Office for National Statistics

Article

Developing new statistics of infrastructure: August 2018

The second in a series of articles on infrastructure statistics, updating measures of infrastructure investment and introducing measures of infrastructure stocks.

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1 . Overview

This is the second in a series of articles that sets out how we are developing statistics on infrastructure. The first of these, published in July 2017, tackled definitional issues and presented an initial look at available data sources to measure infrastructure investment. In this article we update estimates of investment following development work in a number of areas. We also present an initial look at infrastructure stocks, and provide a case study on the available data for the water industry.

We estimate investment in infrastructure by the UK government as £18.9 billion in 2016, of which over 85% was on transport infrastructure. Almost 40% of the investment was funded by local government, with the remainder coming from central government. Infrastructure accounted for 36% of total government investment in 2016, up from 25% in 2010.

Using a new approach, we estimate market sector investment in infrastructure as £10.3 billion in 2016, of which £7.0 billion was by the energy industry. In volume terms, market sector infrastructure investment fell slightly in 2016, following a peak in 2015.

On the supply side, the construction industry built £19.7 billion of new infrastructure in 2017, and carried out a further £8.8 billion on repair and maintenance. Of the new work, 37% was carried out on behalf of public sector clients, the highest public share since 2014. Electricity infrastructure accounted for the largest share (45%) of new infrastructure work in 2017. This data doesn't account for construction done "in-house" by organisations outside the construction industry.

On a regional basis, 31% of new construction work in the North East in 2017 was infrastructure, the largest such share of any region. The lowest share of infrastructure in total new construction work in 2017 was in the West Midlands (7%), closely followed by London (11%). The infrastructure share has fallen sharply in London from 30% in 2011, as other types of construction, including private housing, have risen.

For the first time, using data and methods consistent with official estimates of capital stocks, we estimate the infrastructure stock in the market sector to be worth £130 billion in 2016, which accounts for 6% of the total capital stock in the market sector.

A case study on the available data in the water and sewerage industry highlights the differences in estimates of the value of the infrastructure stock as a result of differing approaches.

Future work will further develop stock estimates, including for the public sector. To do this will require further work on appropriate price indices for different types of infrastructure assets. We also intend to develop some international comparisons. We welcome user feedback to productivity@ons.gov.uk.

2 . Introduction

This is the second in a series of articles that sets out how Office for National Statistics is developing statistics on infrastructure. The first of these, published in July 2017, tackled definitional issues and presented an initial review of available data sources to measure infrastructure investment. In this article we explore how much the UK government and the market sector invest in infrastructure, and how much infrastructure the construction industry supply. We also present initial estimates of the stock of infrastructure capital owned by the market sector, and provide a case study reviewing available data for the water industry.

Infrastructure assets are widely considered to be an important determinant of productivity and the majority of relevant academic studies find a positive effect of infrastructure on productivity and economic growth (for example, Romp and de Haan, 2007). Improvements in infrastructure are thought to increase productivity through reducing the costs of production, reducing barriers to trade, increasing competition through opening up markets and widening the pool of labour from which enterprises can choose. Conversely, the weakening of an economy's infrastructure potentially has a negative impact on productivity: raising the costs of production, reducing the efficiency of trading relationships and limiting market access.

The quality and quantity of infrastructure assets are consequently thought to be important factors in explaining productivity levels, and developments in the "stock of infrastructure assets" may play an important role in enhancing the productive and allocative efficiency of an economy over the long-term. Statistics on investment in infrastructure and the corresponding impact on stocks of these assets and the services derived from them, would therefore be valuable to inform the design of effective policy. As a result, we have identified infrastructure as one of our priorities for research to contribute to the debate on the productive potential of the economy.

3 . What is infrastructure and how do we measure it?

In our first article, we identified that there is currently no definition of infrastructure in either the UK's National Accounts, or the international guidance embodied in the System of National Accounts: SNA 2008 and the European System of Accounts: ESA 2010.

As such, we reviewed the academic literature and definitions used by policy-makers on the topic. We chose to take a simple functional approach to defining infrastructure[1], identifying six "types" of physical capital assets, which we jointly refer to as "economic infrastructure", where the flow of services or benefits accrues to multiple industries beyond the industry possessing the asset:

- transport
- energy
- water
- waste
- communications
- flood defences

Infrastructure, as defined previously, is a type of fixed capital, and as such expenditure on forming new infrastructure assets and major expenditure to repair and maintain existing infrastructure assets are classified as investment in the national accounts. These investments accumulate over time to form a stock of assets, which encompasses all assets still in use in the economy.

Fixed capital assets have economic lives of greater than one year, and so the stock of an asset depends on investments made in current and previous periods. Many infrastructure assets, such as roads and railways, have long economic lives, and so it is necessary to accumulate a long time-series of investment flows in order to assess the value of the infrastructure stock. The existing stock is also affected by depreciation – the outflow from wear and tear or obsolescence that reduces the productive services it generates. Productive services are derived from the whole of the infrastructure stock: the existing stock as well as new investment.

Our previous article focused on infrastructure investment flows as a starting point. As ownership of infrastructure assets is thought to be currently split between the public and private sectors and future planned investments are also financed by both public and private sectors, we identified data sources covering both sectors. Those data sources, and others used in this article, are summarised in Table 1.

In this article we update the investment estimates, incorporating methodological and data improvements. Section 4 contains updated government investment estimates, based on the same methodology as previously, and incorporating some data revisions. Section 5 presents updated estimates of the value of infrastructure work by the construction industry, based on an improved methodology for modelling low-level breakdowns. Section 6 presents new estimates of market sector investment in infrastructure, based on an experimental methodology, which extends the approach in our previous article.

Section 7 of this article presents initial estimates of the infrastructure stock for the market sector (private and public corporations, thus excluding government), calculated using the data in Section 6 and the perpetual inventory method (PIM). These estimates are consistent with official estimates of the capital stock, published alongside this article, and also with estimates of the capital stock used in the Volume Index of Capital Services (VICS). Section 8 contains a case study on the water and sewerage industry, and a comparison of the stock estimates in Section 7 with data from the balance sheets of the companies in this industry.

Table 1: Data sources

Section	ONS Publication	Data source	Breakdown	Infrastructure definition
Government (Section 4)	ESA Table 11	Administrative sources from central government, local government and devolved administrations	Classifications of the Functions of Government (COFOG)	Select COFOG codes (see Section 4)
Construction (Section 5)	Output in the construction industry	Business survey, and modelled using administrative data	Type of work, region	Type of work: infrastructure
Market sector (Section 6 to 7)	N/A – Not currently published	Annual acquisitions and disposals of Capital Assets Survey (ACAS)	Classifications of Product by Activity (CPA)	‘Specialised construction work’ and ‘civil engineering work’ – CPA 43
Water and sewerage industry (Section 8)	N/A	Financial statements of water companies, sourced from Companies House	By asset group	Industrial definition

Source: Office for National Statistics

Notes about What is infrastructure and how do we measure it?

1. We have included neither housing nor social infrastructure (such as the education and health systems), but there may be scope to extend our definition, subject to further investigations.

4 . How much does the UK government invest in infrastructure?

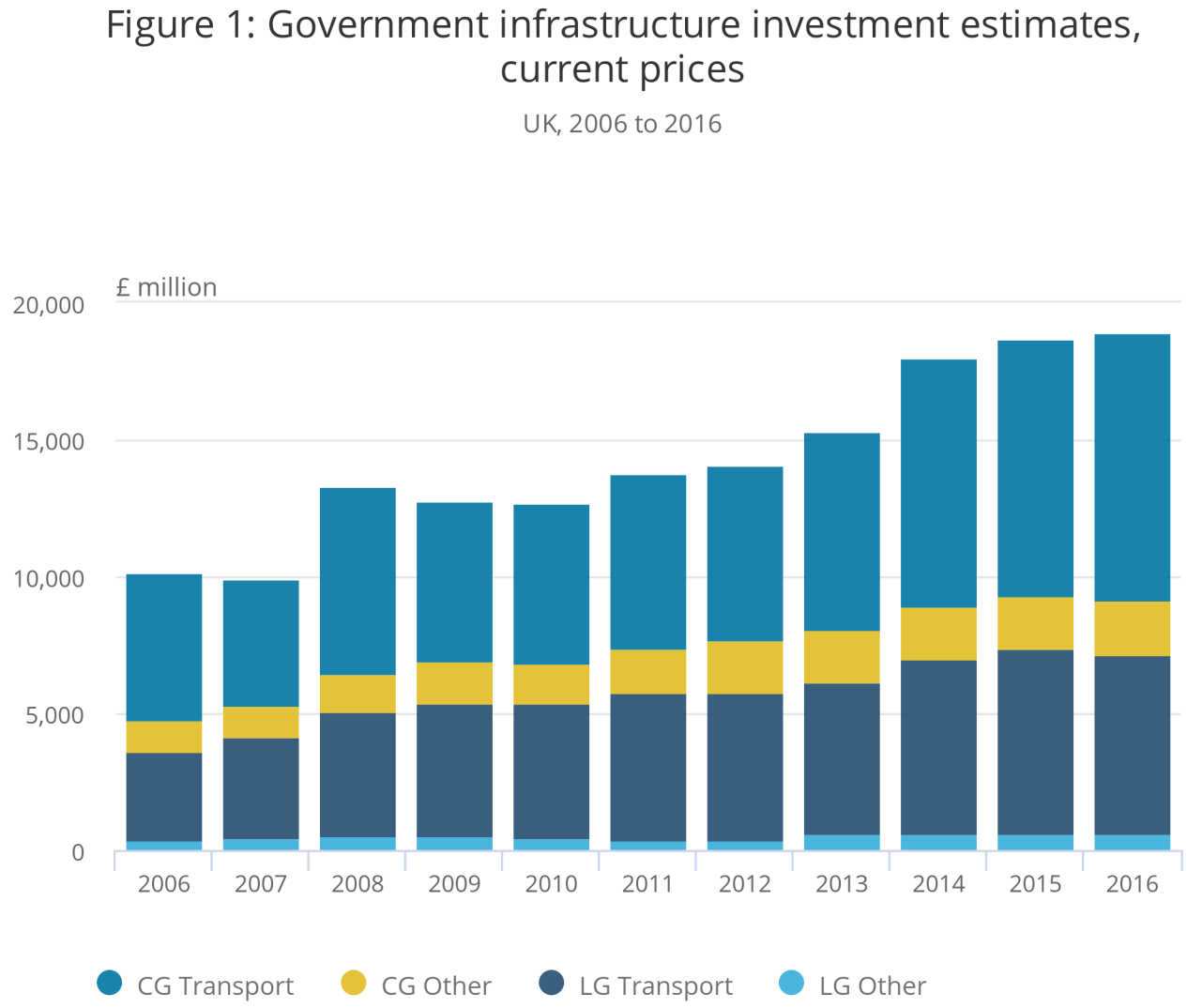
Estimates of government investment in infrastructure in this section follow the methodology set out in our first article. This uses data published by Office for National Statistics (ONS) in European System of Accounts (ESA) delivery Table 11, which includes annual UK government expenditure data broken down by type of spending (for example, investment) and by function, using the Classification of the Functions of Government (COFOG) (PDF, 43KB). COFOG is used to classify a wide range of activities of government, including those that we identify as infrastructure:

- 4.5 – transport
- 4.6 – communication
- 5.1 – waste management
- 5.2 – waste water management
- 6.3 – water supply
- 6.4 – street lighting

To estimate government infrastructure investment, we include all gross capital formation spending (investment on all types of assets) in the selected COFOG categories. Separate data exist for central and local government in ESA Table 11, which permits a more granular view of investment at different levels of government.

Figure 1: Government infrastructure investment estimates, current prices

UK, 2006 to 2016



Source: Office for National Statistics

Notes:

1. CG = Central Government, LG = Local Government.

2. Other = all COFOG codes in our definition except 4.5 (Transport).

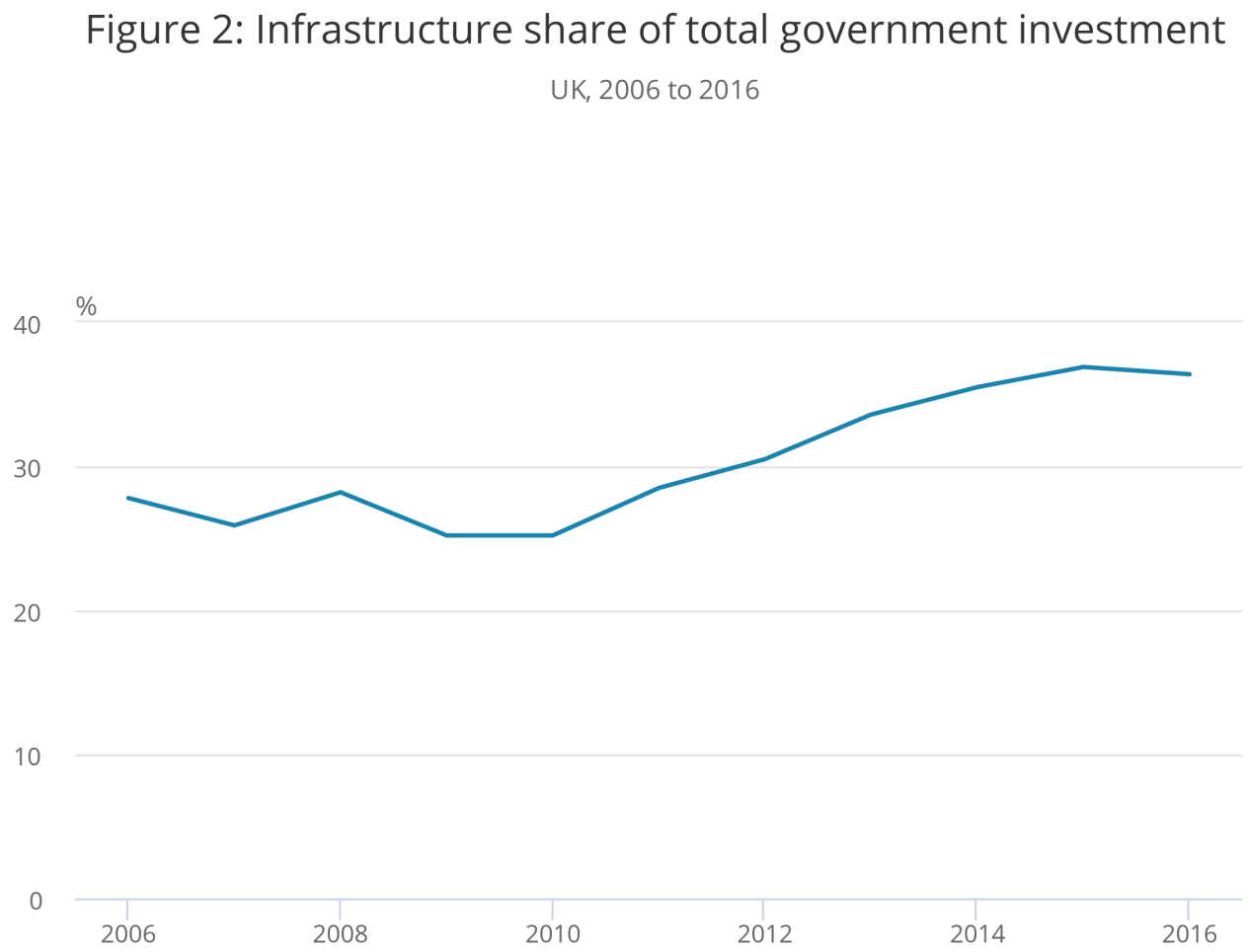
Government invested £18.9 billion in infrastructure in 2016, with almost 40% coming from local government and the remainder coming from central government (Figure 1). Most of the investment was in transport infrastructure (predominantly roads and railways): this amounted to 86% of the total in 2016, and an average of 85% of the total over the whole period. Since our previous article, these estimates have been revised to reflect the latest available data for central and local government.

It is not possible to directly assess volume changes in investment over time using these data, as the data are in current prices, which means they have not been adjusted for inflation. To provide an indication of how government infrastructure investment has changed over time, Figure 2 presents this as a share of total government investment, including investment in other areas (such as education and health).

Infrastructure investment accounted for 36% of total government investment in 2016, down slightly from 37% in 2015, following five consecutive years of growth. Infrastructure's share has grown rapidly in recent years, from its lowest point over the period shown in 2010, when it was only 25%. More broadly, government infrastructure investment accounted for 1.0% of current price gross domestic product (GDP) in 2016.

Figure 2: Infrastructure share of total government investment

UK, 2006 to 2016



Source: Office for National Statistics

5 . How much infrastructure does the construction industry build?

Due to the physical nature of the types of infrastructure we have identified in our definition, data on the output of the construction industry may be helpful in assessing the supply of new infrastructure. Office for National Statistics (ONS) conducts a targeted monthly survey of the construction industry, sampling approximately 8,000 companies per month. As part of the survey, respondents are asked to report the value of new infrastructure construction work and the value of repair and maintenance work to existing infrastructure assets that they carried out during the month.

The data collected on repair and maintenance in the survey covers major and minor repairs, and so only a fraction of this will meet the threshold for capitalisation; the rest will be treated as intermediate consumption. In the survey, infrastructure is defined as: water, sewerage, electricity, gas, communications, air transport, railways, harbours and roads, which is consistent with our definition of infrastructure.

The data in this section cannot be considered to equal the total value of UK infrastructure supply for three main reasons.

Firstly, the survey data reflects only the value of total construction work by enterprises classified to the construction industry, so will not include any “in-house” construction work carried out by businesses outside the construction industry, such as firms in the energy or mining industries, or government departments, for their own use. For example, it will not include work carried out by Network Rail, but will include work carried out on behalf of Network Rail by enterprises in the construction industry.

Secondly, construction output data are measured at basic prices, so do not include transfer costs, installation costs, or taxes less subsidies on the relevant construction products. These extra costs are included in the value of capital expenditure, which is generally valued at purchasers’ prices plus any costs of ownership transfer.

Finally, some infrastructure assets will also be created through a combination of outsourced construction activity and in-house development of specialist equipment or software. For example, a mobile phone mast may be erected by a construction company, but the specialist software that allows it to emit and receive radio waves would likely be developed and installed by the telecommunications firm and thus not identified in construction surveys. For these reasons, construction data are likely to be a lower bound for total infrastructure supply.

Since our first article, methodological improvements have been made to the modelling of low-level breakdowns of construction by sub-sector and region. The monthly construction survey provides data on a breakdown of construction output, of which infrastructure is one component. However, breakdowns of infrastructure into more detailed sub-sectors, such as electricity or roads, are modelled using detailed data on new orders of construction work, provided by Barbour ABI. ONS has improved the way this data is used to estimate low-level breakdowns by sub-sector and region. The data in this section are consistent with these improvements, and thus provide an update to our previous infrastructure article. The full quarterly series can be found in Tables 5 and 6 of the Output in the construction industry publication.

The value of infrastructure construction work by the construction industry in 2017 was £19.7 billion, of which 37% was carried out on behalf of public sector clients, and the remainder was done for private sector clients (see Table 2). This was the highest public share since 2014, and on a quarterly basis, this share increased to 44% in Quarter 1 (Jan to Mar) 2018 – the highest share over the period shown.

The largest type of work in 2017 was electricity, with work by construction firms on electricity infrastructure amounting to £8.9 billion. This has increased over the period due largely to the construction of wind farms. Construction of roads added a further £4.2 billion to the total in 2017. It is likely that for types of work with smaller values, such as water and communications (included in the “other” category), more construction is carried out by businesses outside the construction industry. Repair and maintenance added a further £8.8 billion in 2017.

Table 2: Infrastructure construction (new work) by sub-sector, current prices, Great Britain: 2010 to 2017

Type of work	2010	2011	2012	2013	2014	2015	2016	2017
Water	2,787	2,281	1,824	1,248	691	652	761	1,314
Sewerage	1,037	795	710	480	366	448	651	990
Electricity	1,348	1,635	2,383	3,453	4,829	8,114	7,983	8,903
Roads	3,789	3,836	2,280	2,583	2,762	4,036	4,518	4,221
Railways	2,333	4,065	4,137	5,002	4,066	2,999	2,655	2,879
Harbours	370	462	482	586	897	975	746	665
Other	1,874	2,246	2,607	1,981	1,715	1,589	1,086	755
Total New Work	13,540	15,320	14,425	15,332	15,325	18,812	18,403	19,728
of which: public	37.0%	33.6%	30.0%	39.2%	37.9%	35.9%	36.8%	37.1%
of which: private	63.0%	66.4%	70.0%	60.8%	62.1%	64.1%	63.2%	62.9%
Total repair and maintenance	6,841	7,755	7,672	8,086	8,801	8,496	8,067	8,817

Source: Office for National Statistics

Notes:

1. Other includes gas, communications and air transport

The regional breakdowns also differ to our previous infrastructure article as a result of improvements to the modelling methodology. The full regional breakdowns are available in the accompanying dataset, and in the Output in the construction industry publication.

Infrastructure varies considerably by region as a share of total new work (including housing, commercial and industrial constructions). In the North East, 31% of new construction work was infrastructure, the highest share of any region in 2017 (see Table 3). This reflects primarily various large renewable energy projects, including wind farms and biomass plants. The lowest share of infrastructure in new construction work in 2017 was in the West Midlands, at 7%. The infrastructure share in Scotland and the North East has risen considerably across the period, while the share in London has declined.

Table 3: Infrastructure share of total new construction work by region, Great Britain: 2010 to 2017

Region	2010	2011	2012	2013	2014	2015	2016	2017
North East	8%	15%	25%	16%	20%	35%	28%	31%
North West	18%	19%	19%	18%	21%	21%	20%	18%
Yorkshire and the Humber	26%	18%	17%	20%	17%	17%	19%	19%
East Midlands	15%	16%	21%	20%	15%	22%	23%	23%
West Midlands	13%	12%	17%	18%	14%	16%	10%	7%
East	19%	19%	21%	24%	21%	23%	18%	22%
London	22%	30%	27%	24%	16%	13%	11%	11%
South West	17%	19%	17%	19%	17%	18%	17%	20%
Wales	22%	20%	14%	21%	17%	19%	22%	27%
Scotland	19%	21%	19%	25%	27%	37%	32%	29%

Source: Office for National Statistics

The regional data in Table 3 only reflects work undertaken by the construction industry and so should not be treated as representative of all infrastructure investment.

6 . How much does the market sector invest in infrastructure?

In our previous article we presented initial estimates of private sector investment in infrastructure using data from the Annual Acquisitions and Disposals of Capital Assets Survey (ACAS). This is the only business survey conducted by Office for National Statistics (ONS) that asks questions of sufficient detail to identify infrastructure products. In particular, the questions within this survey allow the identification of the following infrastructure investments:

- civil engineering work – road and rail construction, runways, bridges, construction of power, communication, gas, pipelines and other utility projects, constructions for sport and recreation
- specialised construction work – the construction of oil wells, wind farms, turbines, tunnels, flood barriers, drains

These questions are intended to provide data for the national accounts asset “other structures”, which Grice (2016) uses as a proxy for infrastructure. Grice constructs estimates of the stock of other structures using data from the National Balance Sheet, since official estimates of capital stocks do not currently separate “other structures” from “other buildings”, such as offices, which we would not want to include in a measure of infrastructure.

Using an experimental methodology, we apply a similar approach to Grice to estimate investment in infrastructure by the market sector. We apply findings from ACAS on the split of investment between “other buildings” and “other structures” by industry to official estimates of gross fixed capital formation (GFCF) in the combined asset, “other buildings and structures”[1]. This is preferable to using the ACAS data alone, as ACAS is not designed to provide estimates for the whole population. Official estimates of GFCF rely on data from the Annual Business Survey (ABS) and the Quarterly Acquisitions and Disposals of Capital Assets Survey (QCAS), both of which have much larger samples.

This approach ensures consistency with official estimates of investment (GFCF) and thus, if applying the same asset lives and price indices, with official estimates of capital stocks (published alongside this article). This is the approach taken to create the asset breakdown in the latest Volume Index of Capital Services (VICS) publication, which separates "other buildings" and "other structures". Investment estimates in this section, and stock estimates using this data in Section 7, are consistent at the aggregate with those published in the VICS dataset. This article provides some industry detail. Estimates in this section and Section 7 are for the market sector, that is, the whole economy excluding government and the non-profit institutions serving households (NPISH) sector.

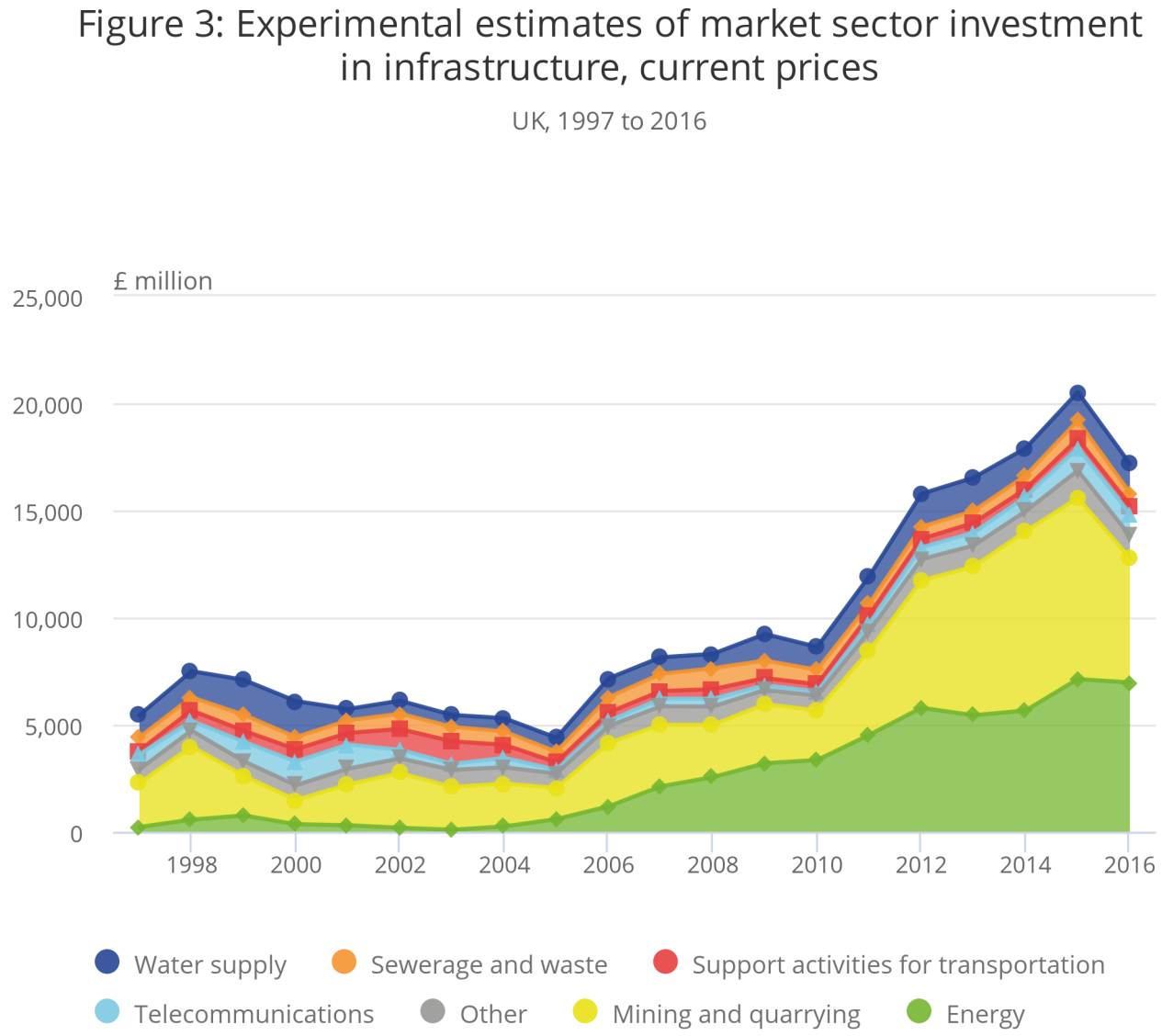
Using this method, we estimate that market sector investment in “other structures” was £17.2 billion in 2016 (Figure 3). Of this, £7.0 billion was carried out by the energy industry (Standard Industrial Classification (SIC) industry 35), and a further £5.8 billion was undertaken by the mining industries (SIC industries 05 to 09). The water and sewerage industries combined invested £1.9 billion – this will be explored in more detail in Section 8.

Based on this method, a small amount of “other structures” is allocated in many industries. In those that are not traditionally associated with infrastructure, such as many services industries, this principally reflects private roads around offices, especially company car parks. These cannot readily be thought of as infrastructure, as they are not publicly available, and so do not form part of the road network. The “other structures” owned in the mining industry are primarily oil wells which, while associated with energy infrastructure, are not directly associated with the generation, transmission or distribution of energy, and it is therefore debatable if this should be included in the definition of infrastructure (see our previous article for a discussion on the definition of infrastructure).

A more conservative approach to estimating infrastructure investment in the market sector would therefore only include the investments in “other structures” in industries that are traditionally associated with infrastructure – namely those reflecting our definition of infrastructure. Including only the investments of those industries traditionally associated with infrastructure in line with our definition, the estimated infrastructure investment in the market sector in 2016 was £10.3 billion.

Figure 3: Experimental estimates of market sector investment in infrastructure, current prices

UK, 1997 to 2016



Source: Office for National Statistics

Notes:

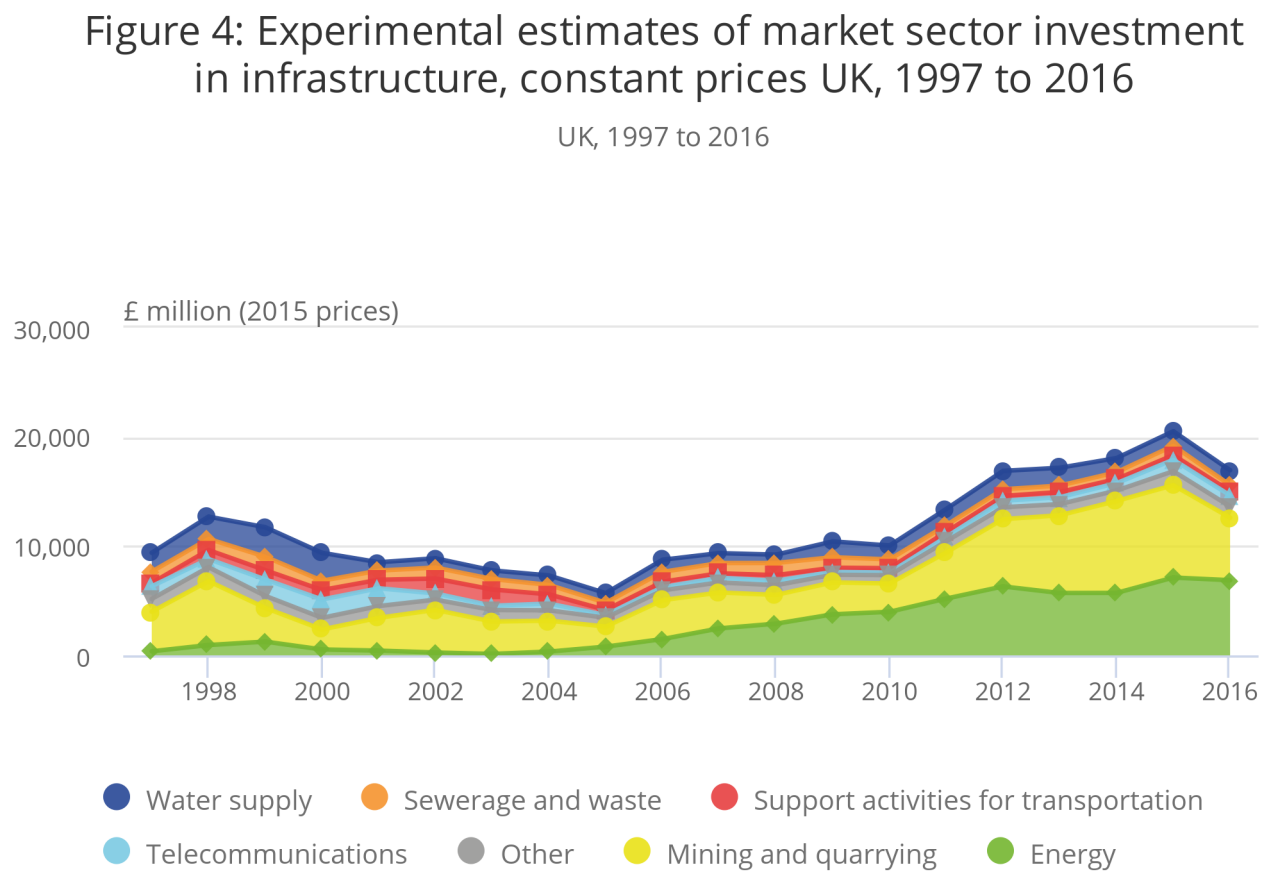
1. SIC codes associated with industry groups: Mining and quarrying = 05-09; Energy = 35; Water supply = 36; Sewerage and waste = 37-39; Support activities for transportation = 52; Telecommunications = 61; Other = all SIC codes not included in other groups.

On a constant price basis, the aggregate level of “other structures” investment in the market sector peaked in 2015 before falling slightly in 2016 (Figure 4). Including only industries traditionally associated with infrastructure as before, the trend was the same.

Note that the same price indices are used in these estimates as are used for “other buildings and structures” in the official estimates of capital stocks. While these likely reflect the changing costs of construction work in a general sense, which may be relevant to infrastructure, the mix of materials, labour and capital needed to create infrastructure likely differ to those needed to create buildings, such as offices. As such, the constant price estimates should be treated with caution, and are published to encourage user input on price indices for infrastructure (for discussion see Section 9 – Future developments).

Figure 4: Experimental estimates of market sector investment in infrastructure, constant prices UK, 1997 to 2016

UK, 1997 to 2016



Source: Office for National Statistics

Notes:

1. SIC codes associated with industry groups: Mining and quarrying = 05-09; Energy = 35; Water supply = 36; Sewerage and waste = 37-39; Support activities for transportation = 52; Telecommunications = 61; Other = all SIC codes not included in other groups.

Notes about How much does the market sector invest in infrastructure?

1. “Land improvements”, a further component of “other buildings and structures”, are not included in these estimates.

7 . How much infrastructure does the market sector own?

Using the investment estimates presented in Section 6 and the perpetual inventory method (PIM) it is possible to estimate the value of the “other structures” stock in the market sector. The PIM accumulates successive investments, revalued to a consistent price base, and depreciates them according to a pre-defined schedule. Assets are removed from the stock (retired) when they exceed the assigned asset life, which is an estimate of the economic life length of an asset. This is the method used in official estimates of capital stocks.

An important set of assumptions for the PIM are the asset lives, as these define how long an asset stays in the stock before being retired, and how quickly the stock depreciates. Note that in these estimates the same asset lives are used as for the “other buildings and structures” asset in official estimates of capital stocks (published alongside this article). Office for National Statistics (ONS) is currently conducting research into the appropriate service lives for a range of assets, including infrastructure assets, as part of a review of the capital stocks methodology. New estimates of the capital stock using these asset lives are anticipated to be available next year. Note also that the same price indices are used in these estimates as are used for “other buildings and structures” in the official estimates of capital stocks – see Section 6 for a discussion.

Estimates presented in this section are consistent with official estimates of capital stocks and with the capital stocks used in, and published with, the latest Volume Index of Capital Services (VICS) publication.

On this basis, the value of the net stock of “other structures” in the market sector at the end of 2016 was £239 billion (see Table 4), which is approximately 11% of the market sector capital stock. Of this, £86.4 billion was owned by the mining industries (Standard Industrial Classification (SIC) industries 05 to 09), and a further £53.3 billion was owned by the energy industry (SIC industry 35). The water and waste industries combined owned £54.0 billion – this will be explored in more detail in Section 8. The remaining stock was owned primarily by the telecommunications industry (SIC industry 61) and the transport infrastructure industry (SIC industry 52). Note that this will not include the road network, as this is owned by central and local government.

Table 4: Experimental estimates of market sector stocks of infrastructure, UK: 2016 (end of period)

Industry group	Other structures net stock (£ million)
Mining and quarrying	86,426
Energy	53,263
Water supply	34,527
Sewerage and waste	19,439
Support activities for transportation	10,137
Telecommunications	12,593
Other	22,726
Total	239,111
Conservative infrastructure estimate	129,959

Source: Office for National Statistics

Based on the method described in Section 6, a small amount of “other structures” is allocated in many industries. Including only the stock of those industries traditionally associated with infrastructure (see Section 6 for a discussion), the estimated infrastructure stock in the market sector in 2016 was in the region of £130 billion in value, or 6% of the capital stock in the market sector.

However, we would also want to include some assets other than “other structures” in our estimate of infrastructure. In particular, infrastructure should include telecommunications equipment owned by the telecommunications industry (SIC industry 61) such as broadband street cabinets, and various machinery, equipment and buildings in the water, sewerage and energy industries, used in the processing and distribution of utilities. As such, the value of “other structures” in relevant industries could be considered a lower bound for the infrastructure stock.

This section highlights the difficulties in measuring infrastructure stocks. These include: the need for accurate, long-run investment flows; appropriate asset lives and price indices; and a precise definition of the industries and assets to include in the measure. Furthermore, this section included only data for the market sector, but it would be necessary to construct estimates for the whole economy on a consistent basis. We will continue to work on all of these issues – see Section 9 Future developments, for further details.

8 . Case study on the water and sewerage industry

The water and sewerage industry provides a convenient case study of a particular type of infrastructure. Following privatisation of the industry in 1989, a relatively small number of large, private companies have dominated the market in England and Wales – as of 2017, there are 10 large water and sewerage companies, and a handful of smaller ones. In Scotland and Northern Ireland, the water and sewerage infrastructure is still publicly owned. This relatively small number of asset owners provides an opportunity to gather data on the whole industry, and assess the available information for valuing the infrastructure stock. In future publications, we intend to replicate this approach for other infrastructure types.

Before privatisation, water and sewerage services were generally organised and provided locally. According to Ofwat (the regulator for the water industry):

“In 1945 there were more than 1,000 bodies involved in the supply of water and around 1,400 bodies responsible for sewerage and sewage disposal. Most of these were local authorities, but there were also several statutory private water companies. Planning for water resources was a highly localised activity, with little co-ordination at either a regional or national level.”

In the decades that followed, the industry was consolidated through various Parliamentary Acts, and increased funding was provided through grants from central government. Services were still mostly provided locally, although some regional bodies were formed, which joined individual local authority operations together. The Water Act 1973 established 10 new regional water and sewerage authorities in England and Wales, taking over responsibility from the local authorities. These authorities operated on a cost recovery (non-profit) basis, and funding for investment was raised through services provided and borrowing from central government.

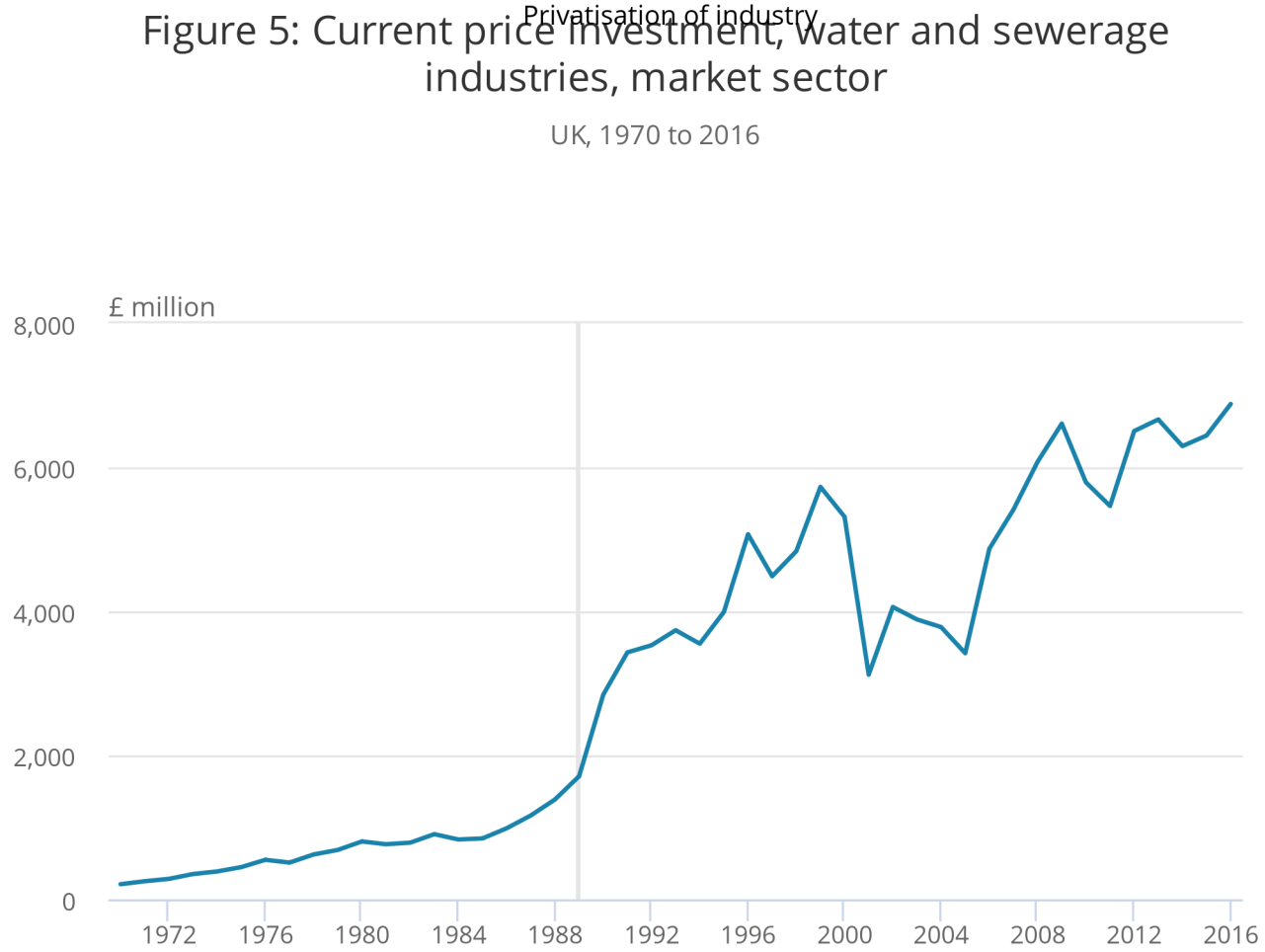
Due to a shortage of investment, the Water Act 1983 allowed the water authorities to access private capital markets, and reduced the input of local government. This was followed by the privatisation of 10 water and sewerage authorities in 1989, which was accompanied by an input of public money to facilitate investment in the infrastructure. Today there remain 10 large water and sewerage companies, and a further 16 smaller companies, which often provide only water services[1].

The data from company financial accounts presented in this section has been collected from the 20 largest water and sewerage providers in England and Wales.

Estimates of investment of the water and sewerage industry in the market sector, used in the calculation of capital stocks, is consistent with this history. Current price investment[2] more than doubles in the two years after privatisation in 1989 (Figure 5). This is also consistent with Ofwat’s assessment that in the last three decades there has been more than £140 billion of investment by the industry – the data in Figure 5 total approximately £135 billion over the same period.

Figure 5: Current price investment, water and sewerage industries, market sector

UK, 1970 to 2016



Source: Office for National Statistics

Notes:

1. Data for SIC section E, division 35-39.

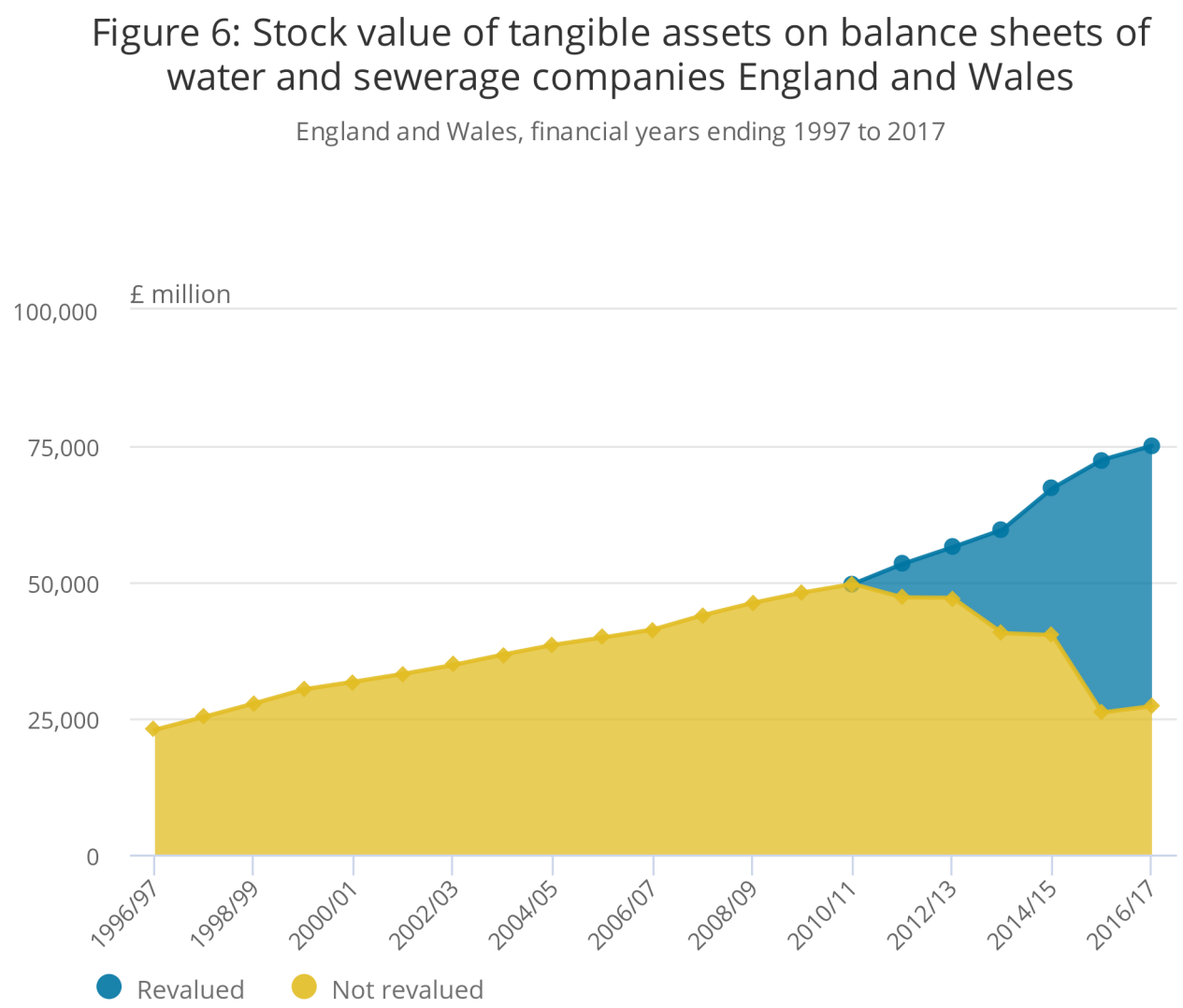
To assess the value of the water and sewerage infrastructure stock, we collated the value of the tangible assets owned by the water and sewerage companies, as reported on their balance sheets in their annual statutory accounts. In all cases we have taken the value of all tangible assets, rather than the value of only the infrastructure assets. We do this primarily because there is no asset breakdown for some companies over some time periods, meaning this approach would have required some imputation of missing values. However, the value of the infrastructure assets dominates the value of other assets on the balance sheets of water companies, so this is likely a small consideration.

From 2011 onwards, many of the water and sewerage companies revalued their assets in line with new accounting guidance. By the financial year ending (FYE) 2017, the latest year for which we have a full set of data, over half the value of the stock collected on this basis has been revalued (Figure 6). Through correspondence with Ofwat, we understand that these revaluations are not to convert from a historic to replacement cost accounting basis, but rather to revalue assets acquired at privatisation that would previously have been valued differently. In some cases, companies have revalued their capital by considering the future returns the assets generate with reference to the regulatory capital value (RCV), as published by Ofwat. As such, the data from the balance sheets can still be considered as historic cost valuations.

Following this approach, the combined value of tangible assets of the water and sewerage industry in FYE 2017 was £75.0 billion, of which £47.8 billion had been revalued in recent years, and £27.2 billion had not.

Figure 6: Stock value of tangible assets on balance sheets of water and sewerage companies England and Wales

England and Wales, financial years ending 1997 to 2017



Source: Company statutory accounts, Office for National Statistics calculations

For the purposes of economic analysis, and in line with international guidance, it is preferable to measure capital stocks on a replacement cost basis. This is where the value of the asset is given as the cost it would take to replace it with an equivalent asset in the current period, which tends to be higher than historic costs due to price increases. The official estimates of capital stocks (published alongside this release), calculated by the perpetual inventory method (PIM), are valued on this basis. Consequently, the value of the stock of tangible assets of the industry as published by Office for National Statistics (ONS) exceeds the value given on the balance sheet of companies (see Table 5).

Table 5: Comparison of valuation methods of the capital stock in the water and sewerage industry, UK: various years

Source	Year	Valuation basis	Method	Valuation
Financial statements	2016/17	Historic cost	Balance sheets, Office for National Statistics calculations	£75 billion
Office for National Statistics Capital Stocks	2016	Depreciated replacement cost	Perpetual Inventory Method (PIM)	£140 billion
Ofwat	2009/10	Full depreciation cost (Modern Equivalent Asset)	Direct valuation	£297 billion

Sources: Companies statutory accounts, ONS calculations, Office for National Statistics, Ofwat

Ofwat also made an assessment of the replacement cost of the industry's infrastructure, which they refer to as a modern equivalent asset (MEA) valuation, although these ceased after FYE 2010. Through correspondence with Ofwat, we understand that these valuations were made by engineers on the replacement cost of assets owned by the industry above and below ground. Assets above ground, such as treatment works, were depreciated according to given assets' lives, and so valuations of these assets would be similar to the net capital stock valuations calculated using a PIM.

However, assets below ground, such as pipelines, were not depreciated, meaning the value of these assets reflects the full replacement cost (including construction costs) of the industry's infrastructure – this implicitly assumes these assets have an indefinite asset life.

By this approach, Ofwat estimated that the industry's infrastructure would cost £297 billion to replace in FYE 2010. This far exceeds the ONS capital stock estimates (see Table 5), which reflects the different valuation methods for assets below ground. This highlights the importance of the measurement basis when valuing infrastructure stocks – in particular, assumptions about asset lives. Historic assets still in use in the water and sewerage industry may well have been retired from the stock in the PIM if the asset lives applied are too short, which may be the case for long-lived infrastructure assets.

ONS is currently conducting research into the appropriate service lives for a range of assets, including infrastructure assets, as part of a review of the capital stocks methodology. New estimates of the capital stock using these asset lives are anticipated to be available next year. We intend to revisit this analysis when new estimates of capital stock are available.

Notes about Case study on the water and sewerage industry

1. The data from company financial accounts presented in this section has been collected from the 20 largest water and sewerage providers in England and Wales.

2. The majority of the water and sewerage companies are recorded in Standard Industrial Classification (SIC) division 36 – water; but some are included in SIC industry 37 – sewerage. We therefore present data for the SIC section E – water, sewerage and waste.

9 . Future developments

The analysis in this article reflects development since our first article, incorporating improvements to methods and data sources, and introducing new approaches. For future articles we will continue to develop the methods used in this article to develop estimates of the stock of infrastructure in the public and private sectors, and ultimately to analyse the impact that changes in the infrastructure stocks have on productivity.

We are keen for your involvement in the development of these new statistics. We would welcome any feedback you may have and would be particularly interested in knowing how you make use of these data to inform your work. Feedback should be directed to our inbox: Productivity@ons.gov.uk.

In future, the scope of this work could be expanded to include measures of housing and “social infrastructure” (such as the education and health systems), subject to user feedback. We will also consider links to Office for National Statistics (ONS) work on other capitals such as natural capital and human capital although we do not plan to include these within the scope of our measures.

A priority for this work is to develop our infrastructure stock estimates further. We intend to continue to use and compare a variety of sources to build a full picture of infrastructure, including survey-based investment data, stocks constructed using a perpetual inventory method (PIM), administrative and regulatory sources, and company accounts. For stock estimates constructed using a PIM, an important development area will be assessing the appropriate economic lives to be used for different types of infrastructure and exploring the availability of price indices. Our research has shown a dearth of price indices for different types of infrastructure, and we welcome user input on this topic to our inbox: Productivity@ons.gov.uk.

We also intend to develop an international comparison of infrastructure, to contextualise the estimates for the UK. This may help to identify differences in the way that infrastructure is funded across countries, and provide useful insight on international comparisons of productivity.

10 . Authors and acknowledgements

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