Denmark

The European Commission and the OECD jointly review investment needs and financing capacities for water supply, sanitation and flood protection in each of the European Union's 28 member countries[1]. A fact sheet was developed for each country. Each fact sheet: (i) highlights the main drivers of future expenditure and quantifies projected investment needs; and (ii) analyses past sources of financing as well as capacities to finance future needs.

The analysis reflected in the fact sheets aims to support cross-country comparisons. For some indicators, trade-offs had to be made between reporting the most up-to-date and accurate data for each individual country and using data available for all countries in order to support such cross-country comparisons. The fact sheets were reviewed by country authorities and have been revised to reflect comments as much as possible. Inaccuracies on selected items may remain, which reflect discrepancies between national and international data sources.

A full methodological document will be published to explain in detail the sources, categories and methods used to produce estimates. In a nutshell:

- Current levels of expenditure (baseline) on water supply and sanitation are based on a range of data sets from Eurostat, which combine water-related public and household expenditures.
- Projections on future expenditures for water supply and sanitation are driven by the growth in urban population. Additional scenarios for water supply and sanitation were developed to factor in such drivers such as compliance with Drinking Water Directive (DWD), Urban Wastewater Treatment Directive (UWWTD) and emerging EU water directives.
- The paucity of data on current levels of flood protection expenditures did not allow for monetisation of projected future investment needs. Projections of growth rates of future expenditures for flood protection combine estimates of exposure of population, assets and GDP to risks of coastal or river floods.
- The characterisation of past sources of financing in each country is derived from baseline data on current levels of public and household expenditures, debt finance and EU transfers.
- Countries' future financing capacities are approximated by analysing room for manoeuvre in 3 areas: i) the ability to raise the price of water services (taking into account affordability concerns); ii) the ability to increase public spending; and iii) the ability to tap into private finance. Affordability analysis is based on water-related household baseline expenditures, not on average tariffs (which are highly uncertain, inaccurate and not comparable across countries).

[1] Further information and project outputs can be found on the websites of the European Commission and the OECD.

The future costs of diffuse pollution, compliance with the Water Framework Directive, adaptation to climate change, contaminants of emerging concern, urban floods from heavy rains, as well as the potential of innovation to minimise future financing needs are explored qualitatively and will be reflected separately. Costs related to water storage and bulk water supply are not considered.

Key messages

- Denmark spends amongst the most per capita on its WSS infrastructure in the EU and enjoys a relatively high performance.
- Denmark relies almost exclusively on tariffs to finance WSS-related upfront capital expenditures and operational expenses.
- The value of assets at risk of flooding is projected to increase by about 50% over the coming decades due to sea level rise and increased precipitation. In particular, coastal flood risk is higher than in other countries and remains an important source of future risk. Flood defences and the sewerage and stormwater system require upgrading to be able to cope with the increased pressure.

Context

Denmark is one the most developed countries in Europe, with a high per-capita GDP. However, future economic growth is expected to be below the median for other member states. Denmark is highly urbanised with around 90% of the population living in urban areas and cities, and its total population continues to grow.

Surface water is scarce. As a result, groundwater is the main source of drinking water. Although Denmark has abundant groundwater resources, some regions experience pressure on groundwater (Statistics Denmark, 2017; OECD, 2017). Urbanisation and a significant increase in demand for irrigation will increase competition for water resources, including groundwater (OECD, 2013). Intrusion of saltwater from sea level rise may affect the quality of groundwater (OECD, 2013). Despite high levels of expenditure on water supply and sanitation, there remains a small compliance gap with wastewater treatment.

The Danish Ministry of Environment and Food is currently processing recommendations from a commissioned group of experts to improve water resources management and alleviate the above pressures.

Table 1 presents a number of key indicators characterising the country context and features relevant to future expenditures for WSS and flood protection. These indicators are further discussed in the next sections, including those that underpin the projections of future investment needs.

Table 1. Key features relevant to future expenditures for WSS and flood protection

	Indicator	Value (rank if applicable)	Data Source	Year
Economy and Demographics	GDP per capita	EUR 48,400 (3)	Eurostat	2016
	Projected GDP growth	1.9% (18)	IMF	2016-2022
	Projected urban population variation by 2050	1.21x (7)	UN	2017-2050
Water Supply and Sanitation	Estimated annual average expenditure per capita	EUR 233	Authors based on EUROSTAT	2011-2015
	Population not connected	3%	EC	2015
	Annual household consumption per capita	n.a.	EUROSTAT	
	Leakage rate for public water supply	14%	EC	2017
	Non-revenue water	c8%	EurEau	2017
	Compliance with UWWTD Art.3, 4 and 5 (Index)	98% (10)	EC	2014
Flood Protection	Estimated annual average expenditure per capita	EUR 2 (22/25)	EC survey	2013-15
	Pop. potentially affected in flood risk areas	not available	EC report	2015
	Value of assets at risk (rise 2015-30):	1.47x (13)	WRI	2015-2030

Note: Rank 1 implies best in class among the EU member countries for which data is available for each indicator.

Main drivers and projections of future investment needs

Water supply and sanitation

Denmark achieves high compliance rates with the requirements of the DWD. In 2013, drinking water was 99-100% compliant with microbiological and chemical parameters and 98.7% compliant with indicator parameters[2] (European Commission, 2016a). Denmark is fully compliant with the UWWTD and demonstrates excellent compliance rates for secondary (99.3%) and tertiary treatment (98.8%) in accordance with Articles 4 and 5, respectively (European Commission, 2016b).

Table 2 projects future investment needs in water supply and sanitation for a business-as-usual and a compliance scenario. The compliance scenario consists of two dimensions (1) investments needed to comply with the revised DWD, extend access to vulnerable populations and improve network efficiency (reduce leakage); and (2) investments needed to comply with the UWWTD.

[2] Indicator parameters are used to assess the acceptability of drinking water by the consumer (e.g. taste, appearance, odour) and potential indirect impacts to human health (e.g. the presence of organic matter which may interfere with proper treatment and disinfection. If indicator parameters exceed the parametric values, this does not necessarily mean a non-compliance of the Drinking Water Directive.

Table 2. Water supply and sanitation: Projected investment needs to 2050 (million EUR)

DENMARK		Baseline 2015	2020	2030	*Total by 2030*	2040	2050
BAU water supply and sanitation	**CAPEX**	**950**	**968**	**999**	-	**999**	**971**
	TOTEX	**1309**	**1373**	**1492**		**1574**	**1618**
Scenario Compliance + for water supply and sanitation	**ADD. CAPEX**	-	**175**	**173**	***1938***	-	-
	ADD. TOTEX		**262**	**271**	***2905***		
Compliance with DWD, access and efficiency (water supply)	ADD. CAPEX	-	9	9	*87*	-	-
	ADD. TOTEX		26	26	*259*		
Compliance with UWWTD (sanitation)	ADD. CAPEX		166	164	1851		
	ADD. TOTEX		236	245	2647		

Note: BAU projections on future expenditures for water supply and sanitation are estimated based on the growth in urban population. Additional scenarios for water supply and sanitation are based on drivers relating to compliance the DWD and UWWTD as well as (for water supply) the cost of connecting vulnerable groups and of reduced leakage. The projections do not take into account the age and pace of renewal of water supply and sanitation assets due to the lack of comprehensive and comparable data across EU member countries.
Source: OECD analysis based on Eurostat (water-related public and household expenditure data) for the baseline; United Nations and Eurostat (total and urban population statistics and projections); European Commission (estimates of costs of compliance with revised DWD and of connecting vulnerable groups, leakage rates, and distance to compliance with UWWTD).

New contaminants are likely to increase the costs of wastewater treatment beyond those presented in Table 2. In particular, as one of the Baltic Coastal Countries, Denmark has agreed to develop measures to address micro-plastics and urban and stormwater discharges to rivers, and to consider possible cost-effective mitigation measures to reduce legacy pollutants and contaminants of emerging concern, including pharmaceuticals (HELCOM, 2018).

Flood risk management

The main climate change threat for Denmark is projected to be increased rainfall and flooding associated with more extreme and frequent storms and sea level rise. The current sewerage and flood protection system requires upgrading to cope with this increased pressure.

Danish sewerage and stormwater systems are not designed to cope with large volumes of water, as was demonstrated during the storms of 2002, 2007 and 2013. The total direct costs of the 2002, 2007 and 2013 floods was EUR 1,400 million. The average cost per flood was EUR 450 million, well above the EU average of EUR 370 million (RPA, 2014). This is a significant challenge for Denmark given that rainfall, sea level and storm surges are projected to increase with climate change. Projected sea level rise and increased precipitation translates into increased risk of flooding. For example, in Copenhagen, the level of flood protection requires upgrading; with a 25 cm sea level rise, the level of protection would decline from 1-in-120 years to 1-in-10 years (Bosello et al., 2012).

Under the EU Floods Directive, 10 flood prone areas were identified by Denmark in 2011. At 9 of the 10 flood prone areas, the source for flooding comes from the sea, or from both the sea and rivers. Only one of the areas has an entirely fluvial risk source. All coastal areas are located at the Baltic Sea coast. Flood prone areas were appointed based on the value of assets

(real estate value >2 billion DKK (€265 million)) and population (>500 persons) exposed to risk.

Major renovation work is planned to install sustainable urban drainage systems as part of the 2012 National Action Plan for a Climate-Proof Denmark (European Commission, 2017; Ministry of Environment and Food, 2012). Examples already exist, which have been co-financed by wastewater utilities (through tariffs), municipalities and private owners (State of Green, 2016).

Table 3 highlights growth factors in future investment needs for protection against riverine and coastal flood risks. The increase in expenditures to protect against coastal flood risk is higher than in other countries and remains an important source of future risk.

Table 3. Protection against coastal and river flood risks: Projected growth rates of investment needs to 2030

	Expenditures to protect against river flood risk			Expenditures to protect against coastal flood risk
	Total growth factors, by 2030			Categories (1-4), by 2030
	Expected urban damage	Expected affected population	Expected affected GDP	
Denmark	1,78	1,51	1,77	2

Note: It was not possible to establish a robust baseline of current expenditures for flood protection due to the absence of comprehensive and comparable data across EU member countries. As a result, this table presents projected growth factors in future expenditures. A growth factor is defined as the factor by which current flood risk expenditures should be multiplied in order to maintain current flood risk protection standards in the future (by 2030). For coastal flood, countries were classified in one of four categories of projected coastal flood risk investment needs, in which 1 indicates very low growth of projected investment needs and 4 very high growth of projected investment needs by 2030.
Source: OECD analysis based on the Aqueduct Global Flood Analyzer of the World Resources Institute (river flood impacts by urban damage, affected GDP, and affected population), the global database of FLOod PROtection Standards (Scussolini et al., 2016) (for countries river flood-related protection level), the European Commission Joint Research Centre (change of build-up in areas vulnerable for coastal flooding), a 2010 study by Hinkel et al, (number of people exposed to coastal flooding, and damage costs in the case of a coastal flood event).

Other pressures affecting water quality compliance with the WFD

The majority of surface water bodies in Denmark do not meet the water quality objectives of the WFD. Good ecological status is achieved in 30% of natural surface water bodies and 17% of heavily modified or artificial water bodies (EC, 2017). Intensive agriculture is the main driver of water pollution in Denmark, in particular diffuse source pollution of nutrients, organic matter and pesticides. Agriculture remains the largest source of pollution to coastal water in the country, and is a significant contributor to eutrophication of the Baltic Sea.

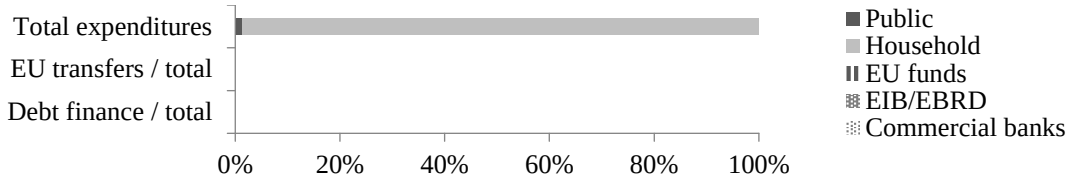
Good chemical status is achieved in 57% of groundwater bodies (European Commission, 2017). Groundwater quality is under threat from pollution with nitrates and pesticides from agriculture in many parts of Denmark (Statistics Denmark, 2017). Good quantitative status is achieved in 65% of groundwater bodies.

Past financing strategies and room for manoeuvre to finance future needs

Water supply and sanitation

Denmark relies almost exclusively on tariffs to finance WSS-related upfront capital expenditures and operational expenses (Figure 1). This has required minimal public expenditure. Denmark has not needed, nor received, EU transfers for water supply and sanitation infrastructure. Water companies also finance their investments by loans.

Figure 1. Share of annual average expenditure on WSS, by source (2011-15 average, %)



Source: Eurostat (for public and household expenditures), European Commission (for EU transfers), European Investment Bank, IJ Global, Thomson Reuters, Dealogic (for debt finance).

Based on indicators in Table 4, Denmark does not face major challenges in terms of financing capacity. Most importantly, current price levels demonstrate the ability to maintain and raise tariffs towards full cost recovery of WSS services without facing major affordability constraints. The Danish "cost-plus" regulation requires that water company expenses for capital, operation, maintenance, administration and interest repayments on loans are covered by WSS tariffs. The financial performance of large water companies is regulated and benchmarked by an independent economic regulator to ensure economic efficiency. The Water Act 2009 ensures that the WSS sector is operated efficiently, supports innovative development and water technology, and achieves high health and environmental quality, and takes into account future risks of supply associated with climate change.

Should the need arise, Denmark would also be in a position to: (i) rely on public spending based on tax revenues and borrowing; and (ii) tap into commercial debt.

Table 4. Indicators of future financing capacities for water supply and sanitation services

	Indicator	Value (rank)	Year	Data Source	Assessment
Ability to price water	Water expenditures in lowest household income decile	1.47% (10/26)	2011-15	Authors based on EUROSTAT	High
	Full cost recovery equivalent in lowest household income decile	1.49% (3/28)	2011-15	Authors based on EUROSTAT	
	At-risk-of-poverty rate	11.9% (3/28)	2016	EUROSTAT	
Ability to raise public spending	Tax revenue / GDP	47.3% (27/28)	2016	EUROSTAT	High
	Government consolidated debt / GDP	37.7% (6/28)	2016	EUROSTAT	
	Sovereign rating	AAA	2017	Standard & Poor's	
Ability to attract private finance	Domestic credit to private sector / GDP	174% (2/28)	2015	World Bank	High

Flood risk management

The Danish Coastal Authority and the Ministry of the Environment and Flood carry out flood national flood risk assessments and mapping. Municipalities are responsible for producing risk management plans in accordance with the EU Floods Directive. Private landowners are responsible for protecting their land against the sea level rise and storm surges.

Regulation under the Ministry of Energy, Utilities and Climate allows wastewater utilities to co-finance projects carried out by municipalities or private enterprises, which involve roads, watercourses and recreational areas and which assist wastewater utilities in their efforts to manage surface water in relation to climate change adaptation (Ministry of Environment and Food of Denmark, 2012).

Insurance mechanisms are not used to minimise exposure to flood risks.

References

Bosello, F. et al. (2012) Economic impacts of climate change in Europe: sea level rise. Climatic Change, 112 (1). pp. 63-81.

European Commission (2017), The EU Environmental Implementation Review Country Report – DENMARK. Accompanying The EU Environmental Implementation Review: Common Challenges and how to combine efforts to deliver better results (SWD(2017) 39 final).

European Commission (2016a). Overview of the drinking water quality in Denmark: Results of the reporting 2011 - 2013 under the Drinking Water Directive 98/83/EC.

European Commission (2016b), Eighth Report on the Implementation Status and the Programmes for Implementation (as required by Article 17) of Council Directive 91/271/EEC concerning urban waste water treatment (COM (2016)105 final) and Commission Staff Working Document accompanying the report (SWD(2016)45 final).

HELCOM (2018), Declaration of the Ministers of the Environment of the Baltic Coastal Countries and the EU Environment Commissioner, Brussels, 6 March 2018, HELCOM, Baltic Marine Environment Protection Commission. http://www.helcom.fi/Documents/HELCOM%20at%20work/HELCOM%20Brussels%20Ministerial%20Declaration.pdf.

Ministry of Environment and Food of Denmark (2012), How to manage cloudburst and rain water – Action plan for a climate-proof Denmark. December 2012. http://en.klimatilpasning.dk/media/590075/action_plan.pdf.

OECD (2013), W*ater and Climate Change Adaptation: Policies to Navigate Uncharted Waters*, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264200449-en.

OECD (2017), *Groundwater Allocation: Managing Growing Pressures on Quantity and Quality*, OECD Studies on Water, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264281554-en.

RPA (2014), Study on Economic and Social Benefits of Environmental Protection and Resource Efficiency Related to the European Semester. Study for the European Commission, Annex 1: Country fiches.

State of Green (2016), Sustainable Urban Drainage Systems: Using rainwater as a resource to create resilient and liveable cities. Think Denmark: White papers for a green transition. https://stateofgreen.com/files/download/9649.

Statistics Denmark (2017), Geography, environment and energy: Statistical Yearbook 2017. http://www.dst.dk/Site/Dst/Udgivelser/GetPubFile.aspx?id=22257&sid=geo.