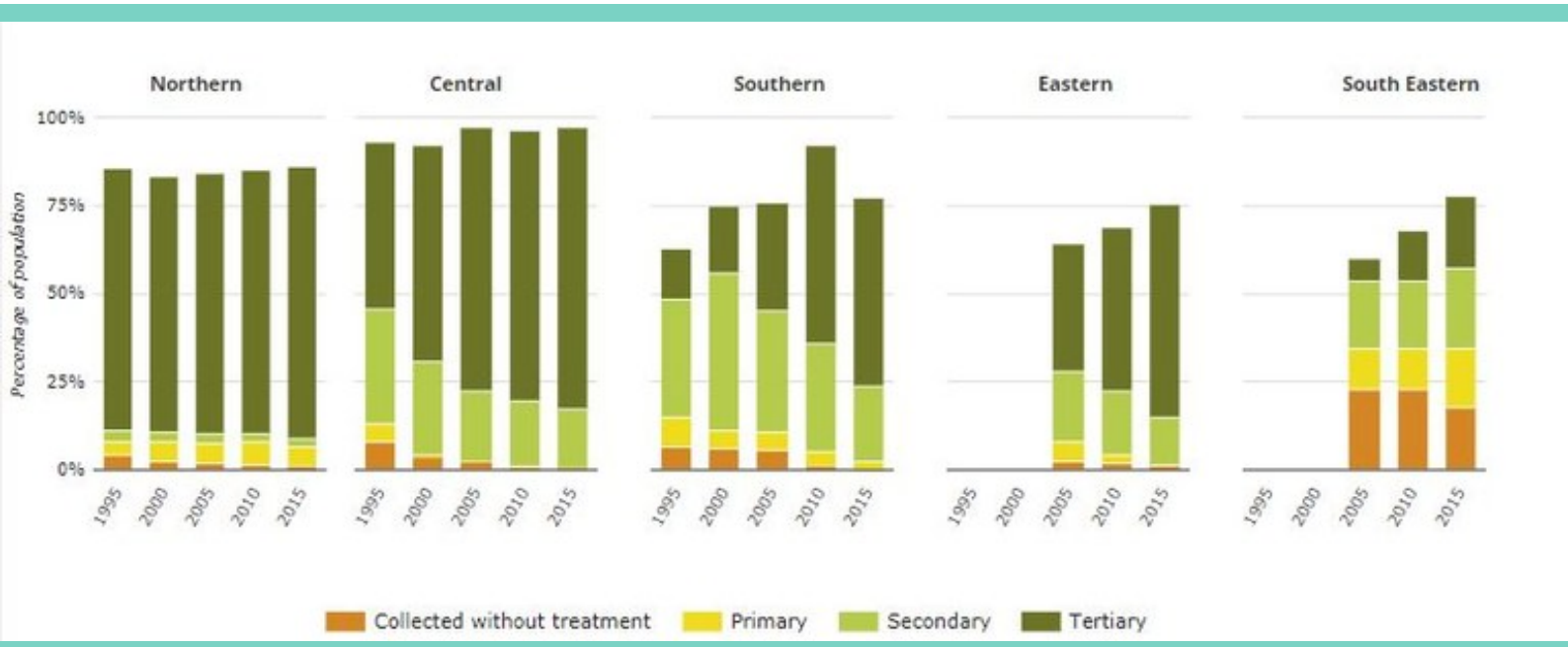
Urban waste water treatment



European Environment Agency

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Urban waste water treatment

Key messages

The treatment of urban waste water is fundamental to ensuring public health and environmental protection. Urban waste water treatment in all parts of Europe has improved over recent decades.

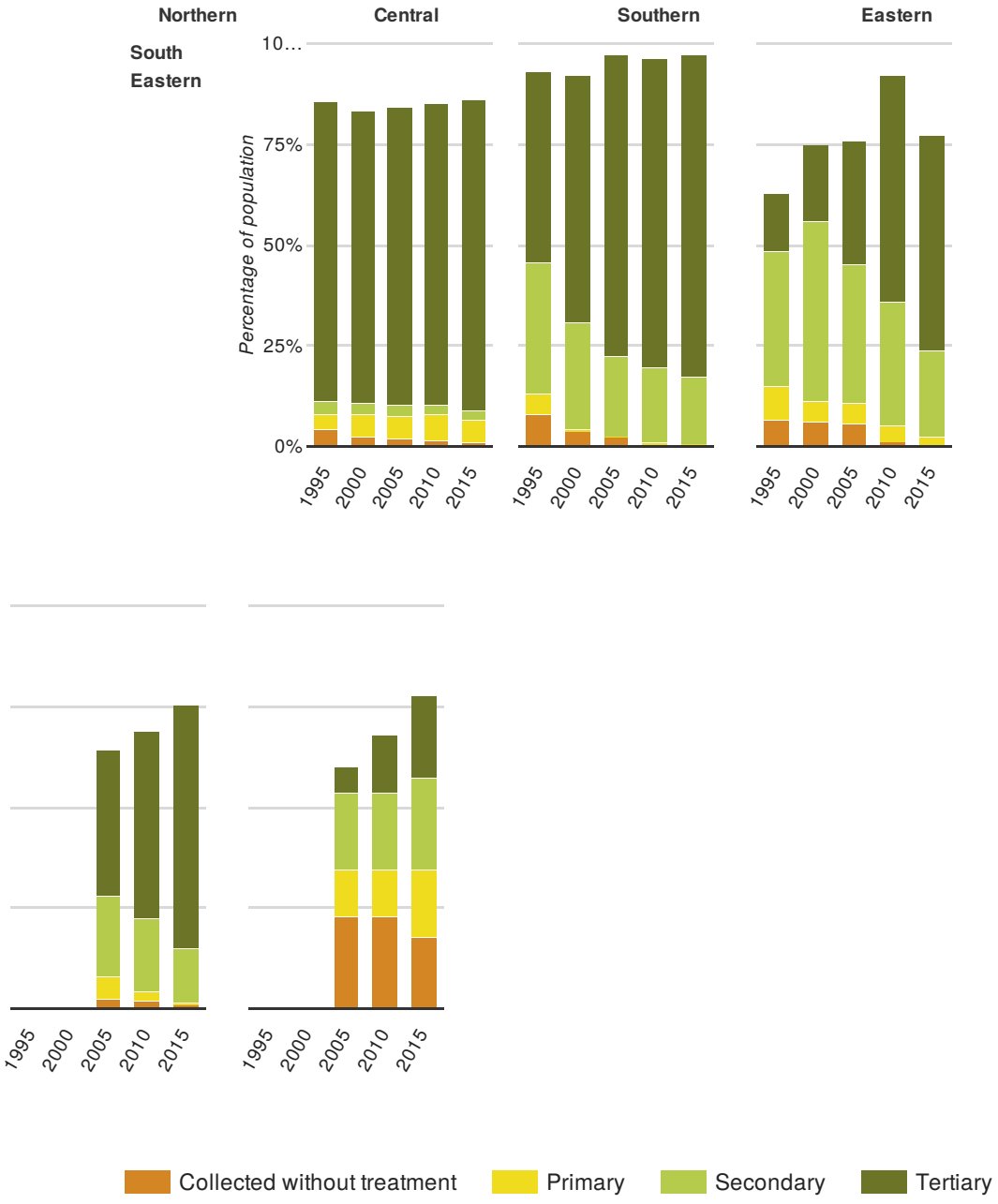
The proportion of the population connected to waste water treatment plants in northern countries has been above 80 % since 1995, with more than 70 % of urban waste water receiving tertiary treatment.

In central European countries, connection rates have increased since 1995 and are now at 97 %, with about 75 % receiving tertiary treatment.

The proportion of the population connected to urban waste water treatment in southern, south-eastern and eastern Europe is generally lower than in other parts of Europe, but has increased over the last 10 years with levels now at about 70 %.

How effective are policies aimed at improving urban waste water treatment at reducing discharges of nutrients and organic matter into surface waters?

Changes in urban waste water treatment in Europe



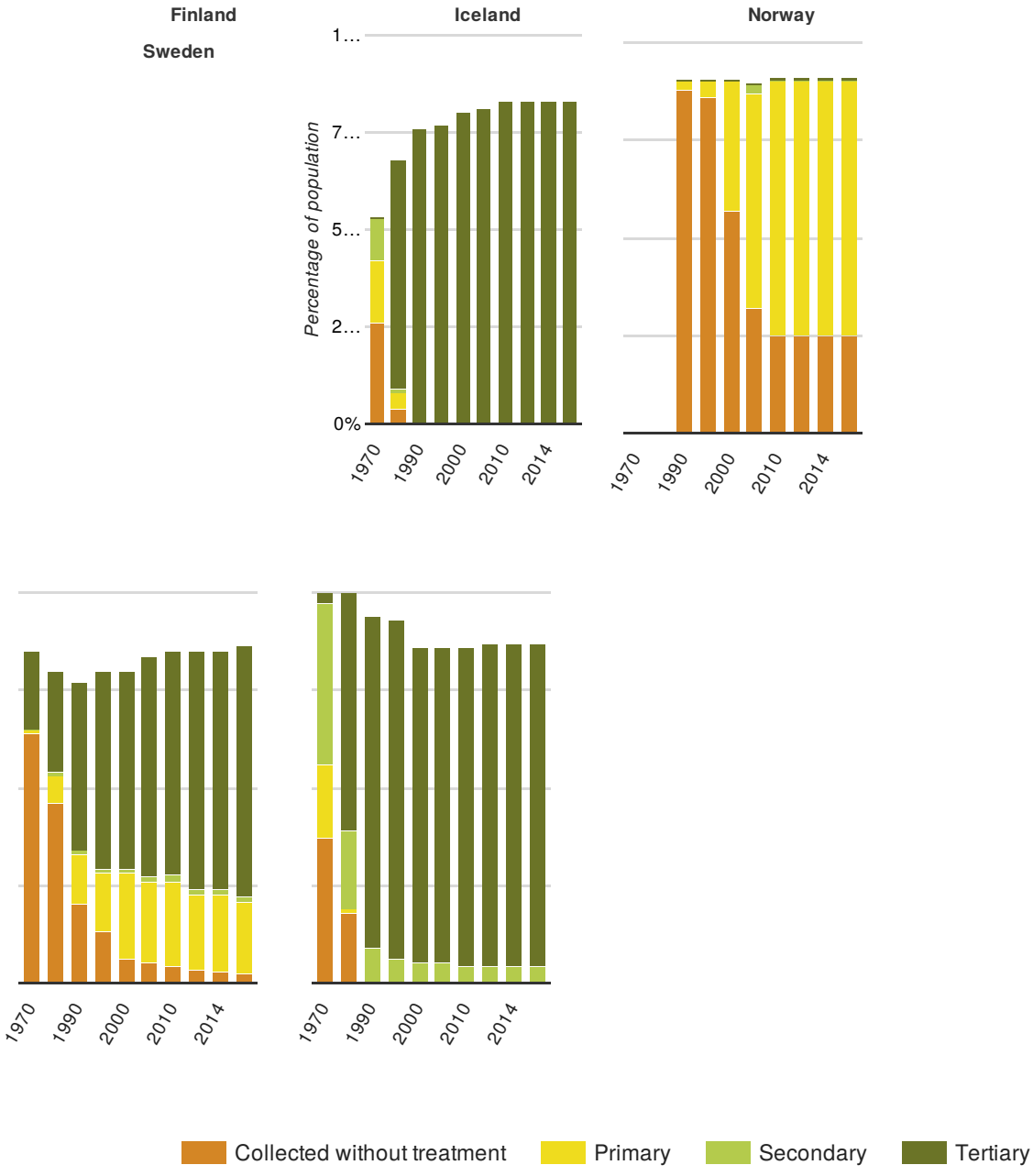
Note:
Northern Europe: Norway, Sweden, Finland and Iceland.
Central Europe: Austria, Belgium, Denmark, Netherlands, Germany, Switzerland, Luxembourg and United Kingdom.
Southern Europe: Greece, Italy, Malta and Spain.
Eastern Europe: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Slovenia.
South-eastern Europe: Bulgaria, Romania and Turkey.

Initially, for the treatment of waste water, sewage collection systems must be installed (orange bars). Waste water can then be subject to primary treatment (yellow bars), such as settling, followed by secondary treatment (green bars) to reduce the amount of dissolved and suspended organic material. Secondary treatments include those using biological methods. More stringent 'tertiary' treatment (dark green bars) can then be applied to remove mainly nutrients.

Data sources:

- Resident population connected to wastewater collection and treatment systems reported to the "OECD/Eurostat Joint Questionnaire - Inland Waters-2012" provided by **Statistical Office of the European Union (Eurostat)**

Changes in urban waste water treatment in northern European countries



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Data sources:

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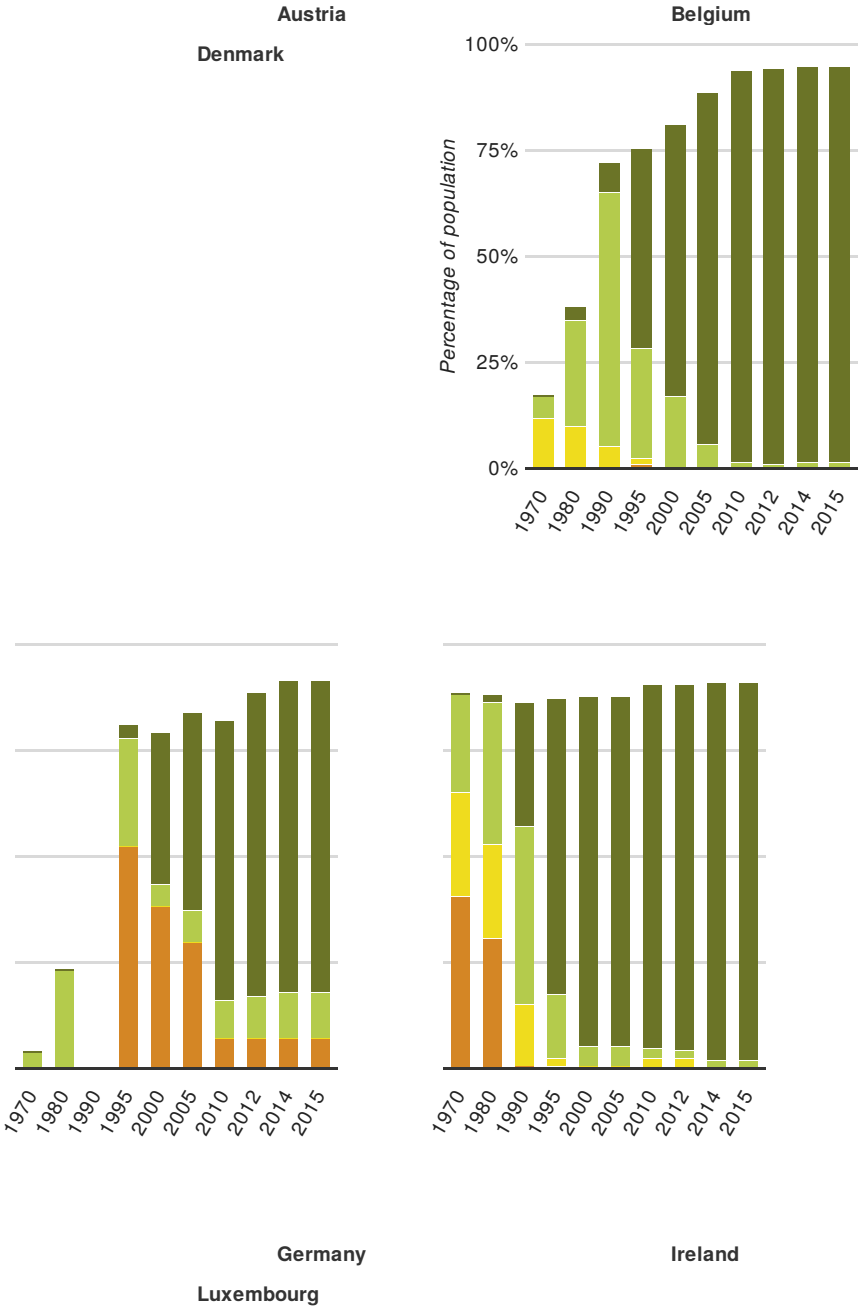
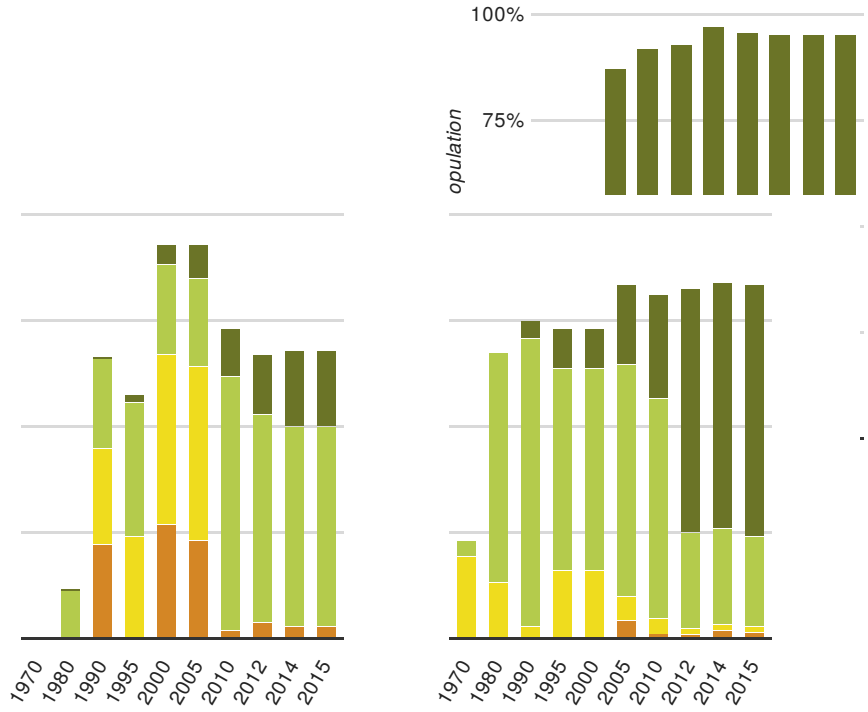
Changes in urban waste water treatment in central Europe

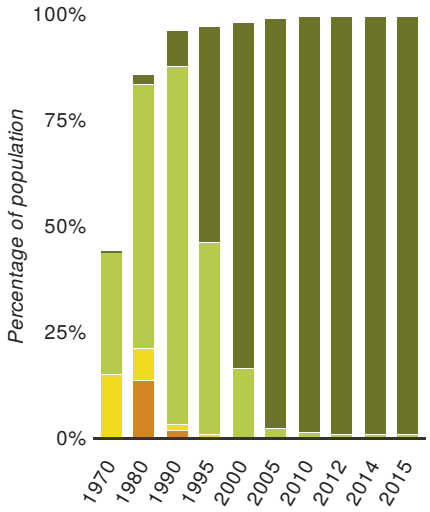


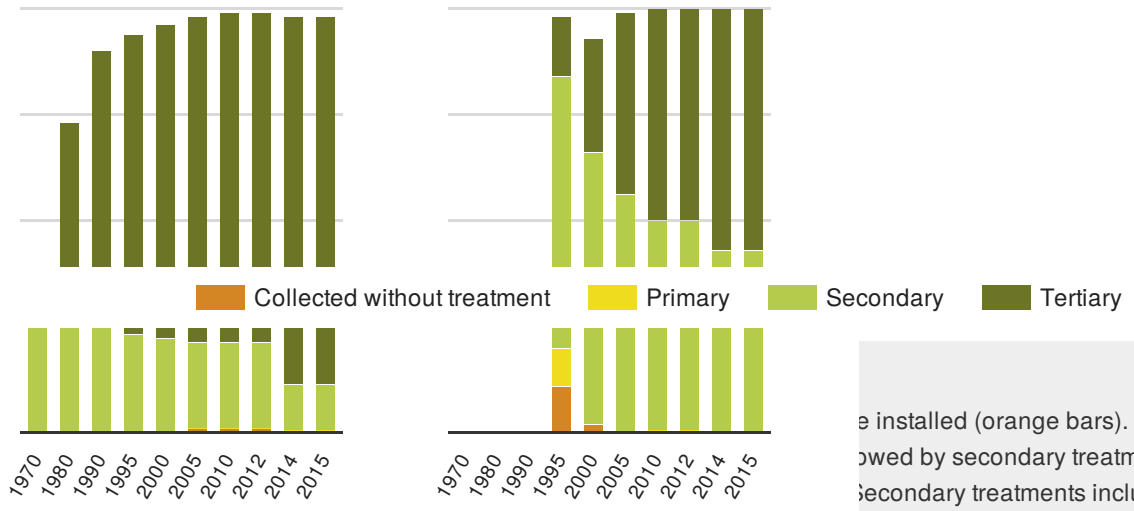


Netherlands

United Kingdom

Switzerland





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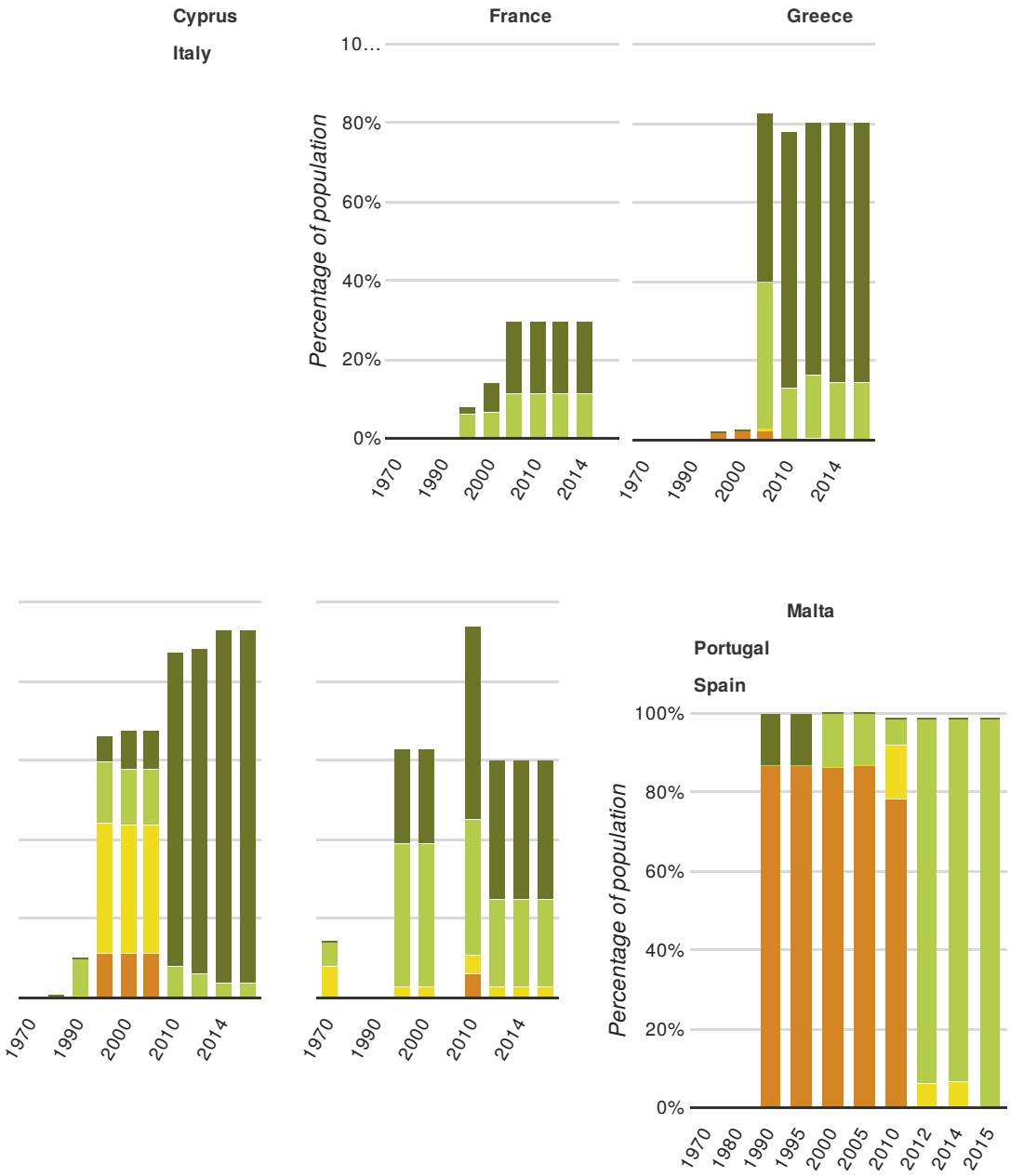
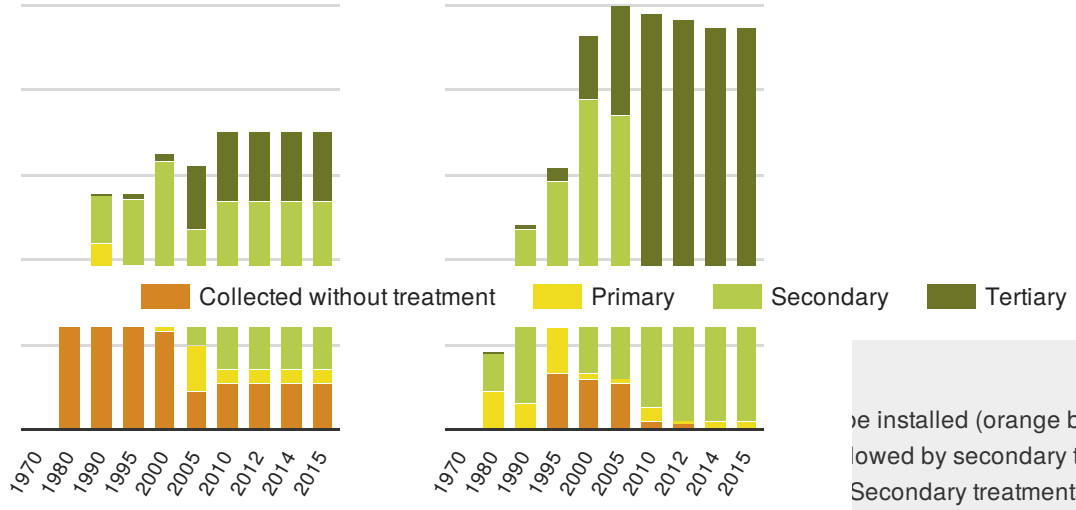
Secondary treatments include those
rs) can then be applied to remove

Data sources:

- Population connected to urban wastewater collecting and treatment systems, by treatment level (ten00020) provided by **Statistical Office of the European Union (Eurostat)**

Changes in urban waste water treatment in southern Europe





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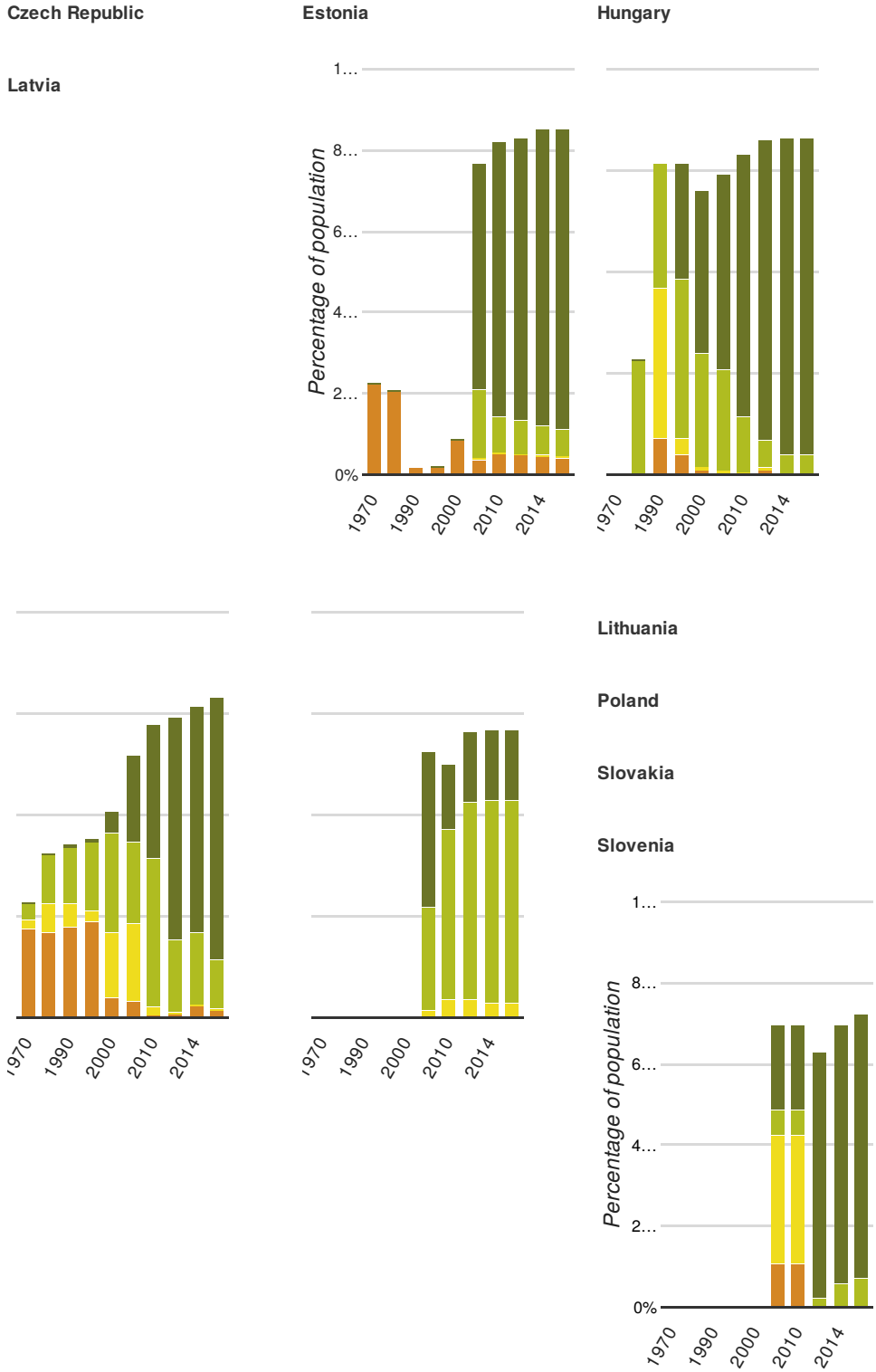
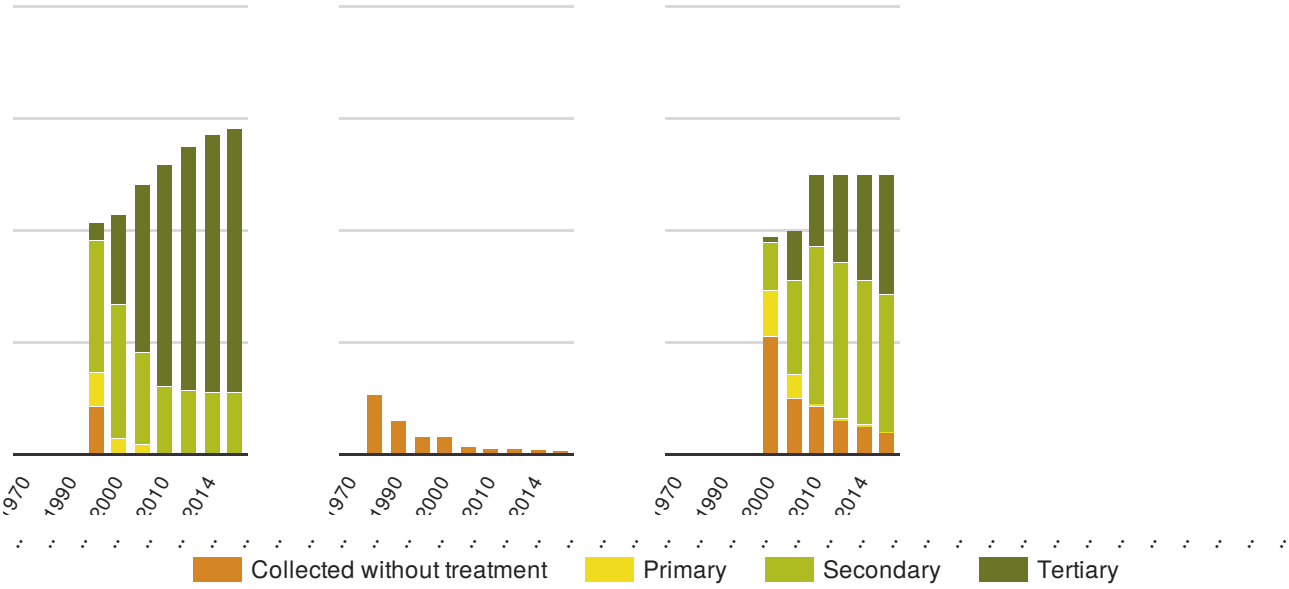
Data sources:

- Population connected to urban wastewater collecting and treatment systems, by treatment level (ten00020) provided by **Statistical Office of the European Union (Eurostat)**

Changes in urban waste water treatment in eastern Europe





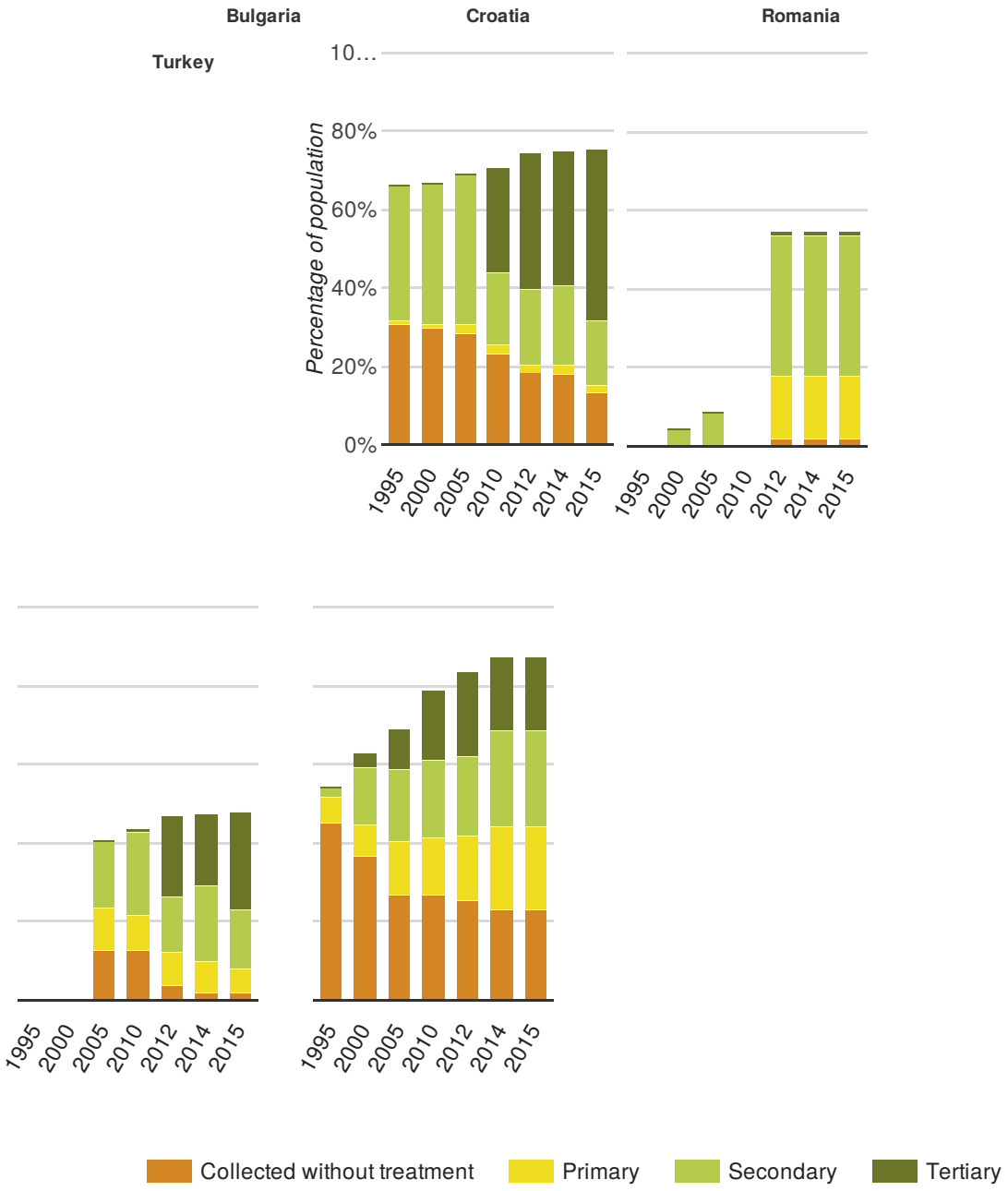
Note:
Slovakia reported that waste water was treated, but did not clarify whether treatment was primary, secondary or tertiary.

Initially, for the treatment of waste water, sewage collection systems must be installed (orange bars). Waste water can then be subject to primary treatment (yellow bars), such as settling, followed by secondary treatment (green bars) to reduce the amount of dissolved and suspended organic material. Secondary treatments include those using biological methods. More stringent 'tertiary' treatment (dark green bars) can then be applied to remove mainly nutrients.

Data sources:

- Population connected to urban wastewater collecting and treatment systems, by treatment level (ten00020) provided by **Statistical Office of the European Union (Eurostat)**

Changes in urban waste water treatment in south-eastern Europe



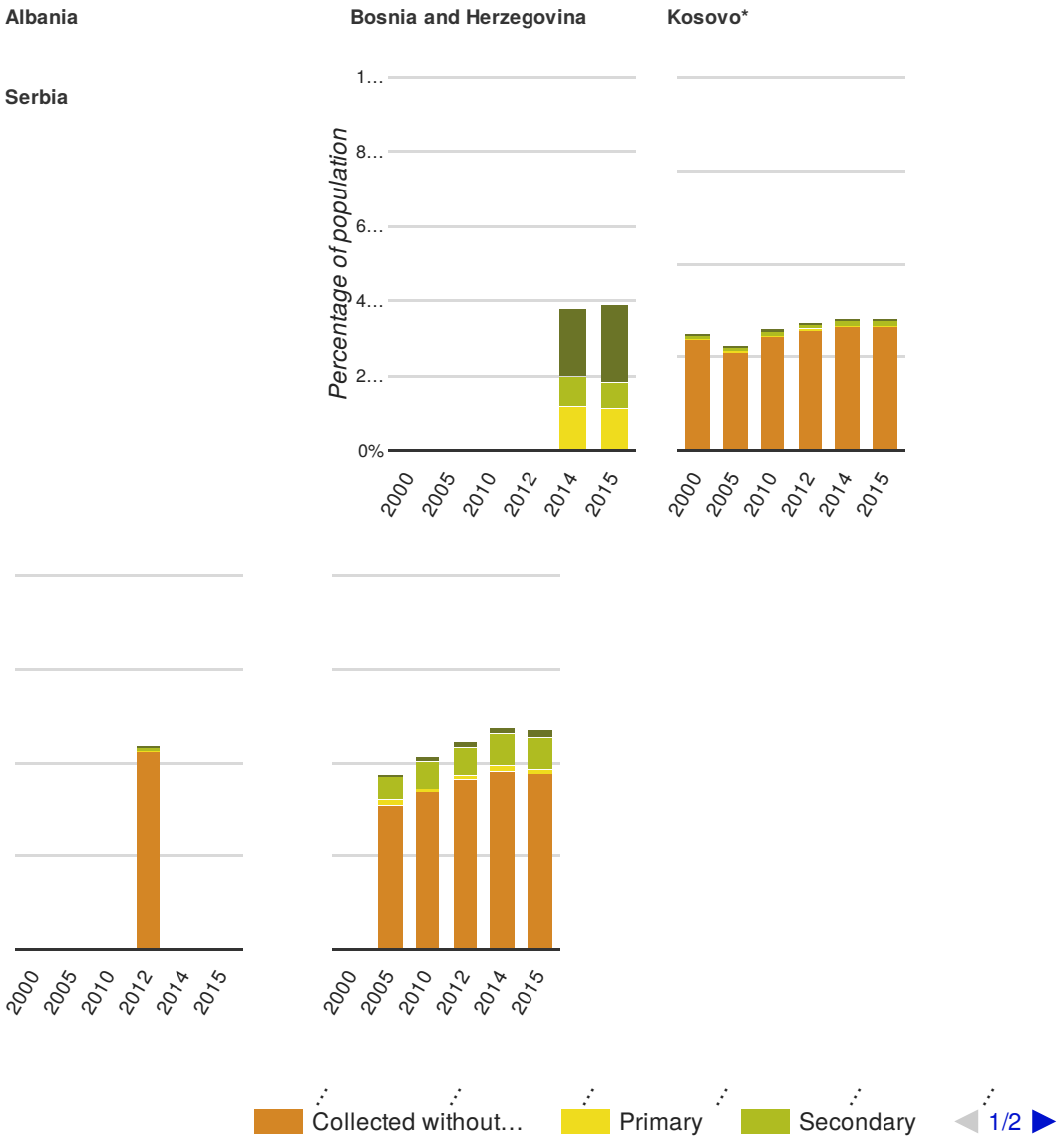
Note:
Initially, for the treatment of waste water, sewage collection systems must be installed (orange bars). Waste water can then be subject to primary treatment (yellow bars), such as settling, followed by secondary treatment (green bars) to reduce the amount of dissolved and suspended organic material. Secondary treatments include those using biological methods. More stringent 'tertiary' treatment (dark green bars) can then be applied to remove mainly nutrients.

Data sources:

- Population connected to urban wastewater collecting and treatment systems, by treatment level

(ten00020) provided by **Statistical Office of the European Union (Eurostat)**

Changes in urban waste water treatment in the Western Balkans



Note:
Kosovo* (Under United Nations Security Council Resolution 1244/99)

Initially, for the treatment of waste water, sewage collection systems must be installed (orange bars). Waste water can then be subject to primary treatment (yellow bars), such as settling, followed by secondary treatment (green bars) to reduce the amount of dissolved and suspended organic material. Secondary treatments include those using biological methods. More stringent 'tertiary' treatment (dark green bars) can then be applied to remove mainly nutrients.

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Data sources:

- Population connected to urban wastewater collecting and treatment systems, by treatment level (ten00020) provided by **Statistical Office of the European Union (Eurostat)**

The treatment of urban waste water from our homes and workplaces is fundamental to ensuring public health and environmental quality. The main objective of the Urban Waste Water Treatment (UWWT) Directive (91/271/EEC), and equivalent national legislation for non-EU countries, is to protect surface waters from the adverse effects of waste water discharges, such as organic pollution, the associated development of bacteria and fungi, and oxygen depletion, which degrade aquatic life. This is achieved through the collection and treatment of waste water in settlements and areas of economic activity (agglomerations) with a population equivalent (p.e.) of more than 2 000. In most cases, the UWWT Directive stipulates that waste water must be subject to biological treatment (secondary treatment), but in catchments with particularly sensitive waters, such as those suffering from eutrophication, more stringent tertiary waste water treatment may be required to substantially reduce nitrogen and phosphorus pollution.

The installation of waste water treatment facilities first requires the set-up of a sewage collection system and then the provision of facilities to treat the collected waste water. Where there is a low proportion of a population connected to waste water treatment facilities, it may be due to a lack of financial resources (or priority) for providing the sanitation services or to a high proportion of the population living outside agglomerations. In the latter case, where people live in scattered communities, individual sanitation systems may be the most feasible solution. Such systems may provide treatment efficiencies that are similar to those of larger urban waste water treatment plants.

The indicators used in this assessment to measure discharged loads of organic matter and nutrients from urban waste water treatment plants to European surface waters are:

the percentage of the national population connected to waste water treatment facilities;

the percentage of the national population connected to tertiary waste water treatment facilities.

Compared with earlier versions of this indicator, some changes in historical data have been included owing to corrections made by countries in the Eurostat data set.

The percentage of the national population connected to urban waste water treatment facilities

In central European countries, there was a high overall urban waste water treatment connection rate, of 97 % (Austria, Belgium, Denmark, Germany, Luxembourg, Netherlands, Switzerland and United Kingdom) in 2015 (Figure 1). The rate is slightly lower in northern countries, at 86 % (Finland, Iceland, Norway and Sweden).

The connection rates in eastern, southern and south-eastern countries are similar:

- 75 % of the population in eastern European countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Slovenia);
- 77 % of the population in southern European countries (Greece, Italy, Malta and

Spain);

- 78 % of the population in south-eastern countries (Bulgaria, Romania and Turkey).

Notes:

1. These statistics are influenced by countries with high numbers of inhabitants; for example, Sweden and Poland account for about half of the total population of the northern and eastern regions, respectively, while Turkey represents about 70 % of the total population of the south-eastern region.

2. There are some countries for which data are reported in Figures 2-8 that are not represented in Figure 1, owing to there being gaps of more than 9 years in the reported data.

2. The percentage of the national population connected to tertiary urban waste water treatment facilities

More than 77 % of the population of northern and central Europe is connected to an urban waste water treatment plant that implements tertiary treatment, preventing significant amounts of nutrients and organic matter from reaching surface waters. Waste water generated by more than half of the population in southern and by over 60 % of the population in eastern Europe receives tertiary treatment. In central and southern countries, this percentage increased between 1995 and 2015 (from 47 % to 80 % in central Europe, and from 15 % to 53 % in southern Europe), while for eastern countries the percentage increased from 36 % to 61% between 2005 and 2015. In south-eastern Europe, the percentage of the population connected to treatment plants with tertiary treatment is lower, at about 20 % (an increase from 7 % in 2005), with 23 % of the population in this region being connected to secondary treatment.

The timetable for the compliance with the UWWT Directive varies. For the EU-15 (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the UK), the latest date to fully comply with the directive was 31 December 2005. For the newer Member States (i.e. the EU-13) in central and eastern Europe and in the Mediterranean, staged transition periods have been set within the Accession Treaties. In principle, these transition periods did not extend beyond 2015. However, in Romania, smaller agglomerations (with less than 10 000 p.e.) should comply with the directive by the end of 2018. Croatia, as the newest EU Member State, has different transition periods, from 2018 to 2023.

Specific regional assessment

Northern Europe (Figure 2): the connection rate is between about 80 and 90 % in Finland, Iceland, Norway and Sweden. In the cases of Finland and Sweden, treatment is almost entirely at the tertiary level. In Norway, about 20 % of connected urban waste water receives primary treatment only, while in Iceland the majority of the collected urban waste water either receives primary treatment only or is not treated. The trends in the rate of the national population connected to urban waste water treatment plants appear stable, with slight increases in the proportion receiving tertiary treatment in Norway being the main change in recent years.

Central Europe (Figure 3): countries in central Europe have some of the highest overall connection rates in Europe — more than 90 % of the population connected in all countries other than Ireland. The proportion of the population connected to tertiary treatment ranges from 80 to 99 % in Austria, Denmark, Germany, the Netherlands and Switzerland. Tertiary treatment connection rates among this group of countries were lowest for Ireland (18 % of the population connected to tertiary treatment).

Southern Europe (Figure 4): the overall percentage of the population connected to urban waste water treatment ranges from 30 to 99 %. The rate is above 90 % in Greece, Malta and Spain. Tertiary treatment is most prevalent in Greece (89 %), followed by France and Spain, with 60-70 % of the urban waste water receiving this high level of treatment. There was a significant upgrade in treatment facilities in these countries between 2005 and 2010. In Cyprus, Malta and Portugal, the percentage of the population connected to tertiary treatment is below 20 %. Moreover, Portugal reported that over 10 % of the population is connected to collecting systems without treatment.

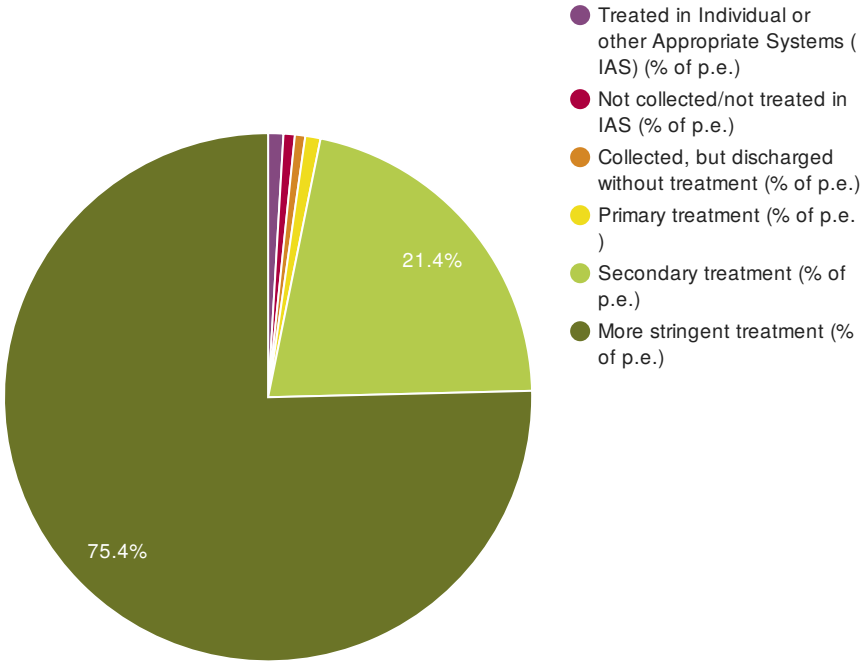
Eastern Europe (Figure 5): the overall proportion of the population connected to urban waste water treatment ranged from 70 to 85 % (with the exception of Slovakia) in 2015. Over 70 % of the population in the Czech Republic and Estonia is connected to tertiary treatment, while Hungary, Lithuania and Poland reported a tertiary treatment connection rate of 59-65 %. In Latvia, the rate of connection to tertiary treatment is lower, at about 17 %, and in Slovenia, about 27 % of the population is connected to tertiary treatment. Slovakia reported that 65% of the population was connected to urban waste water collecting and treatment systems in 2015.

South-eastern Europe (Figure 6): the percentage of the population connected to urban waste water treatment plants ranges from 48 to 87 %. In Bulgaria and Romania, about half of the treatment is tertiary, while in Croatia and Turkey primary or secondary treatment prevails. Just under a quarter of the population of Turkey is connected to collecting systems without treatment, but there has been steady progress in treatment availability and the level of treatment since 1995. While there was a significant increase in treatment availability in Croatia between 2005 and 2012, there has been limited progress in connecting populations to wastewater treatment in Bulgaria and Romania since 2005.

Western Balkans (Figure 7): where it is collected in the Western Balkans, urban waste water is mainly collected without treatment. The overall percentage of the population connected to urban waste water treatment plants ranges from 35 to 59 %, although most of this urban waste water is not treated. In Albania, all the waste water collected receives some level of treatment, with about half receiving tertiary treatment.

What levels of urban waste water treatment are applied in 'big cities' in the EU?

Type of waste water treatment in 'big cities' in the EU



Note:
This figure shows the type of waste water treatment in 'big cities' (agglomerations of more than 150 000 p.e.) in the EU in 2014, expressed as a percentage of the total load of waste water generated.
The graph reflects the percentage of the generated load of large cities for which a specific treatment installation is in place. More stringent treatment is presented as tertiary treatment (representing nutrient removal) and other more stringent treatment (e.g. UV disinfection, filtration).
Individual or other appropriate systems (IAS), such as septic tanks, are used where it is not justified to establish a collecting system, either because it would produce no environmental benefit or because it would involve excessive cost.

Countries included in this assessment are Austria, Belgium, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Greece, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Portugal, Romania, Sweden, Slovenia, Slovakia and the United Kingdom.

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Data sources:

- Waterbase - UWWTD: Urban Waste Water Treatment Directive – reported data provided by **European Environment Agency (EEA)**

Figure 8 summarises the type of treatment applied in the urban waste water treatment plants of large cities in 2013 or 2014. Of the total generated load of larger cities, 75.4 % is treated to remove nitrogen and/or phosphorus. A considerable proportion, namely 21.4 % of the total load, receives secondary treatment, while 0.9 % of the total load of all large cities receives only primary treatment.

Indicator specification and metadata

Indicator definition

The indicator on urban waste water treatment, CSI 024, collects data on the percentage of the population connected to sewage collection systems, as well as on the prevalence of primary, secondary and tertiary urban waste water treatment plants. The amount of urban waste water treated is expressed as population equivalents (p.e.). The indicator illustrates:

- the development of urban waste water collection and treatment in Europe since the 1970s;
- the development of more stringent urban waste water treatment practices;
- the level of urban waste water treatment in 'big cities' (agglomerations of > 150 000 p.e.) in the EU.

Units

The percentages of the population connected to primary, secondary and tertiary urban waste water treatment facilities.

Rationale

Justification for indicator selection

Waste water from households and industry represents a significant pressure on the aquatic environment because of the loads of organic matter and nutrients, as well as hazardous substances. With high levels of the population in EEA member countries living in urban agglomerations, a significant fraction of urban waste water is collected by sewers connected to public waste water treatment plants. The level of treatment before discharge and the sensitivity of the receiving waters determine the scale of the impacts on aquatic ecosystems. The proportion of the population connected to urban waste water treatment plants and the types of treatments used are seen as proxy indicators of the level of purification and the potential for improvement of the water environment.

Primary (mechanical) treatment removes some of the suspended solids, while secondary (biological) treatment uses aerobic or anaerobic microorganisms to decompose most of the organic matter and retain some of the nutrients (around 20-30 %). Tertiary (advanced) treatment removes organic matter even more efficiently. It generally includes phosphorus retention and, in some cases, nitrogen removal. Primary treatment alone removes no ammonium, whereas secondary (biological) treatment removes around 75 % of ammonium.

This indicator tracks the success of policies aimed at reducing pollution from waste water by describing the trends in the percentage of the population connected to urban waste water treatment plants with different levels of purification.

The EEA intends to review this indicator ahead of next publication, to improve the information we provide on urban waste water treatment.

Scientific references

- No rationale references available

Policy context and targets

Context description

The main objective of the UWWT Directive (91/271/EEC), and equivalent national legislation for non-EU countries, is to protect surface waters from the adverse effects of waste water discharges. The UWWT Directive prescribes the level of treatment required before discharge to surface waters. It requires Member States to provide all agglomerations of more than 2 000 p.e. with collecting systems. Primary (mechanical) and secondary (i.e. biological) treatments must be provided for all agglomerations of more than 2 000 p.e. that discharge into fresh waters. Special requirements, with intermediate deadlines depending on the sensitivity of the receiving waters, are placed on agglomerations of more than 10 000 p.e., with various size classes of agglomerations. The performance of the treatment is assessed using five different determinands (biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), total nitrogen (N_{tot}) and total phosphorus (P_{tot})).

For agglomerations smaller than those described above and equipped with a collecting system, the treatment must be 'appropriate', meaning that the discharge must allow the receiving waters to meet the relevant quality standards.

The UWWT Directive, adopted in 1991, is also a basic measure under the Water Framework Directive (WFD). The WFD requires the estimation and identification of significant point- and diffuse-source pollution, in particular by the substances listed in Annex VIII, from urban, industrial, agricultural and other installations and activities, based, inter alia, on information gathered, for instance, under Articles 15 and 17 of the UWWT Directive. Based on the substances listed in Annex VIII WFD, the following are important for this indicator:

- substances that have an unfavourable influence on oxygen balance (and can be measured using parameters such as BOD, COD, etc.);
- materials in suspension;
- substances that contribute to eutrophication (in particular nitrates and phosphates).

Member States should thus take the necessary steps to collect these data. Reducing pollutants stemming from waste water is one of the key challenges of reaching good ecological and good chemical status of surface waters, as required by the WFD.

Targets

The UWWT Directive (91/271/EEC) aims to protect the environment from the adverse effects of urban waste water discharges. It prescribes the level of treatment required before discharge and should have been fully implemented in the EU-15 countries by 2005. For the newer Member States

(i.e. the EU-13), staged transition periods were set within the Accession Treaties which, in principle, did not extend beyond 2015. However, in Romania, smaller agglomerations (with less than 10 000 p.e.) should comply with the directive by the end of 2018, and Croatia has different transition periods, from 2018 to 2023.

Under the directive, EU-15 Member States were required to provide all agglomerations of more than 2 000 p.e. with collecting systems and all waste waters collected had to be provided with appropriate treatment by 2005. Secondary treatment (i.e. biological treatment) must be provided for all agglomerations of more than 2 000 p.e. that discharge into fresh waters, while more advanced treatment (tertiary treatment) is required for discharges into sensitive areas.

The achievements resulting from the UWWT Directive should be seen as an integral part of achieving good status for all waters under the WFD.

Related policy documents

- Commission implementation reports of the Urban Waste Water Treatment Directive
provided by Directorate-General for Environment
- Council Directive (91/271/EEC) of 21 May 1991
Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC)

Methodology

Methodology for indicator calculation

The indicator is based on data from Eurostat, which are then aggregated into groups of countries. Percentages connected to each treatment type, weighted by total population in each country, were obtained from Eurostat tables. Compared with previous versions of the indicator, the time steps have been made consistent and the number of countries reported in each region in Figure 1 has been kept constant across the period.

A p.e. of 1 is equivalent to an organic biodegradable load having a 5-day BOD of 60 g per day.

'Big cities' is a term used in the UWWT Directive to identify cities of at least 150 000 p.e. or agglomerations responsible for large waste water discharges.

Methodology for gap filling

Gap filling was undertaken on the basis that once an urban waste water infrastructure had been put in place, it was likely to be used in subsequent years. Therefore, any gaps were filled with data from the most recent year reported, e.g. 2004 data carried forward to 2005. This approach was used for up to 9 years of gap filling, e.g. 2004 data could be carried forward to up to 2013.

Methodology references

No methodology references available.

Uncertainties

Methodology uncertainty

For the assessment shown in Figure 1, countries have been grouped to show the relative contribution on a larger statistical basis. To provide a complete and comparable data set over the period, some countries have been omitted from the European overview.

Regional results are biased towards countries with the largest population (e.g. Turkey constitutes about 70 % of the inhabitants of the entire south-eastern Europe region).

Data sets uncertainty

Data reported to Eurostat sometimes provide an incomplete picture of inhabitants connected to waste water treatment (e.g. the percentage of the population connected to urban waste water systems is given, but the percentage for which the waste water is collected without treatment is missing).

Slovakia reported much of its urban waste water treatment as 'not specified', which is likely to lead to an underestimate of the percentage of treated waste water in that country.

Rationale uncertainty

Data gained from the UWWT Directive focuses on the performance of the treatment plant alone. However, urban waste water treatment systems could also include sewer networks with storm water overflows and storage, which are complex and therefore overall performance is difficult to assess. In addition to the treatments covered by the UWWT Directive, there are other possible treatments, mostly industrial, but also independent treatments of smaller settlements outside urban agglomerations not included in UWWT Directive reporting. Compliance with the levels defined in the directive therefore does not guarantee that there is no pollution due to urban waste water.

In addition, urban waste water treatment (primary, secondary or tertiary, as described above) is the main waste water treatment used across the EEA area, but there are other possible treatments classified as 'Other Waste Water Treatment', which are mostly industrial or independent treatments. Furthermore, there are differences in how countries have interpreted and implemented the UWWT Directive, leading to differences in the data reported. In particular, there are variations in the definitions of different classes of treatment between countries (classes based on performance or design capacity and tertiary treatment for nitrogen, phosphorus or organic matter) that, in turn,

lead to differences in the level of purification attributed by the countries to the different classes. These differences emphasise the problem of using types of treatment plant as a proxy for the level of purification.

Data sources

- Waterbase - UWWTD: Urban Waste Water Treatment Directive – reported data

provided by **Directorate-General for Environment (DG ENV)** , **European Environment Agency (EEA)**

- Water statistics (Eurostat)

provided by **Statistical Office of the European Union (Eurostat)**

Metadata

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