water asset renewable energy solutions

WARES PROJECT PUBLICATIONS

Overview of Water Services

in Finland, Norway, Scotland, Northern Ireland and Ireland

Victor Pavlov, Niko Hänninen and Eva Pongrácz

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Table of Contents

Introduction

This report is published within the Water Asset Renewable Energy Solutions (WARES) project. WARES is a two-year strategic project of the Northern Periphery Programme, which explores the opportunities to generate renewable energy at water utility assets. The project is led by the International Resources and Recycling Institute in Scotland, in partnership with Action Renewables in Northern-Ireland, Mayo County Council and Clár-ICH in Ireland, Narvik Science Park and Northern Research Institute in Norway, and the University of Oulu in Finland. The Northern Periphery region and the location of partners is illustrated in Figure 1.

The aim of WARES is to provide innovative renewable energy solutions to remote areas by finding unused opportunities for renewable energy generation within the activities and property of the water sector. WARES will establish partnerships between the water industry and neighbouring communities and help sourcing the capital investment required to commercialise these opportunities, such as creating Public Private Partnerships.

This report provides an overview of water services in Finland, Norway, Scotland, Northern Ireland and Ireland. The main aspects discussed are water coverage, organization of water services, ownership issues, water regulation and financing water services.

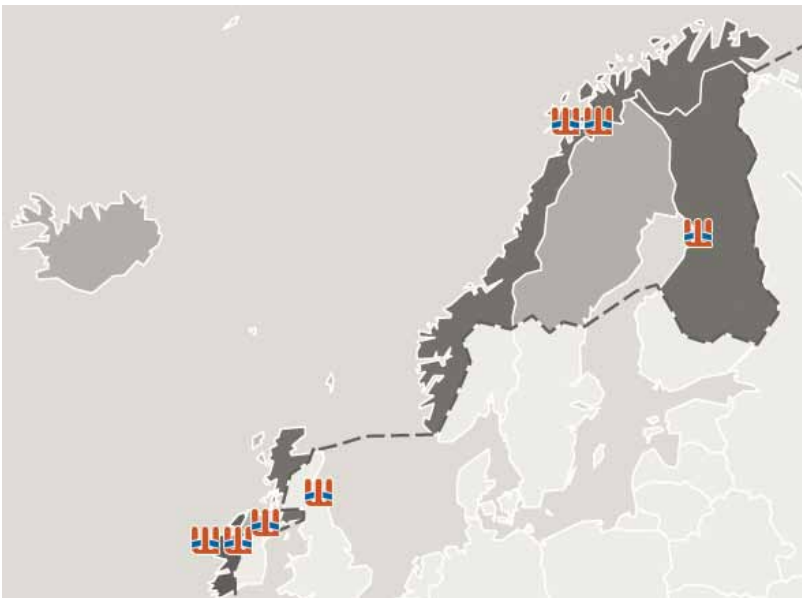

Figure 1. Map of the Northern Periphery area with the locations of WARES project partners.

1 Finland

Finland is often called as the "land of a thousand lakes". According to the statistical data of Finnish Water Forum, there are about 188 000 lakes and 650 rivers in Finland. Water bodies cover about 10% of the country's territory and provide essential recreational value for the country. The volume of fresh water reserves is 21 000 m^3 per person per year. When it comes to the Finnish water supply system, ground water reserves play a more important role compared to surface waters. Ground water share of total water abstraction in Finland is 65%. The main reasons of groundwater use are high water quality, good availability and security of supply. Water supply and wastewater treatment are available for 90% and 81% of the population, respectively, provided by public authorities. The rest of the population also has access to water services, but not from public water services providers. The tap water is potable all through Finland. (FWF, 2012 and 2014)

Finland has globally recognized expertise in integrated water resources management, water construction and services, natural water protection and water research, as well as for water-saving technologies and information and communication technologies for measurement, control and monitoring. (FWF, 2014)

1.1 Water supply and sanitation in Finland

Figure 2 illustrates the system of water supply and wastewater treatment in Finland. There are three levels of stakeholders. At the base are the customers; households, industry, different public institutions and other possible consumers. The most water intensive Finnish industry is pulp and paper production. However, frequently, paper mills have separate water supply and wastewater treatment systems arranged by private companies. On the operational level, there is a difference between Finnish towns and the countryside. In the cities, municipalities own and provide water services. The public sector is in charge of regulation, investments, funding control, maintenance, operation and management.

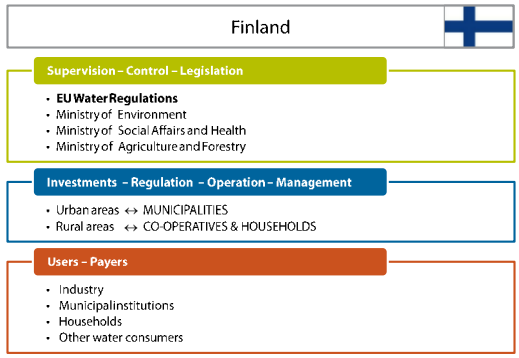

Figure 2. Organization of water supply and wastewater treatment in Finland.

The municipalities are responsible for water services only in population centers and not outside of them. As a rule, water supply and wastewater treatment are carried out by municipally owned water enterprises. Private water companies are not common in Finland. However, there are opportunities according to the Finnish regulations to outsource some services to private companies. Storm water and melt water collection and treatment is also the responsibility of municipal companies. Most storm water is handled via separate pipelines. This decreases the amount of water coming to wastewater treatment facility. In sparsely popu-

lated rural areas, water service companies belong to voluntary establishments: households or co-operatives. In detached houses, it is common to drill water wells or boreholes.

The starting point of water supply is very different in built-up areas and in sparsely populated rural areas. In this sense, sparsely populated area means those outside the municipal water supply and sewerage system. The law requires such single household areas to manage their wastewater by themselves. They are expected to install wastewater treatment systems bearing the Conformité Européenne (CE) mark.

When it comes to co-operatives, there can be two sources of water supply: a) municipal water network use; b) own water source use. In both cases, the co-operatives have to manage related investments, operation and maintenance costs of their water systems. The major difference is that with option a) they only need to take care of network and pumping stations, whereas in option b) they should also consider water intake and treatment measures. (FWF, 2012a; Laitinen, 2012) As for wastewater treatment, co-operatives can either rely on municipal sewerage systems or their own wastewater treatment solutions. In general, co-operatives, as community-based systems allow good water resource management with lower costs to individual water users. When uniting into a co-operative, investment and maintenance costs become lower in comparison to personal in situ water systems. (FWF, 2014b; Laitinen, 2012) Co-operatives may also engage contractors to perform wastewater treatment and maintenance. This solution enables the fulfilment of strict local and EU legal requirements of water quality and supply. (FWF, 2012a; FWF, 2014b; Laitinen, 2012)

In Finland, there are four national programs related to natural water protection. They have been in use since the 1970s. In addition, river basin management is of priority and appropriate plans for seven Finnish regions were accepted by the Finnish government. According to these plans, by 2015, 100% of the ground water reserves, 90% of the lakes and 70% of the rivers there should maintain or reach a good water quality level. The base for the latter was the European Union Water Framework Directive (EU WFD) (Directive 2000/60/EC) about sustainable water use and supply in Europe. There are also other water-related Directives, Acts and Laws regulating (FWF, 2014b):

- Water services,
- Water quality,
- Wastewater treatment,
- Prevention and control of water contamination,
- Environmental protection,
- Healthcare,
- Sludge utilization and landfill disposal,
- Public work and service contracts,
- Procurement operations,
- Land use and construction works,
- Sustainable utilization of natural resources, and
- Other issues.

If there is any industrial or physical activity to be implemented on Finnish territory that influences surface or ground water bodies, according to the Water Act, there is a need to apply for appropriate permit. The activity is allowed to be started only after approval and permit acquisition. In rural areas, the Act for Water Services and the On-site Wastewater Treatment Decree (for the wastewaters out of municipal sewerage systems) also applies to control pollution and sewage treatment. The last mentioned sets also the limits for waste water treatment in terms of biochemidal oxygen demand, total phosphorous content and total nitrogen content. In municipal population centers decisions regarding water industry are taken either by the authorities or by the heads of water companies. The decisive factor is the scale of the proposed activity. If it stays within certain investment costs, profit utilization and material investigation, then the decision can be made at the water company. The same mechanism applies to the cooperatives of rural areas. The cooperatives can decide on smaller investments, but for the bigger ones they have to seek permission from the local authorities. (Mikkonen, 2013; FWF 2014b; Laitinen, 2012)

According to the Finnish Water Forum, currently, there is a tendency to increase inter-munici-

pal cooperation toward joint water and wastewater treatment facilities as well as common sludge disposal. This has been already implemented in such Finnish cities as Helsinki, Turku and Tampere with total populations of 750 000, 280 000 and 200 000 people, respectively. These numbers include populations beyond the cities; for example the Helsinki and Turku wastewater treatment facilities serve five neighboring towns in addition to the inhabitants of the two cities. As another trend, water companies are decreasing their dependency on municipal organizations. (FWF, 2012a; Pietilä, 2006)

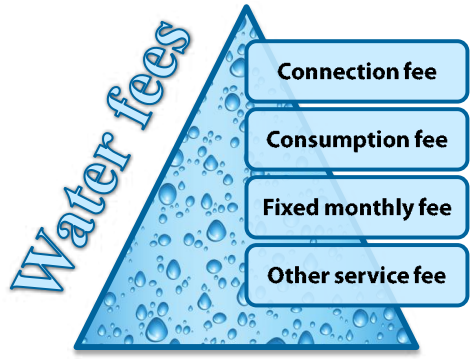

Figure 3. Types of customer water fees in Finland.

1.2 Customer water fees in Finland

The Water Service Act 119/2001 also regulates water fees for users. In municipalities, water fees are the main source of financing water services. The main sources of costs are investments, employee wages, energy supply, chemicals and maintenance operations. The Water Service Act states that all the costs of water supply and wastewater treatment can be covered by customer water fees. The rate of the fees should be mentioned in the water company price list. If there is a need to change the rates, for instance, due to legislation change, authority decision or investment expenses, the company is allowed to do so. It is legitimate under the Water Services Act that, if a water company incurs operational, investment or any other expenses, they be covered by customer water fees. Fees can vary from region to region. Water fees concern and include both potable water and wastewater operations. (FWF, 2012a; HSY, 2011)

There can be three main types of water fees: connection fee, fixed monthly fee, and consumption fee (Figure 3).

The connection fee is paid by a customer to the water company to cover the investment cost of joining the water network. The consumption fee is related to the amount of supplied water that is consumed by the customer. In this case, water consumption needs to be metered. This is a direct responsibility of the water company. They must install water meters at customers' premises so that the customer can follow the volume of water consumed. The water company needs to specify the meter type and provide the customer with this information. The installed water meter is considered as the property of the water company. The consumption fee in Finland is on average about 4,83 euro/m^3 per household in a detached house and 3,96 euro/m^3 per household in an apartment building flat. Based on Finnish Water Forum data, an average Finnish family of four people is assumed to have a monthly water use of 4,5 m^3 per person and, therefore, the monthly water fee costs a family around 2% of their income. (FWF, 2012a) The fixed monthly fee is not tied to the amount of water used by the customer. In this situation, the customer is supposed to pay the fixed fee for water service on a monthly basis. The other service fees are linked to various expenses possible for water company: e.g. water meter installation, storm water collection, pipeline renovation, some other installations or improvements and related expenses. In general, up to 80-90% of overall water company expenses do not arise from customer water consumption. They are fixed and included in the customer water fee. In turn, the municipalities and the national government collect from water companies part of their income (5-25%). Towards co-operatives and households, an obligatory income tax of 26% is applied. (FWF, 2012a; HSY, 2011)

2 Norway

Norway is a country rich in freshwater resources and has abundant water supply for both industrial and domestic use. Water resources are also considered recreational objects. The country is especially abundant in waterfalls and rivers. This facilitates the utilization of hydropower. (EPD, 2007; NMPE, 2013) Norway has a territory of 324 000 sq km, 5% of which is covered by water. The total amount of lakes is about 455 000, however, most are of very small size. There are also large inland water bodies, with the largest six lakes having a surface area of more than 100 sq km each. There are 11 river basin regions in Norway. The south-east of the country contains most of the biggest rivers and their catchment areas. Along the coast, there are some smaller rivers. In total, there are approximately 4 000 rivers in the country. The total amount of annual fresh water resources in Norway is about 377 000 million m^3. The quality of drinking water is good for most water consumers. (EEA, 1996; Stene-Larsen, 2012; EPD, 2007; Statistics Norway, 2008; Gonzalez, et al., 2011)

Regarding water supply in Norway, surface water sources are utilized more than ground water sources. Their shares are 90% and 10%, respectively. In recent years, the proportion of ground water use for drinking water supply has been slowly increasing. This is explained by the intent to reduce costs and decrease public health risks. In general, public water supply is available for around 90% of the Norwegian population. The other 10% of the population has access to potable water provided by smaller waterworks. When it comes to wastewater treatment, 84% of people have access to this public service. (EPD, 2007; Statistics Norway, 2008; Stene-Larsen, 2012; Berge, et al., 2013)

In terms of water expertise, Norway has a strong hydropower expertise. Norway is the largest European producer of hydropower with more than 100 years of experience in all aspects of hydropower implementation: from planning and engineering to equipment installation and management. The Norwegian potential in terms of hydropower is widely utilized; at the present, Norway is more oriented towards respective projects abroad: Central and Southeast Europe, Asia and South America. (NMPE, 2013)

2.1 Water supply and sanitation in Norway

The organization of the Norwegian water supply and sanitation system is illustrated in Figure 4.

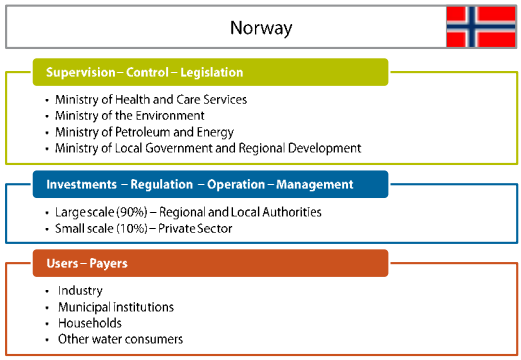

Figure 4. Organization of water supply and wastewater treatment in Norway.

The water consumption rate by users is about 0.7% (approx. 2 700 million m3) of available annual amount of freshwater resources in the country.

The average annual water consumption per capita is 600 m^3 in Norway. This is much lower than the average in the country-members of the Organisation for Economic Co-operation and Development, which is 880 m^3/year. The amount of water consumed on annual basis by the primary industries, the manufacturing industries (especially, metal, chemical, pulp and paper, food industries) and households is 40% (approx. 1000 million m^3), 42% (approx. 1100 million m3) and 14% (approx. 380 million m^3), respectively. (Statistics Norway, 2008)

In terms of operation and management, in 90% of the cases the public sector own water companies and are responsible for water services. There is also small share (10%) of private water treatment facilities operating in the Norwegian water sector in rural areas. The state-owned facilities supply water to about 90% of the population and treat wastewater for about 84%. There are 1 570 waterworks registered in waterworks portal of the National Institute of Public Health that are responsible for water treatment. The number includes both public (municipal and inter-municipal) and private organizations, except water supply stations for holiday homes. In 2012, there were about 2 685 wastewater treatment plants in Norway. The most common method of wastewater treatment is chemical or biochemical processing (in 60% of cases) and mechanical treatment (in about 20% of the cases). Additionally, 3% of wastewater is untreated and discharged as raw sewage. In rural areas, there are smaller wastewater treatment facilities (16%) consisting of sludge separation and filtration. (Berge, et al., 2013; Statistics Norway, 2008)

The main sources of water contamination are agriculture, municipal sewage and fish farming. The role of agriculture in Norway is important and interconnected with water in terms of irrigation, drinking water supply and creation of natural boundaries for livestock. (EPD, 2007; Stene-Larsen, 2012)

On the level of supervision, control and legislation, the key organizations are the Ministry of Health and Care Services, the Ministry of the Environment, the Ministry of Petroleum and Energy and the Ministry of Local Government and Regional Development. The Ministry of Health and Care Services (along with the Norwegian Food Safety Authority and the Norwegian Directorate of Health) is in charge of drinking water quality, the Ministry of the Environment (along with the Directorate for Nature Management and the Climate and Pollution Agency) – is responsible for preservation of water resources, the Ministry of Petroleum and Energy (along with Norwegian Water Resources and Energy Directorate) – is responsible for hydropower and respective regulations, and the Ministry of Local Government and Regional Development (along with the Norwegian Building Authority) – is responsible for the water sector infrastructure. (Stene-Larsen, 2012)

Although not an EU Member State, Norway is also subject to the implementation of requirements of the European Union Water Framework Directive (EU WFD) (Directive 2000/60/EC). The responsibility to coordinate and realize the EU WFD was given to the Ministry of the Environment at the state level and to the county administrations at the regional level. Freshwater use is governed by the Water Resources Act since 2000, which states that river and ground water reserves should be used in a sustainable manner and take into account the interests of local communities. One of the goals of the Water Resources Act is to ensure that water systems are well-preserved, their biodiversity levels are maintained and the vital ecosystem processes are saved. To protect groundwater reserves and avoid overconsumption, the Pollution Control Act is also in force in Norway. (EPD, 2007; NMPE, 2013; Statistics Norway, 2008)

All infrastructures such as railways, car roads, cable cars, ports, as well as plans and programs that deal with water resources should undergo environmental assessment. The requirements are set by the Water Resources Act, and the Planning and Building Act. In addition, the Water Resources Act as well as in the Protection Plan for Water Resources state that rivers should be protected from significant negative influence by energy utilization and other possible works, even though they have high hydropower potential. To start any activity such as

water supply, hydropower development, drainage organization and fish farming projects, according to the Water Resources Act, one needs to receive a special license. The obtained license means that no significant influence towards the environment and the community will take place. The administrative guidance regarding the licenses and the application procedure are also described in the Water Resources Act. (EPD, 2007)

If a water supply or wastewater treatment company is located nearby a river with hydropower potential or in an area with favourable wind profile, this company needs to check at first if it is eligible to use the river or install a windmill to produce energy. In Norway, resources such as land and waterfalls are preferably owned by the public sector. This approach applies also to hydropower resources, which should be state-owned as well. To this end, only the state can use waterfalls, whereas the private sector can own only less than one third of a hydroelectric power plant, for instance. The remaining two thirds should be held in public ownership. If a water company plans to set up a hydropower installation, it should obtain a proper license pursuant with the Industrial Licensing Act. All the fees and basic terms concerning the license application process are mentioned there. Moreover, according to the Industrial Licensing Act, hydropower plant is obliged to sell energy to the municipalities. The latter means that the local authorities have a legitimate right to utilize the power produced at the energy installation. Another regulation that is applicable to hydropower production is the Watercourse Regulation Act. This act requires that water from a regulation reservoir can be used only with a special permit. The regulation reservoir is a vessel, which can store water for energy production. (NMPE, 2013)

2.2 Customer water fees in Norway

According to Norwegian regulations, customers have to pay for the used water in customer fees. These are set by municipalities, but they should only cover the actual costs of water supply and wastewater treatment, such as operating, capital and maintenance costs. The principle of full costing should be fulfilled. (Statistics Norway, 2008) The customer fee types in Norway are normally divided into the following three groups (Statistics Norway, 2008; Berge, et al., 2013):

- Connection fee. This is the fee raised by municipal authorities for connecting a water user to a working water distribution system. In 2013, connection fee was about 1 660 euros.
- Annual consumption fee. This fee is based on the consumption of water by the user, which is measured by water meters. The average annual fee was about 416 euros in 2013. In country scale, the fees vary from county to county, in the range of 80 euros to 695 euros. This substantial difference is stipulated by the location of the municipality and the local geographical conditions: e.g. size of water plant, relief, density of population and other factors;
- Combination of fixed and variable fee. This option includes a fixed fee for the limited initial amount of water determined by water authority, and a variable fee in case this limit is exceeded.

If a property does not have a water meter, the fee is based on water consumption depending on the size of the building in question. The water fee combines both water services: water supply and wastewater treatment. (Statistics Norway, 2008; Berge, et al., 2013)

3 Scotland

Scotland is famous in the UK for its abundance and purity of fresh waters; 90% of the British freshwater volume is concentrated in Scotland. Freshwater lakes and rivers cover 2% of the Scottish territory, and one of the deepest lakes in Europe, Loch Morar, is situated in the country. In total, there are more than 30 000 lakes and 10 000 rivers in the country. The tap water in Scotland is potable: 99,91% of water samples taken from customer taps comply with drinking water standards. (SE, 2003; SNH, 2001 and 2002; Scottish Water, 2013a)

When it comes to water supply, 93% is from surface water and 7% from groundwater. Water services are provided by a single public company: Scottish Water. Water supply and wastewater treatment are available for about 98% of the population. The rest rely on private water supply sources that do not belong to Scottish Water. (Ó. Dochartaigh, et al., 2011; Scottish Water, 2014a; SmithsGore, 2014)

The water services in the country are run efficiently and effectively, when it comes to procurement, operation and maintenance of public-owned water facilities, which deal with water preparation and wastewater treatment. (Scottish Water, 2013b)

3.1 Water supply and sanitation in Scotland

The organization of the water supply and sanitation system in Scotland is illustrated in Figure 5.

The water users are connected to water supply and wastewater treatment system operated by Scottish Water. The most important water intensive industries in Scotland are food and drink production and agriculture. (Scottish Government, 2013)

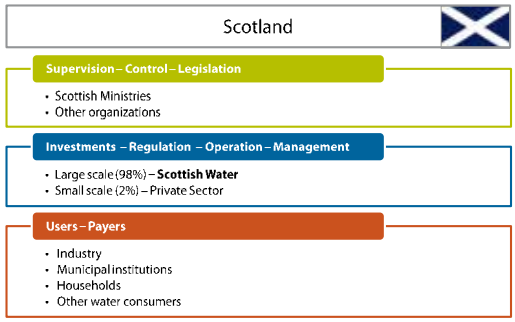

Figure 5. Organization of water supply and wastewater treatment in Scotland.

In terms of operation, Scottish Water own 98% of water facilities and is in charge of water services. A small share, 2% is taken by private water treatment facilities, mainly in rural areas. Scottish Water operates 252 water supply facilities and 1 865 wastewater treatment plants. Scottish Water was formed by the union of the three former regional water authorities; East of Scotland Water, West of Scotland Water, North of Scotland Water in 2002. This, consequently, helped to improve the efficiency of water service and reduced costs by 20%. Scottish Water is a state-owned company that is subordinated by the Scottish Parliament. At the same time, its management and structure are similar to private companies. The company owns not only such assets as water preparation and wastewater treatment facilities, pumping stations, pipeline networks and sewers, but also land. According to Thomson (2013), Scottish Water holds more than 240 sq km as rural catchment estates. Recently, there has been renewable energy development (mostly wind energy and micro-hydropower) on these estates. This serves as

an answer to the current goal of the public company to transform from being one of the largest energy consumers in Scotland towards energy self-sufficiency. In terms of water resources in the country, historically, it was common that land owners had an extended water ownership right. Currently, this is not considered as appropriate for water resource management. In practice, the right to manage water resources has shifted from the private sector to a public entity. Water ownership and who controls the water have become issues of public interest. (EC DGRP, 2004; Hendry, 2013; Scottish Water, 2014a; Scottish Water, 2013b; Thomson, 2013)

The water supply originates mostly from lakes, rivers, reservoirs and partly from boreholes. The drainage system collects storm water and wastewater coming from households and industry. One third of wastewater is composed of storm water from roofs, sidewalks, parking areas and public roads. Scottish Water is responsible for the full cycle of drinking water supply and wastewater treatment including sludge utilization. A larger part of the sludge is recycled whereas a smaller part is disposed at landfills. (Scottish Water, 2014a; Scottish Water, 2014b)

On the supervision level, there are number of Scottish Ministries influencing water services, such as water fees strategy, policy and vision of the water sector, environmental aspects, drinking water quality, customer service and so on. Public authorities are also responsible for making decisions about the amount of financing available to lend to the water company. (WICS, 2013)

Other regulators, to whom Scottish Water is responsible to, are the Water Industry Commissioner for Scotland, the Scottish Environment Protection Agency, the Scottish Executive Water Services Unit (Drinking Water Quality Regulator) and Consumer Futures. The following organizations play important roles and have key functions in the Scottish water sector (Mohajeri, et al., 2003; Scottish Water, 2014d; WICS, 2013):

- The Water Industry Commission for Scotland (the Commission): it deals with the amount of customer fees and acts as an economic regulator;
- The Scottish Environment Protection Agency (SEPA): it conducts monitoring of wastewater discharges as well as determines the standards for it. The main role of SEPA is to promote sustainable development and environmental protection as well as to prevent negative influence on human health. It acts as an environmental regulator;
- The Scottish Executive Water Services Unit (Drinking Water Quality Regulator [DWQR]): it monitors the quality of supplied drinking water and sets the standards for it;
- Consumer Focus Scotland (CFS): it acts as a voice of the water consumers in water issues and water fees;
- The Customer Forum: it represents customers' interests when working with strategic issues in the water sector: e.g. water charges, customer preferences;
- The Outputs Monitoring Group: it is responsible for monitoring the outputs that Scottish Water has to deliver. The main goal is to make it clearer and easier for water consumers to understand the outputs. The group consists of representatives from CFS, the DWQR, SEPA, the Commission, the Scottish Government and Scottish Water.

There is a number of water related regulations in Scotland, the most important being (Scottish Government, 2014a):

- The Water Industry Scotland Act 2002;
- The Water Services etc. (Scotland) Act 2005;
- The Water Supply (Water Quality) (Scotland) Regulations 2001;
- The Provision of Water and Sewerage Service (Reasonable Cost) (Scotland) Regulations 2011 (SSO 2011/119).

The EU Water Framework Directive is also implemented in Scotland. (Scottish Government, 2014b)

3.2 Customer water fees in Scotland

Water services are funded mainly by customer fees. Other possible financial support flows are provided by the Scottish Government. (Scottish Water, 2014d)

There are three general categories of customer water fees in Scotland (Scottish Water, 2014c):

- Water supply fee;
- Wastewater treatment fee;
- Other fees.

The first two categories are applied only if a household or business property is connected to the public water network. The third one includes such services as connection to the public network, standpipe license issue, septic tank de-sludging, provision of information, inspection and application processes. (Scottish Water, 2014c)

Water supplied fees are charged from those consumers, who have a water meter in their household. A metered household is charged with two fees: the annual fixed fee and the volumetric water fee. The annual fixed fee is paid for operation and maintenance of the pipeline system, wastewater treatment facilities and pumping stations. This fee is approximate 174 euros. The volumetric water fee is collected for every cubic meter of water consumed. It applies to the first 25 m^3 of fresh water consumption with one rate (approx. 2,7 euro/m^3) and from the 26th m^3 and further with another rate (approx. 0,9 euro/m^3). If a household is not equipped with a water meter, a variation of the water supply fee is used. For households, the collected fee can vary from 155 euros to 465 euros and the amount of fee depends on the Council Tax Band system. It consists of 8 levels: from A to H. The lowest fee is charged according to Tax Band A and, respectively, the highest according to Tax Band H. (Scottish Water, 2014a; b; c)

The annual fixed fee and volumetric fee for wastewater treatment are based on the same factors, which determine the water supply fees. However, wastewater generation is considered to be 5% less compared to fresh water consumption. An approximate value for the wastewater treatment fee is around 179 euros. The volumetric fee for the first 23,75 m^3 is about 3,5 euro/m^3 and, for volumes beyond 23,75 m^3, approximately 1,7 euros/m^3. In case there is no water meter in a household, Council Tax Band system is used. Based on this, the collected wastewater fees varies: from 180 to 540 euros. (Scottish Water, 2014d) Therefore, the average combined water service fee in Scotland is about 415 euros, which is lower than in England or Wales. (Scottish Water, 2014d)

Apart from the regular wastewater treatment fees, Scottish water consumers pay two other charges (Scottish Water, 2014b):

- Property drainage fee;
- Roads drainage fee.

The drainage fees are also related to the Council Tax Band system. The two fees are identical in cost. The lowest fee of Band A is about 36 euros, whereas the Band H value is approximately 108 euros. The property drainage fee is collected for rainwater, which is directed to the sewer system of the public company. Usually, this water originates from the property roofs, private parking areas and private roads. The roads drainage fee, in turn, concerns storm water from public roads and sidewalks. Both of the fees are levied from households only if applicable. (Scottish Water, 2014b)

The secondary services, which are covered by other fees, are rather varied. One of the most essential services is connection to the public network. In this respect, there are two types of connection fees: for the connection to the pipeline system providing water supply and for the connection to the wastewater treatment network. Both of the fees are equal and are about 409 euros each. (Scottish Water, 2014c)

4 Northern Ireland

Marine waters have both industrial and recreational importance for Northern Ireland. Due to growing energy demand during recent years, there is a tendency of utilizing offshore wind energy, as well as tide and wave power. About 7% of Northern Ireland is covered by surface water bodies. (Christie, 2011; NIEA, 2013) In total, there are about 3 200 rivers and 1 700 lakes in the country (Mehaffey, 2014). The 1,8 million inhabitants of Northern Ireland receive about 562 000 m3 of drinking water on a daily basis. In Northern Ireland, the water supply originates mostly from lakes and rivers (55,95%) as well as reservoirs (44%). The biggest lake, Lough Neagh, supplies 50% of the country's drinking water. Only 0,05% of water supply comes from groundwater sources. In England and Wales, by comparison, about 35% of the water supply is from boreholes. Water services are provided by Northern Ireland Water, a public authority. Public water supply is available for 99,9% of the population of Northern Ireland. In turn, wastewater treatment is provided for 96,5% of the inhabitants. The water is potable; 99,83% of samples taken comply with drinking water standards. (Christie, 2011; NIEA, 2013; NIW, 2012; NIW, 2013; Rippey, et al., 2001)

When it comes to the specific expertise of Northern Ireland, it is advanced in the promotion of renewable energy in both the public and the private sector. It includes provision of advices about energy efficiency, technological solutions and all the adjacent issues. Apart from recent developments in Northern Ireland, there are also a number of collaborative projects within the European Union in this field.

4.1 Water supply and sanitation in Northern Ireland

The organization of water supply and wastewater treatment in Northern Ireland is illustrated by Figure 6.

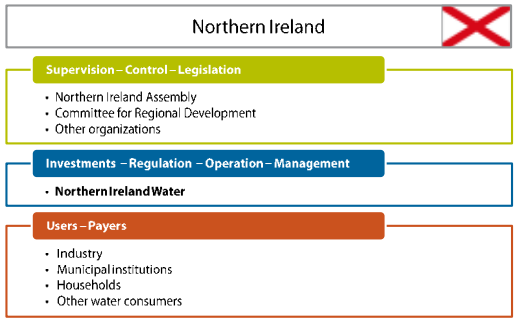

Figure 6. Organization of water supply and wastewater treatment in Northern Ireland.

In Northern Ireland water services – both water supply and wastewater treatment – are provided by a government owned company – Northern Ireland Water (NIW). The most water intensive industry in the country is food and drink production. (NIW, 2013b; McGuigan, G, 2010) NIW is responsible for investments, operation, regulation and management of water services. The water treatment services provided by NIW consist of screening, chemical treatment and clarification, filtration, disinfection and pH adjustment. There are 25 drinking water preparation facilities in the country. NIW is also responsible for wastewater collection and the treatment that the water can be discharged into rivers and the sea. Storm water is also collected into the public

sewer network. The wastewater treatment process includes 4 stages: preliminary step (screening, grit removal), primary step (sedimentation), secondary step (biological filtration/activated sludge) and final step (sedimentation). NIW operates more than 1 000 wastewater treatment works in the country. The operating area of the water company is mainly rural. Northern Ireland Water owns 71 impounding reservoir structures, some land holdings, a network of pipes, pumping stations, sewers, water treatment and wastewater treatment works. (NIA, 2014; NIEA, 2013; NIW, 2012; NIW, 2013; NIW, 2014a; UR, 2013)

In terms of supervision and control, the Northern Ireland Assembly and the Committee for Regional Development monitor the activities of NIW. (NIW, 2013) Ministry for Regional Development under the Northern Ireland Assembly and the Committee for Regional Development are the key legislative bodies. The Department for Regional Development of the above mentioned ministry is in charge of water policies as well as deals with funding of the water company and solving problems related to customer subsidies, investments, lending, etc. The other organizations relevant to water services are (NIW, 2013):

- Northern Ireland Environment Agency. The agency deals with natural environmental heritage and its preservation. It regulates the NIW activity in terms of its compliance with all the needed regulations and environmental permits;
    a) Drinking Water Inspectorate for Northern Ireland: it is responsible for drinking water quality control;
    b) Water Management Unit: it is in charge of the water pollution and protection of water bodies;
- Northern Ireland Authority for Utility Regulation: it provides information for water users and acts as an economic regulator on water, electricity and gas markets;
- Consumer Council for Northern Ireland: it acts as the water consumers' voice and represents their interests. It also gives advice and provides information to water service users.

The EU WFD is also in use in Northern Ireland. In addition, there are various water related policy drivers and regulations, such as (NIEA, 2013):

- The Groundwater Directive (2006/118/EC): it regulates and prevents contamination of groundwater reserves;
- The Drinking Water Directive (80/778/EEC): it controls pollution of and ensures drinking water quality to protect human health;
- International Decade for Action 'Water for life' 2005-2015: it promotes implementation of water related measures as international commitments by 2015;
- The Water Environmental (Water Framework Directive) regulations (Northern Ireland) 2003: it controls and sets standards for quality of river waters.

4.2 Customer water fees in Northern Ireland

The water service fees in Northern Ireland are (NIW, 2014b):

- Water supply fee;
- Wastewater treatment fee;
- Other fees (e.g. connection fee, septic tank de-sludging).

The system of fees is rather close to that of the Scottish system. However, during 2014-2015, domestic water users are not paying any fees. Instead, the Department for Regional Development is covering the fees. The other fees can be collected from domestic customers, for example, if a septic tank de-sludging procedure is ordered more than once a year. Other than that, domestic water users are subsidized by government, with a 100% water service discount. Water use by default is not measured in the households of the country. (NIW, 2014b)

Non-domestic water customers, in turn, must cover water services provided by NIW by paying respective annual fees. The used fee depends on whether there is a water meter installed or not. (NIW, 2014b) If water consumption is metered, the only variable parameter is a supply pipe diameter. The bigger the size of supply pipe, the higher the payment will be. There is a range from less than 20

mm to more than 100 mm. For instance, if it is up to 50 mm, the annual fee for water supply will be 388 euros. If it is over 100 mm, water supply will cost for a non-domestic customer 1 971 euros. The latter fee is called a standing charge for water supply. As an additional fee to a standing charge, there is a variable charge. This fee is collected from a water user depending on the volume of water measured by the water meter. For every cubic meter, the charge is 1,25 euros. When it comes to wastewater generation and related fees, the situation is similar to water supply; there are standing and variable charges. The standing charge can, in accordance with the size of supply pipe, be from 93 euros (for the pipe less than 20 mm in diameter) to 2 256 euros (for the pipe more than 100 mm diameter). The variable charge for wastewater is set at 2 euro per m3. (NIW, 2014b)

When water consumption is not metered, there are the same types of fees as in the previous scenario, with a difference in variable charge. This is set in proportion to the non-domestic property valuation. This procedure is done by Land and Property Services on request. For every 1 000 pound sterling (1 228 euro) of the property value, a non-domestic customer should pay about 12 euros as a variable charge for water supply and approximately 17 euros as a variable charge for wastewater. The charge cap is set at the level of 497 euros for water supply and 528 euros for sewerage. The standing charge is respectively 32 euros for water supply and 44 euros for wastewater. Other possible fees include septic tank de-sludging (91 euros) and connection fee (310 euros). (NIW, 2014b)

5 Ireland

Republic of Ireland occupies five-sixths of the territory of the Island of Ireland. The country is rich in water resources: surface water bodies cover 2% of the country and availability of fresh water is one of the highest in Europe. (Mohajeri, et al., 2003; CIA, 2014)

There are a total of 4 467 lakes and 80 rivers in Ireland. The main source of water supply (around 82%) is the lakes and rivers. The share of groundwater is about 10% of the total water supply, whereas the rest, 8%, originate from springs. 99% of the population has access to water supply and 99,5% to wastewater treatment. The numbers include both public and private water services. Public water supply provides water for approximately 80% of the population. The water supplied by public water authorities is potable. The chemical compliance with drinking water standards is 99,5%. The wastewater treatment share provided by public authorities is about 70%. (Mohajeri, et al., 2003; DCC, 2009; OEE, 2011; ECLG, 2012)

The most significant field of expertise that is mastered by the Irish in the water sector is mostly connected to water and wastewater management. The latter concerns especially the local water authorities. The expertise has been utilized in other European countries as well. (DJEI, 2013)

5.1 Water supply and sanitation in Ireland

The Irish system of water supply and wastewater treatment is currently undergoing great changes. Back in 2011, Ireland was the only country-member of the Organization for Economic Cooperation and Development, which did not have water fees for domestic water users. To improve drinking water quality, improve cost efficiency of water services and preserve national water reserves, the government made a decision to introduce customer water fees and household water meters. Several reasons led to these measures, such as the projected increase of Irish population, large amounts of pipe leaks, requirements of the EU WFD and national water standards, unsustainable funding patterns and high cost of water services provision. The transition period started in the summer of 2012 and, in 2013, a new company called Irish Water Incorporated was established. In the first quarter of 2014, Irish Water made Service Level Agreements with the local authorities about providing water services and the Irish water assets were transferred to Irish Water. In the beginning of 2015, the domestic billing system should start. (Tierney, 2013; ECLG, 2012; BD, 2013; DECLG, 2014)

Figure 7 shows the Irish system of water supply and wastewater treatment.

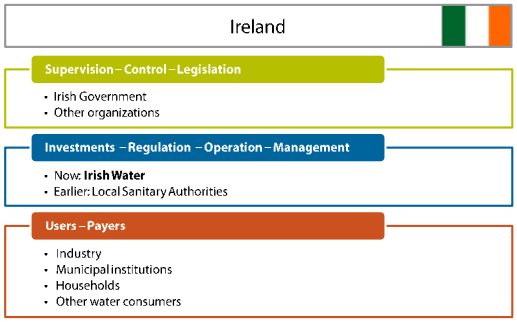

Figure 7. Organization of water supply and wastewater treatment in Ireland.

Water services are provided by the public sector. The most water intensive industries in Ire-

land are production of chemicals, pharmaceuticals, food, beverages and brewing and information technology sector. The average daily water supply provided by water authorities is 1,6 million m3. (CIA, 2014; ECLG, 2012)

As for water service operations, prior to the recent changes, water services were provided by 34 local authorities (29 counties and 5 cities). In 80% of the cases, the water companies were owned and run by the public sector and they were responsible for water services, infrastructure, pumping stations and water preparation and wastewater treatment plants. Within the local authorities under county or city councils, there were Sanitary Authorities with responsibility for water supply and wastewater treatment. The public water companies received their water mainly from surface waters, but that was not always the case with the private companies and Group Water Schemes, which offered water services for the rest of the population (10% each). (Mohajeri, et al., 2003; NPP, 2014c; ECLG, 2012; Tierney, 2013) The Group Water Schemes (GWS) come in two forms: private and semi-private (Mohajeri, et al., 2003). The main difference is the source of water supply. In the semi-private variant, the drinking water originates from public water network. It is metered and paid according to the amount of water consumed by the group. In this case, a group of households usually makes special purchase agreement with the public authority. Private GWS, on the other hand, receive water from the group's own water source, such as a well or springs. This scheme is used mostly in rural areas. The main reason for the existence of GWSs is that there are some households in Ireland that do not have access to a Sanitary Authority drinking water supply. In 1997, the number of non-connected dwellings was around 200 000, but nowadays it is about 3 000 households. GWSs can receive financial support from the public sector for their operations. (Mohajeri, et al., 2003; ECLG, 2012)

The Irish water sector has undergone significant changes in the past few years, which are by no means over yet. Irish Water has taken over the water assets of the 34 public water authorities, who were in charge of water supply and wastewater treatment. Large and complex structural changes are still ongoing, but Irish Water, as a self-financing water authority, should be completely formed by 2017. (ECLG, 2012; BD, 2013; DECLG, 2012; DECLG, 2014)

Irish Water will be in charge of the provision of water services for domestic and non-domestic customers as well as for strategic planning and development on national level, investment programs, operations and upgrading of current water infrastructure. Irish Water will introduce water meters to the Irish households, but offers also a single customer service point with all the information related to water services. Basically, the new company should take over all the responsibilities of Sanitary Authorities. (BD, 2013; ECLG, 2012)

In terms of supervision, control and legislation, the Government of Ireland is in charge of controlling the activities of Irish Water. In addition, the Department of the Environment, Community and Local Government, local authorities and Board Gáis Éireann group support the establishment and operations of Irish Water. (DECLG, 2012)

Other regulators, to whom Irish Water has to answer, are (Mohajeri, et al., 2003; BD, 2013):

- Environmental Protection Agency. EPA is in charge of pollution control and mitigation of negative environmental influences from the water industry. It also issues licenses for wastewater discharges, thus, supporting the "polluter pays" principle;
- Commission for Energy Regulation. This acts as an economic regulator. It sets the water charges both for domestic and non-domestic customers.

The EU WFD is also applicable in Ireland. In addition, there are many other regulations affecting the Irish water sector. For example, the acts and laws are listed below (Mohajeri, et al., 2003; ECLG, 2012):

- The Local Government (Sanitary Services) Act, 1964;
- The Private Water Supplies and Sewerage Facilities Regulations, 1978;
- The Local Government (Water Pollution) Act, 1990;

- The European Communities (Quality of Salmonid Waters) Regulations, 1988;
- The European Communities (Quality of Water Intended for Human Consumption) Regulations, 1988;
- The European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations, 1989;
- The Local Government (Financial Provisions) Act, 1997;
- The Environment Protection Agency Act, 1992;
- The Local Government (Dublin) Act, 1993;
- The Local Government (Water Pollution) (Nutrient Management Planning Consultation) Regulations, 1998;
- The Water Pollution Act, 1990;
- The Water Services Act, 2007;
- Other regulations.

5.2 Customer water fees in Ireland

Before 1997, there were charges for water services. In 1997, after the Local Government (Financial Provisions) Act was introduced, the water customer fees for domestic users started to be subsidized. In practice, this meant that domestic water supply and wastewater treatment became free of charge. Non-domestic customers were and are obliged to pay water fees. As a rule, water consumption at industrial, agricultural and commercial enterprises has been measured with water meters. In addition, these non-domestic users have to pay a connection fee when connecting to the public water network. The same is applicable for Group Water Schemes of more than 5 households. For other domestic water users, connection to the public network is free of charge. (Mohajeri, et al., 2003)

Nowadays, in direct connection to the reform in the Irish water sector, water charges are also introduced for domestic customers. (DECLG, 2014) The amounts for water fees are not known yet, but the Minister for the Environment, Community and Local Government has declared that it will be about 296 euro per year. The final decision should be taken by Commission for Energy Regulation. (DECLG, 2014)

There are two possible options of water fees for domestic customers (DECLG, 2014):

- Equipped with water meter:
  a) Water supply fee;
  b) Wastewater treatment fee;
- Not equipped with water meter:
  a) Assessed water supply fee;
  b) Assessed wastewater treatment fee.

In the first case, the water fees are based on household water consumption/wastewater generation. Part of the domestic water usage is subsidized with a free allowance. Free allowance covers on an annual basis 30 m3 of water supplied to household and corresponding volume of wastewater collected from household. Moreover, there is also a special "water" support for children in Ireland. Every child should have free access to 38 m3/year of drinking water supply and a free wastewater treatment service for respective amount of sewage. Hence, if we consider an average Irish family of 4 people and its average water consumption of about 190 m3 per year, they will have to pay only for 84 m3 of water supplied and appropriate volume of wastewater collected. These subsidies save more than 50% of the total amount to be paid as water service fees. (DECLG, 2014)

In case a household does not have a meter, then the water fees are based on assessments. The amount of water charges will be comparable to those in metered households. (DECLG, 2014)

6 Summary

Table 1 summarizes the key figures of water assets of Finland, Norway, Scotland, Northern Ireland and Ireland.

Finland and Northern Ireland have the largest amount of surface water resources. All five countries have abundant water supply and safe drinking water resources. Despite this fact, measures are still taken to preserve the natural water reserves and prevent their pollution. This is done in accordance with the EU Water Framework Directive that applies to all of the considered countries.

In terms of water resource utilization, Norway, has a favorable mountain conditions and an abundance of rivers, and is a leader in hydropower generation. Hydropower is one of the key water expertise fields of Norway. There is also substantial small-scale hydropower potential in Scotland that is increasingly utilized.

Groundwater reserves for drinking water supply are utilized mostly in Finland and Ireland. In the other three countries less than 10% of water supply originates from ground water sources. One of the main reasons, why Finland relies more on groundwater reserves rather than on surface waters, is its good availability and high drinking water quality, as well as water security issues.

In all countries the water companies are mostly run by the public sector. The biggest difference between these public organizations in different countries is their right to own land and water resources. Scottish Water, as the main public water company, owns significant amounts of land in rural catchment estates. Northern Ireland Water in turn, can own water resources in the form of impounding reservoirs. In Finland and Norway, water companies do not own land or water resources. In some other countries, for instance in England, water services are organized by private water companies, whereas in Wales, it is done by a not-for-profit water company (NIW, 2013b).

The lowest percentage of public water supply and wastewater treatment is currently in Ireland (80% and 70%). This was one of the reasons that led to radical changes in the whole Irish water sector and the creation of a single public water company – Irish Water. It is expected that this measure will help to solve many problems in the Irish water sector. Scotland and Northern Ireland are in the best position within the water industry, where the coverage of water services is higher than 96%.

The most water intensive industries are pulp and paper industry as well as food and drinks production. The first mentioned is common in Finland and Norway, whereas the second is important especially in Scotland, Northern Ireland and Ireland.

In terms of expertise within the water sector, there is plenty of know how in certain areas in each of the country. Finland is expert on water-saving; use of ICT in measuring, control and monitoring; integrated water resources management; water-related construction and services; natural water protection; and water research. Norway is a world leader hydropower expert, as proven by the high share of hydropower (90%) of the total renewable energy generation (IEA, 2011). In Scotland, expertise lies within efficient and effective procurement, operation and maintenance of the public water services providers. Northern Ireland is an expert in renewables promotion in the public and private sector. Finally, Ireland is experienced in water and wastewa-

Table 1. Summary of water assets of Finland, Norway, Scotland, Northern Ireland and Ireland.

	Finland	Norway	Scotland	Northern Ireland	Ireland
Territory	338 145 sq km	323 802 sq km	77 925 sq km	14 135 sq km	70 273 sq km
Water coverage	10%	5%	2%	7%	2%
Number of rivers	650	4 000	10 000	3 200	80
Number of lakes	188 000	455 000	30 000	1 700	4 467
Ground water use	65%	10%	7%	0,05%	18% (incl. 8% from springs)
Surface water use	35%	90%	93%	99,95% (incl. 44% from reservoirs)	82%
Public water supply	90%	90%	98%	99,9%	80%
Public wastewater treatment coverage	81%	84%	98%	96,5%	70%
Water expertise	Water-saving; ICT; integrated water resources management; water construction and services; natural water protection; water research	Hydropower: from planning and engineering to equipment installation and management	Efficient and effective procurement, operation and maintenance of the public water services providers	Renewable energy promotion in the public and private sector: energy efficiency, technologies	Water and wastewater management on local authorities' level
Example of water intensive industry	Pulp and paper production	Metallurgy chemical, pulp and paper, food industry	Food and drink industry, agriculture	Food and drink industry	Food and drink industry; chemical industry; pharmaceutics; IT industry
Ownership	Public	Public	Public (Scottish Water owns infrastructure and land)	Public (Northern Ireland Water owns infrastructure and impounding reservoirs)	Public (Irish Water owns infrastructure)

Sources: Finnish Water Forum; Northern Ireland Assembly; Northern Ireland Water, Northern Ireland Environment Agency; Scottish Government; Scottish Natural Heritage; Scottish Water; Statistics Norway; Berge, et al., 2013; Bord Gais, 2013; Christie, 2011;; CIA, 2014a, b, c; DJEI, 2013; Dochartaigh, et al., 2011; Dublin City Council, 2009; EB, 2014a, b; ECLG, 2012; Gonzalez, et al., 2011; McGuigan, G, 2010; Mikkonen, 2013; NMPE, 2013; OEE, 2011; Rippey, et al., 2001; Stene-Larsen, 2012; Thomson, 2013; Utility Regulator, 2013.

ter management on local authorities' level.

Customer fees, summarized in Table 2, are a common feature of the water sector in all the countries. However, there are no two identical systems of customer fees.

The fees differ also depending on if there is a water meter installed in the household or not. Finland is the only country of these five ones, where fees are paid on monthly level. Depending on the availability of water meters, the fees are either metered consumption fees or non-metered fixed fees. There are some additional service fees, such as for water meter installation, pipelines renovation, etc. A water metered household in Norway can pay either a consumption fee or both a fixed fee for a fixed amount of water and a variable fee when the limit is exceeded. From non-water metered households, an assessed fee is collected. Finland and Norway water fee includes both water services: water supply and wastewater treatment. In Scotland, Northern Ireland and Ireland, there are two separate water fees: one for drinking water supply and the other one for wastewater treatment. In Scottish properties with water meters, there is a fixed and a volumetric fee applicable for both water supply and wastewater treatment. In households not equipped with a water meters, there is a variable fee for water services in accordance with a Council Tax Band. Among other water fees, there may be fees for property and roads drainage. Northern Ireland is an exceptional country in that sense that there are almost no fees for domestic water users. Only non-domestic consumers are obliged to pay fees. Depending on diameter of water supply pipe, there is a standing fee for water supply and wastewater treatment. This fee is paid no matter if there is a water meter installed in property or not. In metered properties, there is a variable fee for both of the services. In properties not equipped with water meters, the variable fee is also collected but based on property evaluation. A septic tank de-sludge fee can also be charged as one of other service fees. In Ireland, there were also no fees for domestic users before. However, due to the ongoing transition of the system domestic fees are going to be introduced starting from 2015. Water metered households will pay a water supply fee and a wastewater fee. Households without water meters will be obliged to pay assessed fees for both water services. Despite all these differences, there are also similar features. One of them is the connection fee that a non-domestic consumer has to pay in order to join the public water network.

Finally, it is to be reiterated that all five countries are exceptional in terms of richness of water assets, both in terms of water supply, as well as with quality of public services, water services coverage, water expertise and also renewable energy potential. This makes these countries ideal for demonstrating efficient water asset utilization.

Table 2. Customer fees in Finland, Norway, Scotland, Northern Ireland and Ireland.

<table>
<tr><th></th><th colspan="4">Customer fees</th></tr>
<tr><th></th><th>Water metered property</th><th>Non-metered property</th><th>Other fees</th><th>Average domestic fee for metered household</th></tr>
<tr><td>Finland</td><td>➢ Monthly metered consumption fee</td><td>➢ Monthly fixed fee</td><td>➢ Connection fee;
➢ Other service fee</td><td>579 euro/year</td></tr>
<tr><td>Norway</td><td>➢ Annual metered consumption fee;
➢ Combination of annual fixed and variable fee</td><td>➢ Assessed fee</td><td>➢ Connection fee</td><td>416 euro/year</td></tr>
<tr><td>Scotland</td><td>➢ Annual fixed and volumetric water supply fee;
➢ Annual fixed and volumetric wastewater treatment fee</td><td>➢ Variable water supply fee (Council Tax Band based);
➢ Variable wastewater treatment fee (Council Tax Band based)</td><td>➢ Connection fee;
➢ Property drainage fee;
➢ Roads drainage fee</td><td>415 euro/year</td></tr>
<tr><td rowspan="2">Northern Ireland</td><td>➢ Annual variable water supply fee;
➢ Annual variable wastewater fee;</td><td>➢ Annual variable water supply fee (based on property valuation);
➢ Annual variable wastewater fee (based on property valuation)
<u>Domestic customers</u>:
➢ No meters, no fees;
➢ But the fee for septic tank de-sludge (if over 1 time per year)</td><td rowspan="2">➢ Connection fee;
➢ Septic tank de-sludge</td><td rowspan="2">No fee</td></tr>
<tr><td colspan="2"><u>Non-domestic customers</u>:
➢ Annual standing charge for water supply (depends on diameter of supply pipe);
➢ Annual standing charge for wastewater (depends on diameter of supply pipe)</td></tr>
<tr><td>Ireland</td><td>➢ Annual water supply fee;
➢ Annual wastewater fee</td><td>➢ Assessed water supply fee;
➢ Assessed wastewater fee</td><td>➢ Connection fee</td><td>296 euro/year</td></tr>
</table>

Sources: Berge, et al., 2013; DECLG, 2014; FWF, 2012a; HSY, 2011; Mikkonen, 2013; Mohajeri, et al., 2003; Northern Ireland Water; Official Statistics of Finland, 2010; Scottish Water, Statistics Norway

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wares
water asset renewable energy solutions

WARES (Water Asset Renewable Energy Solutions) is a 2-year Northern Periphery Programme strategic project which explores the opportunities to generate renewable energy at water utility assets. The focus is on sites with previously unused, hidden potential. The outcomes of the project will be used to propose a scheme of policy refinements for each region. The project is implemented during 2012-2014.

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