buildings) but the uptake rates of improved buildings will be increased. The impacts for energy and carbon are similar to B1. Other environmental impacts are similar to H1.

The same capital costs as for B1 will be incurred. Owner-tenant cost imbalances are similar to B1. Similarly to other options, water bills will be reduced, but water prices may go up (see H1). Where mandatory schemes are involved, administrative burden to monitor and enforce the obligations will occur. Other economic impacts are positive as private companies may green their image and buildings may have a better attractiveness in these cases (see B1).

In terms of social impacts, the development of a standard, and the provision of advice for companies who wish to improve their ratings/meet the standard will develop employment. However, it will require the education and training of skilled workers (i.e. 'Other social impacts' is negative, since an effort is needed). Additionally, administrators will be needed to control the implementation of the certification schemes and of any accompanying financial schemes, possibly increasing public jobs. Synergies with administrations monitoring the implementation of the EPBD may be fostered.

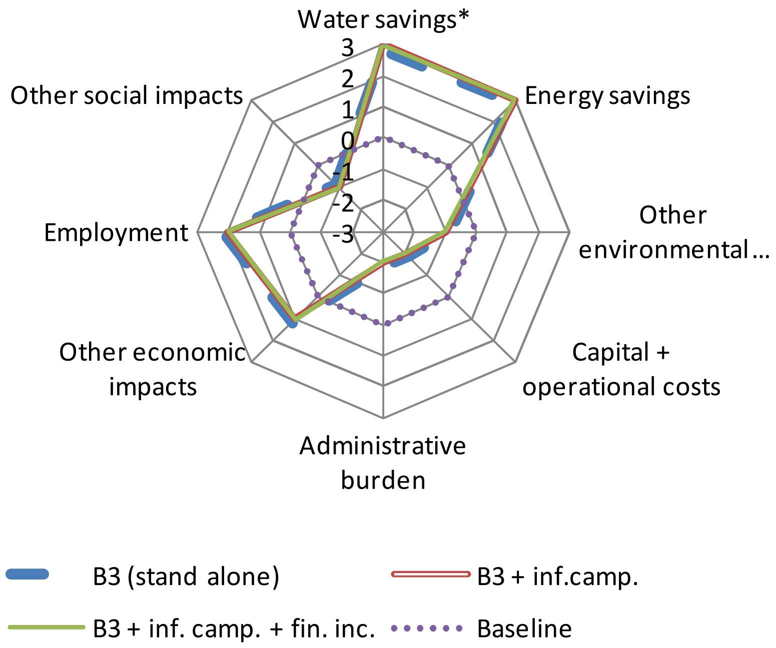


Figure 20 - Graphical assessment of the building-level policies B3 (inf. camp.= information campaigns, fin. inc = financial incentives)

Minimum requirements would be implemented for new and to be renovated buildings. This would target only a small part of the buildings in the EU, but reduce the water used compared to constructing buildings that would be lower performers. In addition, while the improvement may seem low since it targets a relatively low number of buildings, with time more buildings will be concerned, bringing high benefits in the longer-term. In order to allow a smooth implementation, with reasonable threshold as minimum requirement, 10% water savings are foreseen for all buildings. The impacts for energy and carbon are similar to B1 and linked to water savings. Other environmental impacts are similar to H1 impacts.

The same capital costs as for B1 will be incurred. However this will apply for more buildings, as the requirements are obligatory, while operational costs should be lower as the buildings would be more efficient. Owner-tenant cost imbalances are similar to B1. Similarly to other options, water bills will be reduced, but water prices may go up (see H1). Where minimum requirements are involved, administrative burden to control the obligations will occur. Other economic impacts are positive as private companies may green their image and buildings have a better attractiveness in these cases (see B1).

In terms of social impacts, employment will increase in the green building businesses, through advice to be given to companies to meet the requirement and constructing buildings meeting the requirements. However, it will require the education and training of skilled workers (i.e. 'Other social impacts' is negative, since an effort is needed). Additionally, administrators would be needed to control the implementation of the certification schemes and of any accompanying financial schemes, possibly increasing public jobs. Synergies with administrations controlling the implementation of the EPBD may be fostered.

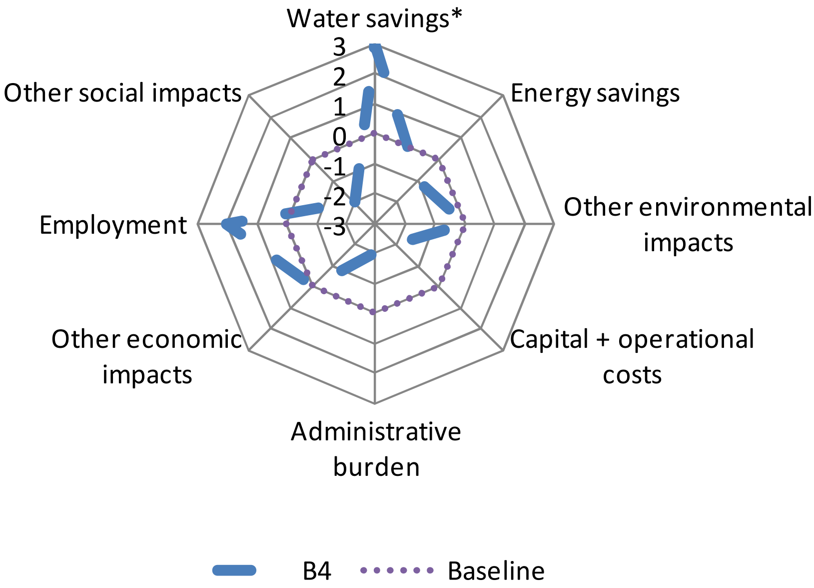


Figure 21 - Graphical assessment of the building-level policies B4

Water reuse and rainwater harvesting do not reduce the amount of water used every day by households. Yet, they carry significant potentials for reduced pressure on ecosystems by reducing the abstraction of freshwater from surface and groundwater sources (i.e. freshwaters). Greywater yields vary between types of buildings. Systems that may be implemented for rainwater harvesting and greywater reuse also imply very different measures if implemented in new or existing buildings. As a significant part of that water can be used for toilet flushing, the water savings (in terms of reduced need for freshwater) are expected to be high, but with relatively low uptakes in existing buildings. The production and installation of the systems, as well as water treatment during the lifetime of the system (even if the treatment is limited), have high energy and carbon costs. Energy and carbon could be saved if such systems are implemented at an early stage in new buildings, and possibly in to be renovated buildings. On the opposite, the carbon costs overrun the benefits in existing buildings, whether residential or not. Grey water reuse presents higher carbon costs than rainwater harvesting. Other systems using the heat from wastewater and gravity treatment are also under investigation and could modify these results. Other environmental impacts are similar to H1 impacts, apart for rainwater harvesting. An additional positive impact is the reduction in rainwater runoff and potential to collect water in water-rich seasons to use it in water scarce seasons.

Capital costs will be borne by the owner to install such systems and may be relatively high, in particular as the option includes a certification scheme to ensure the systems do not present any health risks and are well installed. Owner-tenant cost imbalances are similar to P1, as generally the costs for installing such systems are borne by owners. Similarly to other options, water bills will be reduced, but water prices may go up (see H1). In addition, costs for treatment of the water will occur. Systems installed at a larger scale than a single building (e.g. neighbourhood, residential area, municipalities, etc.) could have benefits in terms of the amount of wastewater produced that may be used in the buildings and reduced costs through mutualisation. The administrative burden would be relatively high to verify compliance of the systems.

Rainwater harvesting and grey water reuse schemes are expected to result in the training (in particular with regard to the sanitary risks) and employment of specialised plumbers. They also increase business revenues of both the companies building those systems, and of certification companies, with positive impacts on employment.

The use of non-potable water in households (through grey water reuse and rainwater harvesting) is still hampered by population reluctance, mainly related to their perception of sanitary risks and/or disgust reactions. This is illustrated by a negative score in 'Other social impacts'. Indeed, sanitary issues are linked especially to installation, maintenance and operation of rainwater harvesting and grey water recycling. Public perceptions and acceptance of water reuse are now recognised as key factors of success for water reuse projects. According to a CSIRO study[195], social marketing or persuasion is ineffective in influencing people to use recycled water. Consumers today require evidence-based information before engaging themselves in a water reuse project. Information provision, including communication about the risks, has been shown to reduce people's concerns about reuse and to increase the perceived safety of the projects[196].

- Comparison

Policy options B1, B2 and B3 offer a significant potential for water and energy savings, especially as the use of hot water would be better targeted. The development of green marketing would also lead to positive economic impacts in addition to the creation of jobs. Policy option B4 also offers great potential in terms of water savings but the overall energy balance would not be advantageous.

[195] Po M., Kaercher J. and Nancarrow B.E. CSIRO Land and Water (2004), Literature review of factors influencing public perceptions of water reuse.www.clw.csiro.au/awcrrp/stage1files/AWCRRP_1A_Final_23June04.pdf

[196] Marks, J., Cromar, N., Howard, F., Oemcke, D., & Zadoroznyj, M. (2002a, April). Community experience and perceptions of water reuse. Paper presented at the Enviro 2002 Convention and Exhibition, Melbourne, Australia.

Chapter 5: Comparison of policy options

In this chapter, the policy options are further compared to the baseline scenario and to each other, based on the assessment of impacts in the previous section.

5.1 Summary matrix

Table 26 - whose scoring is explained in Table 25 - summarises the potential environmental, economic, and social impacts for the different policy options. At this stage, no differentiation between new and existing buildings is made. In each cell of the matrix a score is given, forming the basis for identifying the most suitable policy approach in an efficient and effective manner.

Table 26 - Comparison of environmental, economic and social impacts of policy options to address the water performance of buildings

		Environmental Impacts			Economic Impacts			Social impacts	
		Water saving (by 2025)	Energy savings	Other environmental impacts	Capital + operational costs	Administrative burden	Other economic impacts	Employment	Other social impacts
No action	No action	0	0	0	0	0	0	0	0
Horizontal Policies	H1	2.5%	++	-	-	-	0	0	0
	H2	?	?	-	?	-	0	0	-
	H3	3.0%	++	-	-	0	0	0	0
Product-level Policies	P1 (standalone)	0.9%	+	-	-	-	0	+	0
	P1 + inf. camp.	2.1%	+	-	-	-	0	+	0
	P1 + inf. camp. + fin. inc.	3.4%	++	-	--	-	0	+	0
	P2 (standalone)	2.1%	+	-	-	--	0	++	0
	P2 + inf. camp.	2.9%	++	-	-	--	0	++	0
	P2 + inf. camp. + fin. inc.	3.5%	++	-	--	--	0	++	0
	P3 (standalone)	6.2%	+++	-	-	--	0	++	0
	P3 + inf. camp.	>6.2%	+++	-	-	--	0	++	0
	P3 + inf. camp. + fin. inc.	>6.2%	+++	-	--	--	0	++	0

		Environmental Impacts			Economic Impacts			Social impacts	
		Water saving (by 2025)	Energy savings	Other environmental impacts	Capital + operational costs	Administrative burden	Other economic impacts	Employment	Other social impacts
Building-level Policies	B1 (standalone)	1.0%	++	-	--	-	+	+	-
	B1 + inf. camp.	2.5%	++	-	--	-	+	+	-
	B1 + inf. camp. + fin. inc.	4.1%	+++	-	--	-	+	+	-
	B2 (standalone)	4.1%	+++	-	--	--	+	++	-
	B2 + inf. camp.	7.8%	+++	-	--	--	+	++	-
	B2 + inf. camp. + fin. inc.	11.1%	+++	-	--	--	+	++	-
	B3 (standalone)	10%	+++	-	--	--	+	++	-
	B3 + inf. camp.	>10%	+++	-	--	--	+	++	-
	B3 + inf. camp + fin. inc.	>10%	+++	-	--	--	+	++	-
	B4	5.2%	-	0	--	--	0	++	--

* *quantitative estimates (see section 5.2.1)*

Legend: Inf. camp. = information campaigns, fin. Inc. = financial incentives.

5.1.1 Environmental impacts

The scores on energy savings for the different policy options are assumed to have a linear relationship with the estimated water savings (see section 4.2.1) as they directly relate to the saving in the energy required for pumping, heating, and treating water. For building-level policies (B1/B2/B3), energy savings could be further increased (++/+++) compared to product-level policies (+ to +++), as hot water would be better addressed at building scale (e.g. optimised distance between water heaters and points-of-use, recirculation of greywater to preheat clean water, etc.). For the certification for rainwater harvesting and greywater reuse (B4), the energy use will be higher (-) due to the installation of such systems and needs to treat the water to a certain extent before reuse (see section 4.2.3).

Other major environmental impacts are the risk of wastewater blockage due to low flows and the production of more concentrated wastewater, which apply for all policy options (see section 4.2.4). However, with rainwater harvesting (B4), it is considered that a better resilience to climate change at local scale could be expected, as this system is more flexible to potential changes in precipitation patterns. Therefore, the other environmental impacts would be balanced (0) for this policy option.

Building-level policies (B2 + inf. camp + fin. inc) and B3 offer greatest potential in terms of environmental impacts with notably more than 10% of water savings, compared to the baseline scenario.

5.1.2 Economic impacts

In terms of capital and operational costs, horizontal and product-level policies, while obviously resulting in a cost increase, are less expensive (-) to implement for the constructors and owners of buildings than building-level policies (--) (see sections 4.3.2and 4.3.3), except when financial incentives are foreseen (in which case the financial burden is shifted to the State or the authority financing the incentive). Normally, horizontal and product-level policies have shorter payback times and the tenants/owners can directly benefit from money savings in a reasonable timeframe (see section 4.3.3) without engaging large investment costs. These saving are visible on the water bill, but more significantly on the energy bill, given the increasing energy prices in recent years. If the policy is coupled with potential future actions on water pricing (H2), payback times may reduce even further.

Financial incentives are an important driver to help owners to invest in water-efficient technologies/schemes (see section 4.3.2). However, in the context of the financial crisis, the EU currently faces a lack of public funds, so it is difficult to plan financial incentives for that matter. An alternative solution could be to seek a greater involvement of the private sector, as seen in the case of the “Green Deal” (see section 3.2.2). Mandatory schemes and minimum requirements on product or building performance also lead to higher administrative burden than voluntary schemes at product- and building- levels, as compliance and market surveillance procedures are required.

In other economic impacts, building auditing/rating schemes could lead to profits as “green building” could be presented as a marketing criteria in the non-residential sector and allow direct economic benefits while also contributing to improve a company’s image.

In economic terms, horizontal and product-level policies are less costly to put in place than building-level policies, but retrofitting is also more costly than ensuring that water performing products and technologies are incorporated when the building is planned. Costs also increase when the measures get stricter (i.e. from voluntary, mandatory to minimum performance requirements).

5.1.3 Social impacts

Regarding social impacts, mandatory schemes and minimum requirements will generate more job opportunities than voluntary schemes at product- and building-levels, as more products/buildings will have to be verified and monitored. However, this demand for skilled manpower may not be easily fulfilled as not enough people are currently trained for this new expertise and no suitable training exists in the building sector (or are only emerging).

Moreover, the risk of water poverty should be taken into account and avoided when implementing a change in water pricing and cost strategy (H2).

In terms of social impacts, product-level policies have greatest potential as less specific training is required compared to building-level policies. Indeed, plumbers are aware and have already access to efficient WuPs in the market and end-users may directly change some WuPs without any professional expertise. Public acceptance plays a major role in the implementation of B4 and the promoted use of alternative water types (e.g. greywater).

5.1.4 Preliminary conclusions

In order to identify the best option, it is important to find a balance between the benefits and the costs. From the summary matrix and the spider diagrams presented above, the following conclusions can be drawn.

In the short-term, horizontal and product-level policies are best suited as they lead to significant water savings at reasonable costs for the tenants / owners but also for the relevant authorities. Moreover, they are better suited to address water saving in existing buildings, which represent the majority of the stock. It could be expected that the consumers would progressively replace water using products with more efficient ones while awareness on water issues (through H3) and water billing (H1 and H2) continues to grow.

Consumer behaviour is a key driver for water use in buildings and it is difficult to model it accurately in the policy scenarios. Therefore, awareness-raising (H3) may actually lead to larger savings than what is presented in section 4.2.1 (3% - also depending on the type of information campaigns), but low communication could also reduce expected beneficial impacts of other policies (e.g. if WuP are not used efficiently). Product-level policies could be quite easily understood by consumers, through their previous knowledge of the EU labelling and mandatory measures for energy-related products.

Building-level schemes provide more potential for water savings but the investment costs may represent a strong deterrent for constructors and owners. In the long-term, these policy options also offer more potential for job opportunities if proper training can be offered to certifiers and building experts to prepare the transition. Therefore, building-level policies are relevant in a long-term strategy as they could first be implemented in new buildings where related costs could be integrated at an early stage in the construction and in existing buildings where it would be technically feasible and cost-efficient. Given the renovation and construction rates (a 40 year lifetime is considered), the stock of water-efficient buildings will grow progressively. It would also be relevant to introduce water requirements with regards to new buildings early, as otherwise the stock of relatively inefficient buildings will grow during the time that the policy is not implemented. This however requires some common understanding of the criteria for identifying a water-efficient building.

5.2 Discussion

While each policy option has its own advantages and disadvantages, combining the options could ensure higher savings at lower costs. However, it is important to recognise that this can entail difficulties and would need a careful consideration when devising policy mixes. This section discusses three aspects, namely:

- Total water savings and overlapping effects
- Type of buildings
- Implementing instruments
- Identification of policy mixes

5.2.1 Total water savings and overlapping effects

Overlaps in terms of water savings can exist between different types of policy actions and the combination of policy options may not always be cumulative in terms of water savings, at least not for all combinations. In particular, building schemes (B1/B2/B3) often require metering to be installed, so as to improve identification of leaks (overlapping with H1), and/or the installation of water-efficient products (overlapping with P1/P2/P3) or of systems to use alternative water types (overlapping with B4). Indeed, in existing building certification schemes, credits are awarded to the use of metering, efficient WuPs or alternative water systems (see Annex 2).

Therefore, for policy scenarios where B1 / B2 / B3 would be implemented along with H1, P1/P2/P3 and/or B4, some adjustments would be necessary in the model to take into account the overlaps in the estimated water savings.

In a low scenario (maximum overlap), the combination of H1, P1/P2/P3 and/or B4 would completely cover the saving potential of the implementation of B1 / B2 / B3 alone and in a high scenario (minimum overlap), the saving potentials of all options would be directly cumulative in order to evaluate a theoretical potential as a maximum reference.

5.2.2 Analysis by sector/building type

- Residential / non-residential sectors

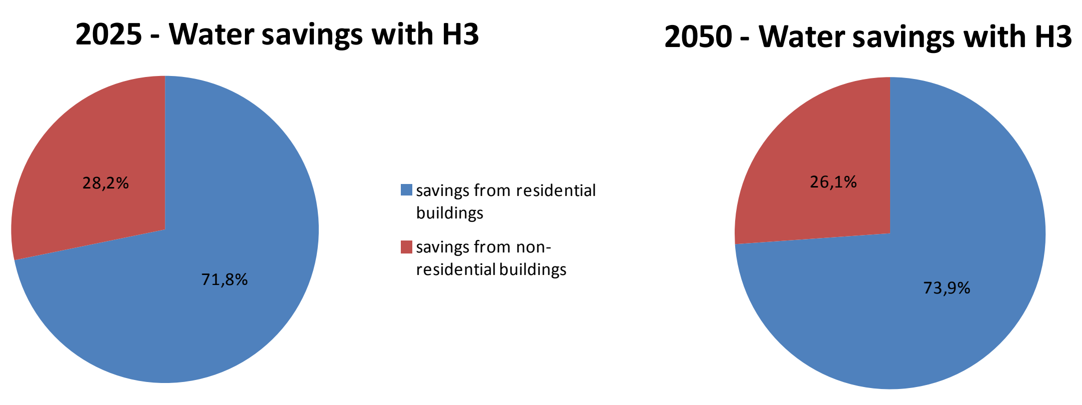
As discussed in section 2.2.1, a strong difference in the number of buildings is observed between residential (>98%) and non-residential buildings. However, potential water savings in non-residential areas are higher, as shown in Figure 22:

- For horizontal policies (e.g. H3), water savings in non-residential buildings is in line with the current share of water use for non-residential sector (around 73%, see section 2.2.1) and this share will remain stable by 2050.
- For product-level policies, the residential sector will provide most of the water savings by 2050, compared to the baseline scenario.
- For building-level policies, the non-residential sector represents more than 40% of water savings by 2025, then reducing to around 15% by 2050.

These results suggest that it is useful to address water consumption in non-residential buildings even if the stock is negligible compared to residential buildings. This is particularly relevant with regard to building-level policies.

It might be better however to adopt a progressive approach, initially targeting the state-owned non-residential buildings (e.g. through GPP), and then the rest of the non-residential sector, for which the potential for building's green bonus is higher than for the residential sector (as shown in section 5.3).

It is important to have measures that cover both sectors, but sectors, implementing instruments within product- and building- policy-levels (whether voluntary, mandatory or minimum requirements) can be prioritised.



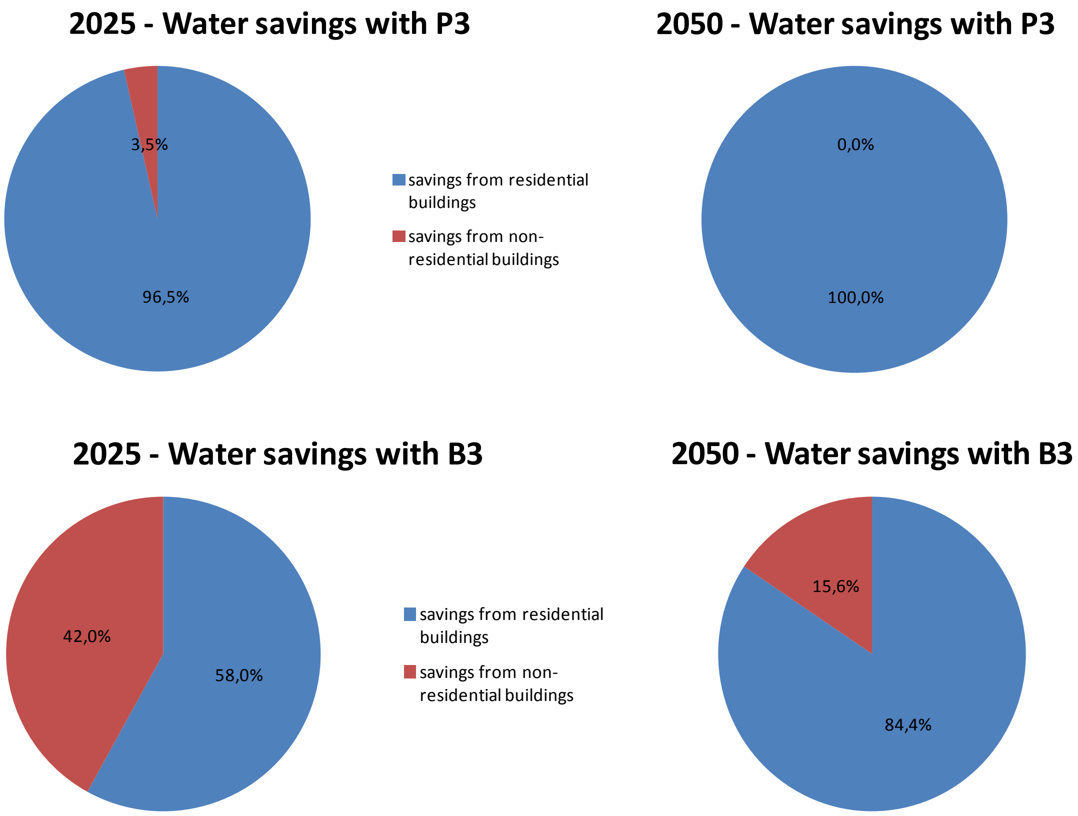


Figure 22 - Origin of the water savings for the different policy levels (compared to the baseline)

- New/ to be refurbished and existing buildings

As a first step, new buildings will be easier to target, as it would be possible to develop buildings that meet the requirements from a rating/certification scheme and/or to include efficient products attached in the building (e.g. toilets and taps) at the design stage for new buildings. Moreover, with the current development and use of several building schemes for new buildings in different MS, the risks of confusion for the public and of burden for the construction sector would be avoided if a harmonised approach is adopted for the EU. Moreover, with regard to refurbished buildings, the criteria to define "refurbishment" has to be further discussed and agreed on, as highlighted in section 2.2.2.

For existing buildings, it is technically difficult to implement mandatory schemes and minimum requirements without generating significant capital costs and little control can be ensured. Moreover, some buildings would be difficult to target such as historical buildings.

5.2.3 Implementing instruments

The evaluation of policy options and policy mixes reveals a maximum potential of around 30% of water savings for buildings by 2050. This potential relies on coordinated actions to be taken at horizontal, product, and building levels. A key issue determining the possible success in the implementation of such policy components is to highlight their cost-effectiveness but also their practicability (see sections 6.1 and 6.2.3).

For each specific objectives identified for implementing such policies (see Chapter 2:), this section discusses how these objectives can be achieved, with the policy options assessed in this document and the pros and cons. For each, three different implementation approaches are discussed:

- no EU action,
- incorporating new elements in the existing EU instruments, and
- developing new EU measures.

Whatever the means for implementation, it is important to acknowledge that voluntary measures will result in less certainty in terms of water saved, even if voluntary measures can achieve high (and as a maximum the same) savings in theory. Table 27 synthesises the information provided on these three implementation approaches.

Improve water efficiency in buildings

- No EU action

Through no EU action, MS and local authorities would continue the current situation of developing their own responses to local water scarcity issues. Based on the information provided earlier, it seems that this would probably lead to reduced water use in 2050, thanks to existing improvements already on-going. However, risks of crisis because of scarcity or droughts increase in the shorter term if no actions are taken.

In addition, no strong signal for water efficiency would be given at EU level, which would encourage MS to implement relevant measures.

In the long-term, climate change effects on water use and water availability, which include the risk of not meeting the WFD objectives, could increase the need for coordinated actions. Indeed, possible conflicts between MS upstream and downstream the same water bodies could appear.

There is currently little willingness in the construction and real estate sectors to develop a measure to address the water performance of buildings at EU level, as these sectors are still coping with the implementation of the EPBD. The EPBD is a much more recent and complex regulation than Ecodesign and stakeholders believe that it is too early to be able to launch and/or integrate any comparable measure on water, although an integration of the two instruments (energy and water) would be preferable to the establishment of a completely new measure in terms of implementation and operational costs (i.e. economies of scales) and administrative burden. In addition, water is considered to be more of a consumer issue than energy, for buildings.

- Incorporating new elements in the existing EU instruments

As identified in the no action section, while stakeholders consider it is early to implement water-targeted measures, they are in favour of combining measures targeting energy or other environmental issues rather than developing stand-alone measures. The Eco-design Directive and the EPBD are two instruments that could be amended to improve water efficiency requirements, respectively for products and buildings.

The GPP could be used to help progressively introduce building-level requirements, as presented in the long-term scenario (see section 6.3), targeting public buildings first.

- Developing new EU measures

The development of a EU harmonised water rating/auditing building scheme (B1/B3/B3) would avoid confusion in the building sector and tenants/owners therefore build trust in such schemes. In the short-term, the difficulty to develop a common methodology and the related capital costs may be a deterrent but a progressive approach targeting first new buildings will provide cost-efficient outcomes for water and energy savings in the long-term.

The *Blueprint to Safeguard Europe's Water Resources* to be published in November 2012 will also have a key role to inform the decision-makers and the public on the water challenges that the EU faces. Moreover, the Blueprint Communication will also cover other sectors than the water use in buildings, so that one can have a more global view of the water situation in EU and understand that joint efforts are to be made in the different sectors, in order to protect water resources and reduce pressure on EU water bodies. Therefore, although it is not a binding measure, the Blueprint Communication will ensure coordinated actions and give a strong signal to address water on the EU agenda.

The strongest signal to increase water efficiency would be to introduce a stand-alone Water-efficiency Directive or Regulation that would include a combination of the measures identified to increase water efficiency in the EU, or a toolbox for MS to choose from with binding targets. This would however entail additional administrative burden, stakeholder involvement, efforts, and time and would not necessarily allow a timely reaction to the issues at hand.

Increase water savings in water scarce areas and seasons

As identified above, water issues are most prominent in certain regions and at certain periods of the year. Regions mostly impacted are Mediterranean areas, but also for instance the South East of England. Summer periods are periods with generally lower water availability from surface and groundwater, combined with higher demands. These differences call for differentiated responses, adapted to each situation.

- No EU action

In a no EU action scenario, MS and local authorities would have flexibility to develop their own schemes to face local water scarcity issues, as is currently the case. This would allow strongly regionalised responses, with no burden or pressure put from the EU level. However, this would also mean that MS that do not wish to implement measures for different reasons (lack of political will, other funding priorities, etc.) and even where these would be needed, would not improve the situation, and on the opposite risk further water stresses. Countries that do not wish to focus on water will also not be further incentivised or required to take action in the building sector, which has a relatively high potential, even if reducing their water use would be desirable from an 'ethical' (reduce wastage), environmental and economic point of view.

- Incorporating new elements in the existing EU instruments or developing new EU measures

Measures at EU level are not necessarily implemented blindly everywhere in the same way. While MS that are already efficient in their water uses (e.g. Germany, Belgium, etc.) would have no additional burden from EU measures in case of no action, efficient countries could also have minimal burden if measures are implemented. EU policies can for example use a threshold based on data already reported by the MS (e.g. in Eurostat) to ensure actions are taken in relevant areas. The main challenge will be to develop common methodologies so that evaluations are based on the same criteria throughout the EU.

Improve the behaviour of water users to encourage responsible water use

A major driver of water use is consumer behaviour. Messages and measures to increase awareness and give consumers the means to improve their consumption are thus critical. Awareness- raising is considered by all stakeholders consulted an imperative measure, whether alone, or as an accompanying measure to others.

- No EU action

MS, local authorities and other stakeholders (e.g. water companies, NGOs) are already communicating on these aspects to improve consumer behaviour. However, no strong signal for water efficiency would be given at EU level with no action. In a medium to long-term, confusion in the EU population could grow due to the multiplication of local/ national schemes to inform consumers about the performances of WuP and buildings. An existing scheme at EU level that can already be used, but does not focus specifically on water, and is only relevant for certain non-residential buildings is EMAS.

- Incorporating new elements in the existing EU instruments

The EU already implements quite a few awareness-raising campaigns in sectors related to water use, e.g. resource efficiency campaigns. Including water messages in such campaigns will give a strong message to support sustainable management of resources in the short-term, while water-targeted information campaign may be preferable in the long-term to highlight specific issues (H3).

The EU has already a strong role in developing requirements and labels to inform consumers. The eco-label is now implemented on many products and the energy efficient labels derived from the implementation of the eco-design Directive (for products) and the EPBD (for buildings) are increasingly familiar to EU citizens. Implementing similar labels for water, or including a water component, would help citizens understand the consequences of their choices. An EU Ecolabel for buildings is currently being discussed.

The WFD already requires adequate pricing of water. Ensuring that pricing (H2) is linked to actual use through the installation of water meters, as already implemented in many MS and taking into account technical difficulties and costs, would improve the situation. In addition, the acceptability by consumers is high for paying by volumes. Such link would help to foster a change in consumer's water use.

- Developing new EU measures

Another way to implement meters would be to require their installation, with some conditions to ensure that technical issues and costs are taken into account, e.g. in a stand-alone Water-efficiency Directive or Regulation, but would require more efforts and time.

Increase reuse of water where relevant

- No EU action

With no action at EU level, MS would continue to choose whether or not to develop water reuse, depending on their situation and political choices.

- Incorporating new elements in the existing EU instruments

Where the goal is to provide the customers with assurance regarding the reliability of the water reuse system, the labelling systems at EU level could be relevant, such as the implementation of an eco-label. However, since the eco-label is based on best practices, it is not necessarily the best scheme for achieving these objectives.

- Developing new EU measures

A new scheme that specifically addresses the use of rainwater harvesting and greywater reuse (B4) could be beneficial in a short- to long-term, as it would give a robust (certified) framework to such systems. It would also provide manufacturers with certainty for marketing their products and a common level of information to EU citizens.

Foster energy savings by reducing water pumping, heating and treatment requirements

As highlighted in the report, the water-energy nexus has become a major issue (see current work from UNFCCC in section 5.3.2) as the water sector consumes energy for extracting, pumping, circulating, heating and treating water.

- No EU action

In a no EU action scenario, initiatives would continue burgeoning, but the risk is that countries that do not wish to focus on water may miss the opportunity to take synergistic actions in the building sector, reducing both water and energy use.

- Incorporating new elements in the existing EU instruments

EU instruments to improve the water efficiency of products and buildings already exist. The instruments could be improved by including a water component in these instruments and/or in the prioritisation process for implementing these requirements on certain products. This would provide common objectives for overall energy and water reductions, could lead to synergetic actions, promote resource-efficiency and reduce potential contradictory effects. In 2012, the 2nd Working Plan of the Ecodesign Directive (2012-2014) is planned to be finalised. It sets out an indicative list of 14 product groups (out of 36) which are considered priorities for the adoption of implementing measures under the Ecodesign Directive and includes taps and showerheads, and toilets[197]. This shows that WuP are already considered in these plans, but could be further improved.

Requirements could also be added in (co-)funding schemes to ensure that when infrastructures are (co-)funded (e.g. through Regional Funds, etc.) they include water issues.

- Developing new EU measures

A stand-alone Water-efficiency Directive or Regulation could also be implemented, but would require more efforts and time.

Table 27 - Characterisation of the policy approaches

Approach	Policy Instruments	Pros	Cons
No action	Current EU regulatory framework (WFD, and daughter directives)	- Flexibility at local scale - No measures for MS where a high water-efficiency in buildings is already observed (less administrative burden).	- No strong EU signal - Confusion due to multiplication of local/MS schemes (mid- / long-terms) - Adaptation to climate change (mid-/long-term) - Possible conflicts between MS upstream and downstream the same rivers - Risk of not meeting the WFD objectives
Incorporate new elements in the existing instruments	Ecodesign Directive (P2, P3)	- Straight-forward approach (to consumers) (short-term) - Progressive approach to address priority WuPs. (mid-/long-term) - Synergetic trade-off with energy consumption	- Competition with Energy-related products on the Working Plan agenda.
	Ecolabel (for WuPs and buildings) (P1, B1)	- Promotion of best practices (short-term) - Synergetic trade-off with energy consumption	- Difficulty to develop common criteria and methodologies at EU level (mid-/long-terms) - Limited direct impact on water savings (mid-/long-terms)
	GPP (for WuPs and buildings) (P1, B1)	- Promotion of best practices (short-term) - Synergetic trade-off with energy consumption - Significant share of public non-residential buildings for new buildings and to be renovated buildings.	- Limited direct impact on water savings (mid-/long-terms)
	EMAS (B1)	- Promotion of best practices (short-term)	- Limited direct impact on water savings (mid-/long-terms)

Approach	Policy Instruments	Pros	Cons
	EPBD (B2, B3, B4)	- Avoid some administrative burden compared to a self-standing water performance directive - Synergies (time, costs) when new construction and renovation are scheduled. (short-/mid-terms) - Promotion of resource-efficiency (mid-/long-terms) - Potential for economies of scale (mid-term)	- Complexity to integrate (e.g. definition for refurbishment) and implement consistently within the EU (short-term) - Potential deterrent from rental or renovation for owners due to stronger constraints in one combined scheme (short-/mid-terms)
	Energy Efficiency Directive (B1, B2, B3)	- Provide common objectives for overall reduction (long-term)	- Not focused on water targets and therefore potential competition between energy and water issues (short-term)
	Resource efficiency campaign (H3)	- Strong and common signal on sustainable management of resources (short-term)	- No strong signal on Water (long-term)
Elaborate new measures	Metering (H1)	- Could be coupled (mid-term) - High acceptability by consumers (already implemented in several MS)	- Technical difficulty to cover individual flats
	Water pricing and cost strategy (H2)		- Risk of water poverty, need for a change of economic model
	Green / Water rating/auditing for building (B1, B2, B3),	- Harmonisation of current green building schemes - Easier to target new buildings than the whole stock of buildings	- Costs to develop new harmonised schemes (but on-going initiative through the eco-label and costs reduced in the longer-term by reducing the number of schemes) - Difficulty to develop common criteria and methodologies at EU level (mid-/long-terms) - Place of water within overarching environmental schemes (short-/mid-terms)

Approach	Policy Instruments	Pros	Cons
	Certification for rainwater harvesting and greywater reuse (B4)	- Formalisation and harmonisation at EU level on the use of alternative waters (short-term)	- Need to build robust expertise (short-term)
	Water efficiency campaign (H3)	- Strong signal on water - Possibility to address water quality issues	- No direct link to energy - Risk of multiplication of environmental messages
	Blueprint Communication (H3)	- Strong focus on Water	- Non-binding measure

Barriers for implementation

- Lessons from current instruments

For product-level policies, the EU experience gained through policies such as the energy label, ecolabel or Ecodesign Directive would surely ease the potential implementation of any similar measures regarding WuPs. This straight forward approach, easy to understand by the consumers would be organised in a progressive manner in order to target priority WuPs and ensure a smooth adaptation of the market.

Regarding building-level policies, there is currently little willingness in the construction and real estate sectors to address the water performance of buildings at EU level as these sectors are still coping with the implementation of the EPBD and believe that it is too early to be able to launch (or integrate) any comparable measure on water. Stakeholders have little hindsight on the benefits of the energy performance certificates and have raised concerns on some relevant discrepancies in the EPBD implementation in the different MS. Moreover, they feel that there exist sufficient obligations on the building sector (e.g. construction standards and building codes, inspections and certifications related to natural and technologic risks, lift standards, health and safety obligations (e.g. asbestos, lead in piping), gas and electricity inspection and certifications, etc.), so any new measure would have to be proven necessary.

- Regional issues

Different EU regions are facing different problems in terms of their water use, and will see different impacts from climate change. The scale at which these issues are dealt with are the river basins (RB), since the implementation of the WFD. Different RB will have different water availabilities, but also different water needs, depending on the agriculture, industry and urban uses. These differences must be taken into account to implement effective and relevant water policies.

As highlighted by the outcomes from the public consultation (see Figure 23) but also stakeholders, the potential implementing measures should take into account the local water scarcity situation.

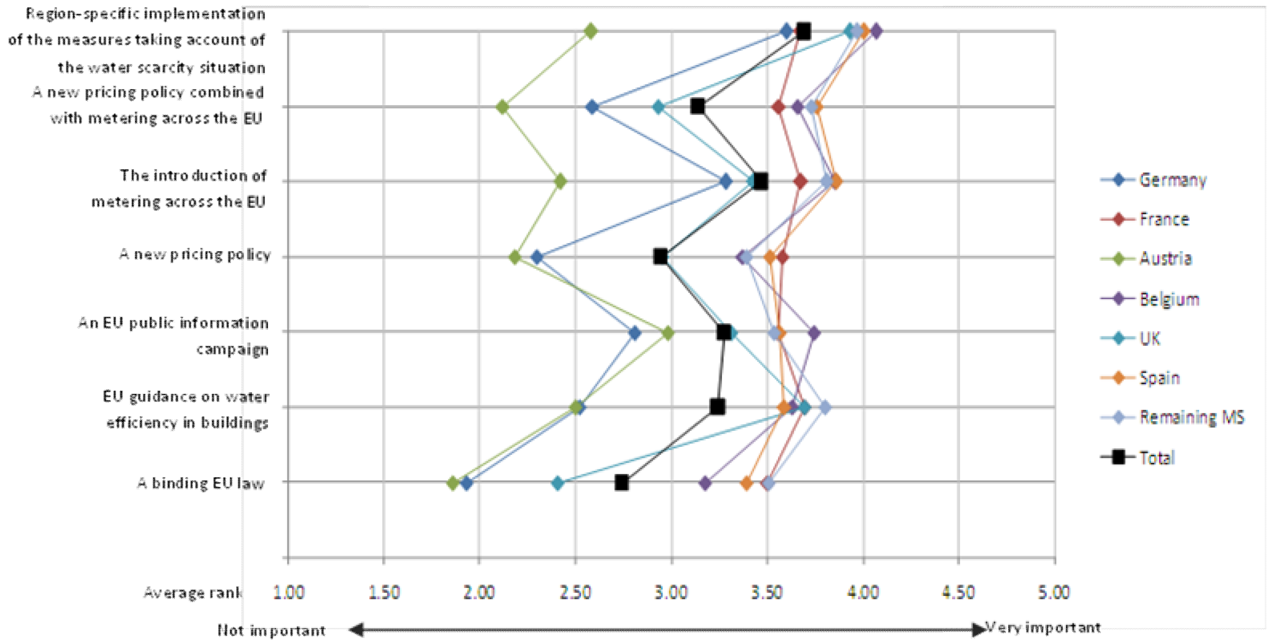


Figure 23 - Importance of water efficiency challenges in the EU

The EU could be divided in water areas - based on climate conditions and user habits - in agreement with local water managers (data could be made available by water suppliers). Regional differences could determine different minimum requirements (i.e. different thresholds), based on common criteria and methodologies. Indeed, northern MS may consider to have already achieved a satisfying level of water efficiency, and therefore little margin for improvement would remain. Likewise, Germany and Austria (as highlighted in table) do not favour any EU binding initiatives, as they trust that efforts could be better focused on water-inefficient areas. MS that would be more likely to be exposed to water scarcity and droughts issues, e.g. Spain, recognises the importance of local actions.

In general, there is a need for strong guidance at EU level to foster local implementation of measures and give more value to water.

5.2.4 Identification of policy mixes

The identified policy options are not mutually exclusive and increasing the water performance in buildings would require combined measures. Two policy mixes are therefore envisaged, taking into account the impact assessment of the policy options as well as experts' feedbacks. Moreover, as highlighted by the outcomes from the public consultation, the EU population recognises the importance of policy actions to improve the water performance of buildings and already provides some appreciation of which policy options could be prioritised (see Figure 23).

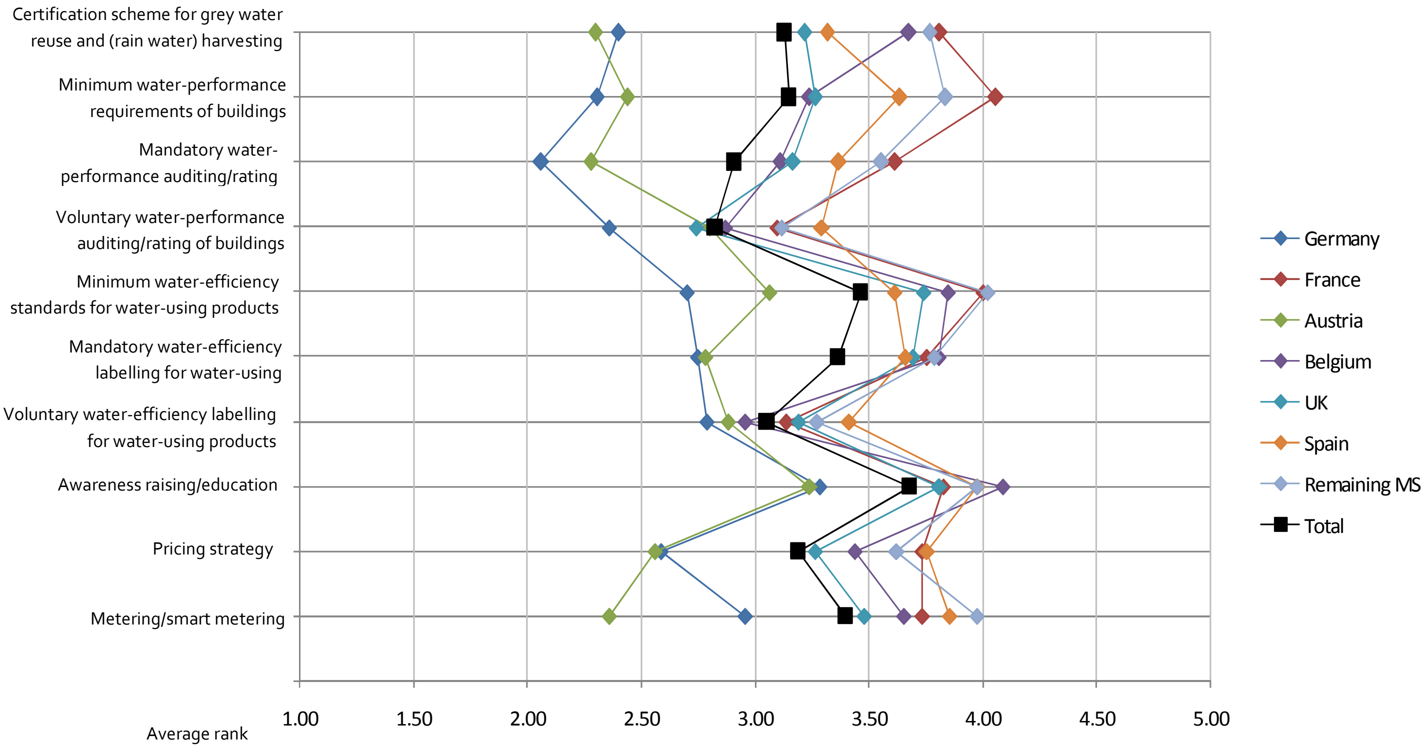


Figure 24 - Scores on the importance of the policy options

The identification of relevant policy mixes could set the ground for a Directive on Water Performance of Buildings. Such a potential Directive could indeed integrate policy components at horizontal, product- and building- levels in order to ensure coordinated actions and accelerate the uptake of water-efficient schemes.

In this section, two scenarios are analysed:

- Scenario S1 targets significant outcomes in terms of water (and energy) savings, but with limited implementation costs and aims for relatively high savings in the short-term;
- Scenario S2 targets more ambitious water savings compared to the baseline, with longer return on investments.

Scenario S1

In line with the cost-benefit discussions from section 5.1, horizontal and product-level policies are foreseen for this scenario, as they would allow significant water (and energy) savings at a reasonable cost and relatively within a short timeframe.

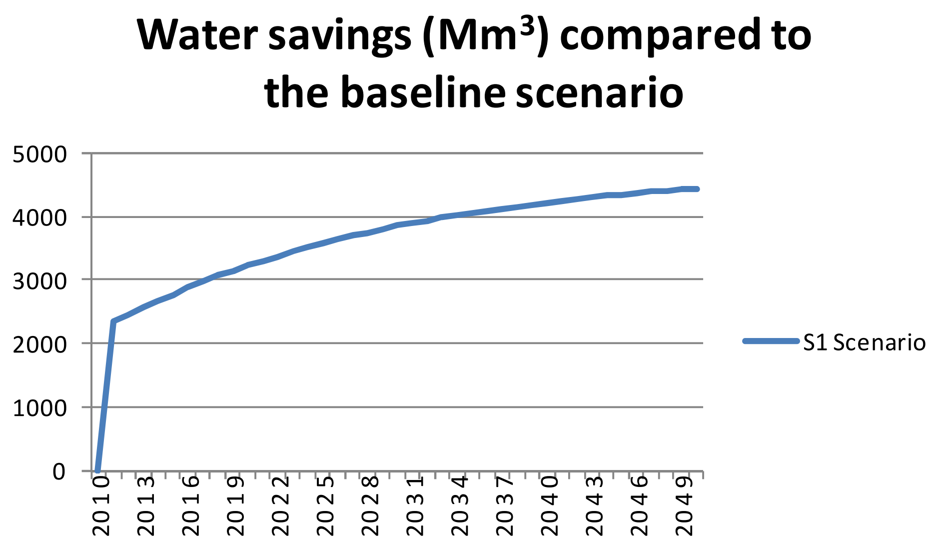
The combined (and cumulative) policy options considered in this scenario are:

- H1 - Water metering
- H3 - Awareness-raising
- P2 - Mandatory labelling for WuPs (with information campaigns and financial incentives)

These options are combined in the model that was built to assess the baseline, and which was modified to account for the implementation of the above-mentioned measures. As shown in Figure 25, such a scenario would lead to almost 9% of water savings by 2025 and about 11% by 2050, based on the model.

A graphical representation of the impacts of scenario S1 is presented in Figure 21 based on the direct compilation of the impacts of individual policy options:

- In terms of environmental impacts, water and energy savings are high (+3 scoring) while other environment impacts are similar to other policy options.
- In terms of economic impacts, capital and operational costs as well as administrative burden are higher than the baseline (-2 scoring) due to the mandatory requirements of H1 and P2.
- With regard to social impacts, the employment potential is mainly driven by the impacts of P2 (2 scoring).



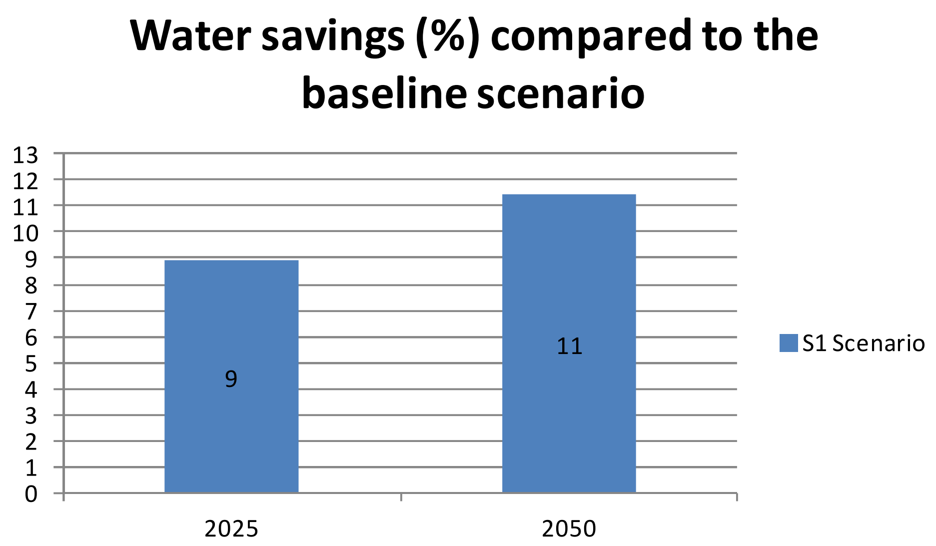


Figure 25 - Water savings in Mm3 and % compared to the baseline for the S1 scenario.

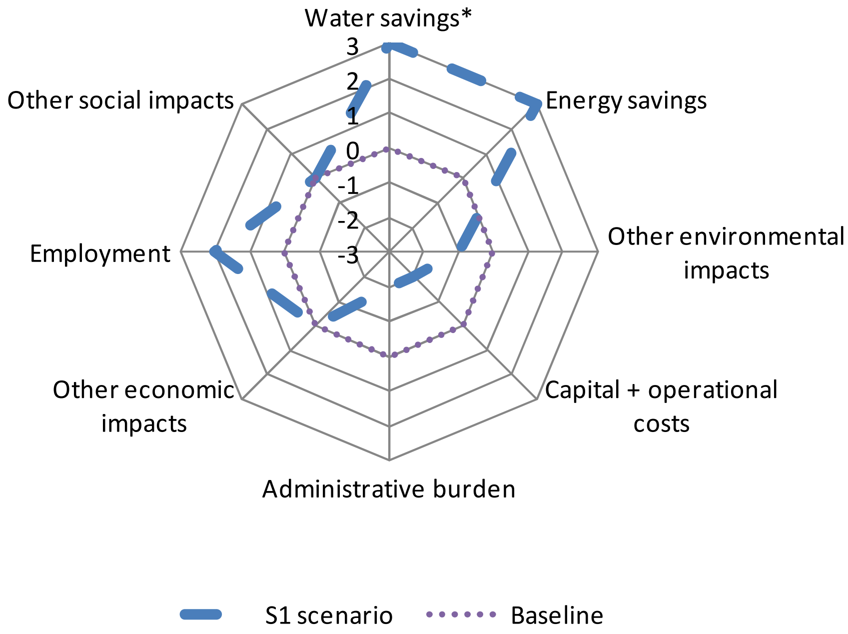


Figure 26 - Graphical assessment of impacts for the S1 scenario

This scenario is interesting as it reduces the water use by about 11% in 2050, but as shown in Figure 25, from 2025 the savings are very low. The advantage of this scenario is its relatively high acceptance (metering is debated, but the other policy options were well accepted by all stakeholders) and easy implementation in the short term. However, it does not deliver ambitious savings and may not be an adequate answer to future challenges.

Scenario S2

For improving water savings in a long-term perspective, additional policy components could be added to scenario S1, in order to allow a smooth transition and ensure the water efficiency of buildings with longer payback times. Such a policy mix is more ambitious in terms of water (and energy) savings that can be reached, also involving more capital and operational costs than in scenario S1. Scenario S2 includes the following measures:

- H1 and H3 (same as for scenario S1)
- Compared to scenario S1, P2 will be upgraded to P3 to allow only efficient WuPs to be placed on the market.
- B1 (voluntary) for the residential sector and B2 (mandatory) for the non-residential sector are introduced to target building schemes, taking into account the differences between sectors.
- B4 is introduced to certify the use of alternative waters.

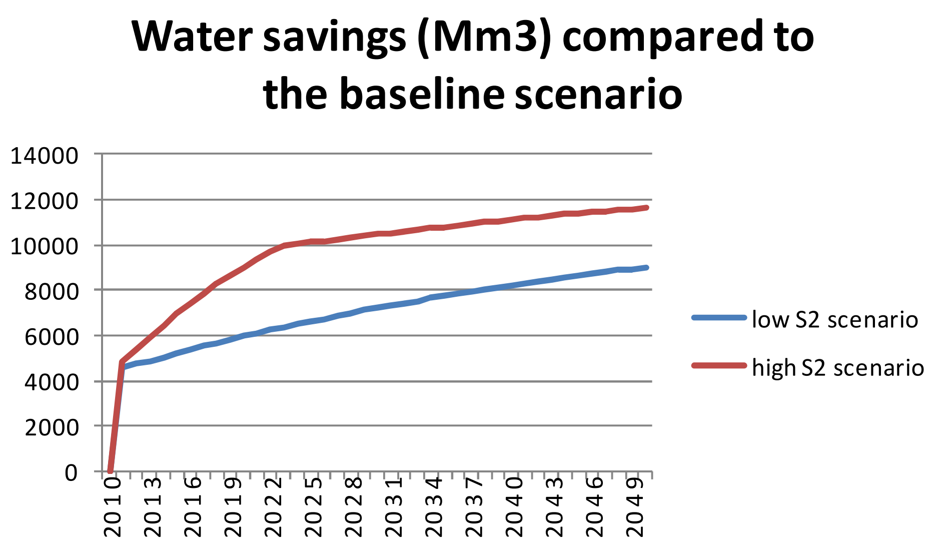
As B1 and B2 are introduced in the policy mix, some overlapping effects occur (see section 6.2.1). Therefore, two variations can be modelled:

- Low scenario S2, where the effects of B1 and B2 fully overlap the effects of H1, P3 and B4.
- High scenario S2, where B1 and B2 are additional to the other policy components.

The results in terms of water savings are computed by the model and are presented in Figure 27. In the long-term perspective, between 16 and 26% of water savings could be expected by 2025, and between 23 and 30% by 2050.

A graphical representation of the impacts from scenario S2 is presented in Figure 28, based on the overlapping effects of the individual policy options.

- In terms of environmental impacts, water and energy savings are still considered to be high (+ 3 scoring) but other environmental impacts are expected to worsen (-2 scoring) as more combined impacts on the water and wastewater infrastructure could be expected.
- In terms of economic impacts, capital and operational costs as well as administrative burden are higher than both the baseline and S1 (-3 scoring) due to the combined mandatory requirements of H1, P3, B2 and B4.
- With regards to social impacts, the employment potential is further enhanced compared to the baseline (+3 scoring) with the implementation of mandatory schemes (especially P3 and B4), while the issue of public acceptance and sanitary risk related to B4 lead to a negative score (-1) for 'Other social impacts'.



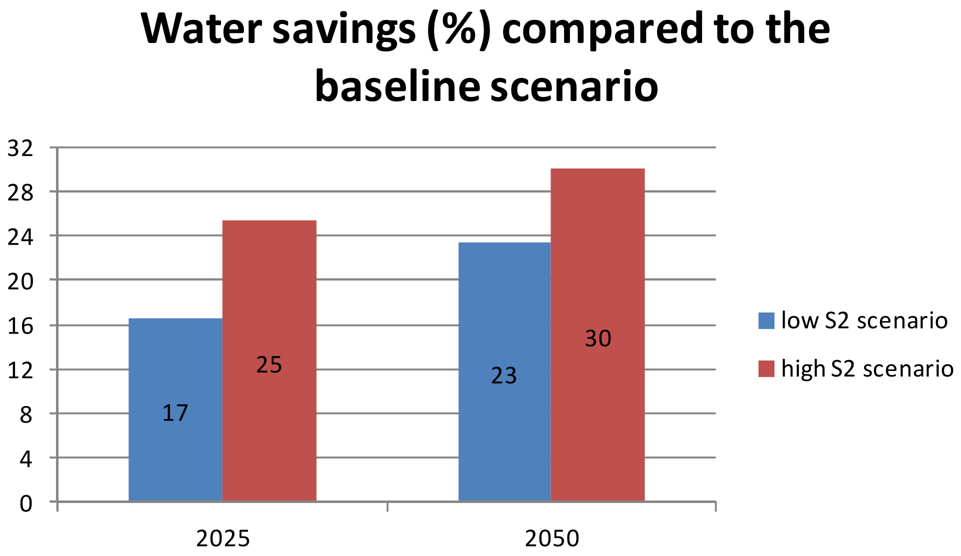


Figure 27 - Water savings in Mm3 and % compared to the baseline for the S2 scenario

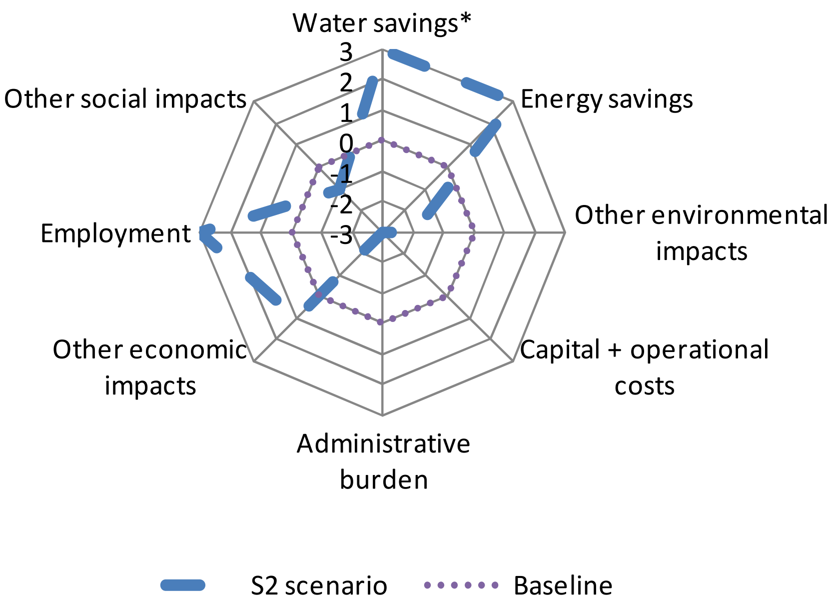


Figure 28 - Graphical assessment of impacts for the S2 scenario

The results from scenario S2 show much higher savings, and a sustained saving in the long term (while the speed of savings is highest from now to 2025, it remains quite high between 2025 and 2050, especially compared to scenario S1). On the other hand, the burden from S2 is much higher, and some options could not be implemented so soon. In particular, if building schemes and certification schemes for water reuse/harvesting would need to be agreed upon (even if existing national green building standards could already be used). The burden put on the estate sector would also be very high, and additional to the recent implementation of the new requirements from the EPBD. It is unlikely such measures could be introduced very soon. However, there are also many synergies and lessons to be learned from the EPBD, in particular e.g. to organise a certification that includes energy and water, if that scheme is implemented. Scenario S2 could be introduced at a later stage (e.g. 2020 or 2025) to allow for preparation and organisation of the implementation. This could however mean that the response to water issues comes too late.

- Overview of scenarios

The two scenarios analysed show that different results can be achieved by implementing policy options, with respective costs and benefits. As more options are implemented in scenario S2, obviously more savings are achieved. This would also increase costs. In a long-term perspective, such costs may be acceptable when accounting for returns on investment.

If these measures were implemented in a Directive, in addition to the impacts analysed above, administrative burden would occur at EU and national levels. Indeed, they would require an agreement on the Directive by all MS, organisation of transposition, implementation and enforcement, including at river basin level, etc. Scenario S2 could also be implemented after a certain period of implementation of S1, so that citizens and stakeholders are prepared, schemes for products and buildings are ready and tested, etc. This would however postpone the actual savings far into the future, and does not seem appropriate given the need for urgent action.

5.2.5 Data gaps and approaches to water savings in buildings

The impact assessment performed in this study is based on the collection of available data both from the literature and from the feedback from stakeholders that contributed to the Public Consultation organised by the EC from November 2011 to February 2012. While data from a number of initiatives is available and many initiatives are emerging in relation to the water use in buildings, few data actually evaluate these initiatives in terms of water savings, costs and other impacts; and few data allow to have a robust picture, at the right level of details , to understand water use in different MS, split between residential and non-residential, or age of buildings. In addition, as water use is dependent on consumer behaviour, it also depends upon cultural habits, which are different in various MS, and would result in different success rates in each MS. The study thus has shown a **need to gather more specific data on water use from buildings, and data that would allow a robust evaluation of the results of implemented initiatives** (e.g. evaluating the final water use in a household implementing certain water products, as done in certain studies that were used in this report, and which allow to contextualise the implementation of efficient WuPs, balancing their potential with their actual use). This would allow to present a more robust picture of potential water savings in the EU.

An alternative to the approach taken in this study, which is a bottom-up approach (i.e. it evaluates the potential water savings from the implementation of specific policies), is to adopt a top-down approach. This was used in several preceding studies that aimed at evaluating potential for savings, without evaluating what actions could lead to what savings. Such top-down approach estimates the savings if a set target of water use per day per capita was implemented, and which could be, for the residential sector mostly, a target to be achieved for each river basin and/or MS. This would leave national and local authorities with more freedom as to what should be implemented to reach these targets. The current study on the other hand estimated impacts from specific initiatives, and thus had to identify potential water savings covering different sectors (residential vs. non-residential) and different types of buildings (new, to be renovated and existing), for which the investigation was quite comprehensive, even if it revealed data gaps. In particular, it was observed that some countries have more data than others (e.g. the UK, and outside the EU, the USA and Australia), which can be explained by cultural differences or specific issues with water in recent times, or more recent initiatives. It is however delicate to extrapolate such data to the whole of the EU. This data gap explains the difficulties and assumptions that were made in this study, based on the best available data and with support from a wide range of stakeholders. To increase the robustness of the results, the gathering of more targeted data and implementation of pilot projects specifically designed to evaluate results would be needed.

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Chapter 6: Monitoring and Evaluation

In this section, a set of measurable indicators are identified that cover the objectives that implementing a policy to improve water efficiency in buildings aim at. The plans for evaluation are also defined. In this way it is ensured that adequate data will be available and that future evaluations focus on the most relevant questions and core progress indicators.

6.1 Core indicators of progress towards meeting the objectives

The indicators can be organised through the specific objectives identified in this impact assessment:

- Improve water efficiency in buildings

Indicators:

- Public water supply per year at national level
- Public water demand per year at national level
- Water use by residential buildings per year at national level
- Water use by non-residential buildings per year at national level
- Number (or percentage) of buildings equipped with water-efficient devices (or only new buildings)
- Number (or percentage) of buildings certified with a water-standard or an environmental-standard that include requirements about water (or only new buildings)
- Number (or percentage) of new buildings that use water recycling/harvesting technologies
- Measures included in the RBMP that target efficient water use in buildings

- Increase savings in water scarce areas and seasons

Indicators:

- Water exploitation index (or new indicators currently under development by the EC and EEA), at river basin and/or seasonal level
- Number of river basins considered to face water scarcity
- Public water demand evolution within a year at river basin level

- Improve the behaviour of water users to encourage responsible water use

Indicators:

- Number (or percentage) of people that are aware of water scarcity and droughts issues in the EU
- Number (or percentage) of people that report they responsibly use water in their daily life
- Number (or percentage) of people that are aware of the existence of (or take into account in their buying/renting choices) water-efficient products and water-efficient buildings

- Increase reuse of water where relevant.

Indicators:

- Number (or percentage) of new buildings that use water recycling/harvesting technologies
- Number (or percentage) of people that report they use recycled water for certain uses

- Foster energy savings by reducing water pumping, heating and treatment requirements

Indicators:

- Energy consumption for the public water supply (including water treatment and distribution phase)
- Energy consumption for the wastewater treatment

6.2 Broad outline of possible monitoring and evaluation arrangements

The MS are already required through the WFD and daughter Directives to report a number of aspects regarding water to the European Commission. In addition, for each RB a River Basin Authority drafts a RBMP that describes the actions taken at their level. The RBMP must include the information laid down in Annex VII of the Directive. The first reports by MS were made in 2004 (for Article 3) and 2005 (for Article 5). The RBMP had to be published by 2009 including the Programme of Measures. The second cycle of the WFD, including the publication of a second RBMP in each RB, will begin in 2015. The EC is already assessing and evaluating the RBMP according to a number of criteria. Specific measures in certain sectors could be required to be reported, including on buildings (quantitative or qualitative).

In addition, through Eurostat, data on demand and supply are collected at national level each year. Through the new indicators being developed by the EC and EEA, information at RB and/or seasonal level are likely to be required in the future. The indicators mentioned above could thus be implemented without a high supplementary burden for RB authorities nor Eurostat, the EEA or the EC.

More specific data on number (or percentage) of buildings are currently not included in any survey at EU level through European institutions, but a study was done by EUREAU on residential and non-residential uses which could inspire data collection, or be renewed. Further information on water-efficient devices, water-efficient buildings and/or buildings equipped with water harvesting and recycling technologies would need to be surveyed specifically, but could probably be done through manufacturer's organisations.

Lastly, the Eurobarometer regularly asks information to EU citizens, including on water. The March 2012 survey[198] on water issues shows for instance that fewer than four out of ten respondents feel well or very well informed about problems facing water bodies in their country. It also shows an increase in the number of respondents that consider that water consumption has an impact on quantity and quality of water in 2012 than in 2009. Specific questions on behaviour could be inserted to gain views on these aspects.

[198] Flash Eurobarometer 344, Attitudes of Europeans towards Water – related Issues, March 2012, available from http://ec.europa.eu/public_opinion/flash/fl_344_sum_en.pdf

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