

# Annex: National Infrastructure Assessment impact and costings notes

July 2018

# Contents

Introduction to the impact and costings notes .....	2
Cities and local transport .....	7
Energy (heat, energy efficiency and electric vehicles).....	11
Flood resilience .....	16
Full fibre.....	20
Waste.....	24
Water .....	29

## Introduction to the impact and costings notes

### Overview

For each of the Commission’s recommendations with significant spending implications, an ‘impact and costing note’ has been produced to assess:

- the impact of the recommendation on the Commission’s objectives to support sustainable economic growth across all regions of the UK, improve competitiveness and improve quality of life
- the expected costs of the recommendation, and their impact on the Commission’s fiscal and economic remits
- uncertainty, distributional effects and risks around these estimates and the balance of evidence behind recommendations, as far as it has been possible to make these assessments.

The impact and costings notes record the Commission’s assessment of these factors in a standard format. These notes have been made available to commissioners to support their decision making.

The core of each impact and costing note is how the cost of the recommendation affects the Commission’s fiscal and economic remits. These were set out by government in ‘Remit Letter to the National Infrastructure Commission’.<sup>1</sup>

The content of the impact and costings notes is explained below, and the notes for each sector are appended in the following sections.

### Objectives

The Commission has three overarching objectives as set out in the *Charter for the National Infrastructure Commission*, to support sustainable economic growth across all regions of the UK,

improve competitiveness and improve quality of life.<sup>2</sup> The impact of the Commission's recommendations on each of these objectives is assessed, and quantified where possible:

- Sustainable growth: to contribute towards this objective, there must be evidence that the recommendation is expected to have a significant impact on economic output measured in GDP, or to reduce the climate change impact of output by reducing emissions of carbon or other greenhouse gases. Increasing capacity to accommodate future population or economic growth is also noted here, but contributes less than interventions which actively increase economic output.
- Balance across regions: whether the recommendation is expected to have a significant impact on economic growth in different parts of the UK. Regional impacts other than the impact on growth are considered separately as distributional impacts.
- Competitiveness: whether the recommendation is expected to increase productivity (measured in output per hour worked), or to increase the attractiveness of the UK as a location for private investment.
- Quality of life: this objective captures multiple factors that could improve quality of life. It includes impacts on local pollution and environment, health, user experience and resilience. Financial savings are not a major consideration for quality of life as these are captured in the impact on bills estimates below.

### **Fiscal remit**

The fiscal remit is a long term funding guideline given to the Commission by government, which states the Commission “must be able to demonstrate that its recommendations for economic infrastructure are consistent with, and set out how they can be accommodated within, gross public investment in economic infrastructure of between 1.0% and 1.2% of GDP in each year between 2020 and 2050.”

All figures in the fiscal remit, and in the tables presented in this document, are in 2018/19 prices. These have been deflated according to standard practise using the Office for Budget Responsibility's GDP deflator, set out in the Economic and Fiscal Outlook (March, 2018).<sup>3</sup>

To identify the appropriate scale of investment needed in future periods, and the resources available for additional projects, the Commission has had to estimate what baseline and committed expenditure would 'look like' in the future. This approach has been necessarily high level given the level of uncertainty.

In the local transport, waste and flood risk management sectors, rather than apply sector-specific deflators the Commission has taken the average of historic levels of investment as a percentage of GDP and rolled these forward.

Between 2025/26 and 2029/30, the Commission has applied a 5 per cent efficiency target to renewals on transport networks. This includes: Network Rail, Highways England, Transport for London and local transport. This has not been applied to the rail mega projects. A 5 per cent efficiency target over five years is in line with the government's 2 per cent annual efficiency target set out in *Transforming Infrastructure Performance*.<sup>4</sup>

## **Economic remit/impact on bills**

Households typically pay for infrastructure via bills where consumers can choose how much, or what level, of a service to purchase. For example, linking households' energy bills to their usage helps to keep total consumption at an efficient and sustainable level.

The economic remit specifies that the Commission is required to provide 'a transparent assessment of the overall impact on costs to businesses, consumers, public bodies and other end users of infrastructure.'

The economic remit includes all costs imposed by infrastructure recommendations which are not covered by the fiscal remit. This is everything except public sector capital expenditure.<sup>5</sup> The economic remit includes:

- bills, fees, tolls and charges paid by households, businesses and the public sector for utilities and access to infrastructure
- other public sector resource expenditure, which is more day to day spending by the public than capital investment. As well as utility bills paid by the public sector, this includes many operational costs of public infrastructure such as wages and salaries, and fees paid to private sector providers
- other spending by households and businesses on specific goods and services that are affected by recommendations, for example the cost of packaging.

The economic remit does not include tax implications. All bills and prices are calculated excluding VAT and duties: it is assumed that any changes in tax revenues resulting from the Commission's recommendations will be compensated for elsewhere in government tax and spending, so do not reflect a loss or gain to households and businesses. This is also the case for increases in costs to local authorities.

## **Pass through of bills impacts**

Households will ultimately pay the costs of infrastructure. This could be directly through bills, fees, tolls and charges, or indirectly through higher prices paid by businesses, and higher taxes or lower spending elsewhere in the public sector.

Sometimes the Commission's analysis has estimated the costs to households where it is reasonable to assume that most or all of costs will be passed through, for example in water recommendations where the cost of new infrastructure is recovered from households through water bills.

In other cases, how additional costs or savings will be passed on is not sufficiently clear to make this assessment. For example, changes to the cost of waste collection and treatment affect businesses and local authorities directly, but no assumption is made of whether or how they will pass these changes onto households.

Where assumptions are made about how changes to costs are passed through, these are set out in the ‘methodology and assumptions’ section of each impact and costing note.

No estimate has been made in the bills impacts of the consequences of households choosing to take up new or different services, such as higher broadband speeds, where this is purely an option available to households.

### **Presentation of bills impacts in the impact costings notes**

The specific bills impacts which are relevant vary between infrastructure sectors, so are explained in each impact and costing note. These impacts include some or all of:

- Additional aggregate impact by sector (households, businesses, public sector) relative to a baseline which reflects a counterfactual world without the recommendation.
- Average impact per household relative to average expenditure today.
- Aggregate impact on business relative to the baseline and as a proportion of total business costs, which are taken from the Annual Business Survey.<sup>6</sup>

All costs are adjusted to constant 2018/19 prices using the Office for Budget Responsibility’s latest forecast for the GDP deflator from the *March 2018 Economic and Fiscal Outlook*.<sup>7</sup>

### **Uncertainty**

This assesses the degree of confidence in the fiscal and bills remit estimates, and the reasons for this judgement. This is purely an assessment of confidence in the underlying data and modelling approaches used. It does not consider the robustness of recommendations to different future states of the world, which is considered in the Risks section below.

### **Distributional impacts**

Where it has been possible to assess them, key distributional impacts have been included, considering several dimensions: regional, which includes impacts by location or urban/rural areas; ‘winners’ and ‘losers’ which are groups that are expected to experience a net benefit or net cost from the recommendation; and impacts on vulnerable and protected groups.

### **Indirect effects**

This considers second-round impacts and behavioural responses that could affect the impacts on objectives and costs described in impact and costing note. Whether these have been included in the modelling is explained, and the likely direction and scale of their effect.

### **Risks**

The risks section assesses how robust the Commission’s central recommendation is expected to be to different possible future states of the world to the scenario on which the recommendation is based. Scenarios have been derived from a range of risk drivers, primarily those described in *Congestion, Capacity, Carbon – Modelling annex*. National Infrastructure Commission (2017), *Congestion, capacity, carbon – modelling annex*.<sup>8</sup>

Risks are judged to be low if the recommendation is ‘no regrets’ and would remain the preferred option in different scenarios; medium if the recommendation would be similar but with different parameters such as the scale or timing of investment; or high if there is a significant risk that the recommendation could be unviable or obsolete in some possible scenarios.

### **Assumptions and methodology**

Lists the key assumptions and methodological steps used to arrive at the estimated fiscal remit and bills impacts from the underlying costs and savings of the recommendation. This focuses on the modelling carried out to estimate the funding implications rather than the modelling used to produce the underlying cost estimates and to advise on the choice of recommendation: details of the latter are considered in separate reports.

---

<sup>1</sup> HM Treasury (23 November 2016), Remit Letter to the National Infrastructure Commission. Accessed at: <https://www.gov.uk/government/publications/remit-letter-to-the-national-infrastructure-commission>

<sup>2</sup> HM Government (2016), Charter for the National Infrastructure Commission

<sup>3</sup> Office for Budget Responsibility (2018) Economic and Fiscal Outlook

<sup>4</sup> Infrastructure and Project Authority (2017) Transforming Infrastructure Performance

<sup>5</sup> HM Treasury (2013), How to understand public sector spending. Accessed at: <https://www.gov.uk/government/publications/how-to-understand-public-sector-spending/how-to-understand-public-sector-spending>

<sup>6</sup> Office for National Statistics (2017), Annual Business Survey, UK non-financial business economy: 2016 provisional results. ‘Total purchases’ used to represent total business costs, which are assumed to grow in line with forecast future GDP. Accessed at: <https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/bulletins/uknonfinancialbusinesseconomy/2016provisionalresults>

<sup>7</sup> Office for Budget Responsibility (2018), Economic and fiscal outlook – March 2018. Accessed at: <http://obr.uk/efo/economic-fiscal-outlook-march-2018/>

<sup>8</sup> National Infrastructure Commission (2017), Congestion, capacity, carbon – modelling annex. Accessed at: <https://www.nic.org.uk/publications/1481/>

## Cities and local transport

**Description:** This includes devolved transport budgets for all cities to fund maintenance and small to medium enhancement projects, including the budget for Transport for London. It includes funding for major urban transport projects to fund significant enhancements that are needed in priority cities and are too large for devolved budgets to meet. Finally, it includes devolved transport budgets for local authorities outside cities, again covering maintenance and smaller enhancements.

### Objectives

Sustainable growth	Transport investment allows cities to grow in population and employment without increasing congestion. Several different studies have indicated that urban and local transport projects have benefits around four times their cost.
Balance across regions	The urban investment recommended here will benefit each region by enabling more people to live and work in cities, increasing regional productivity. There are fast growing, infrastructure constrained cities spread across the regions of the UK.
Competitiveness	Projects to improve urban and local transport should increase productivity. Higher densities in urban centres deliver productivity benefits through learning, matching and sharing. <sup>9</sup> A range of studies have shown that doubling city centre densities increases productivity by nearly 5 per cent. <sup>10</sup> This drives the international competitiveness and attractiveness of the UK economy.
Quality of life	Enabling more people to choose to live and work in cities will increase access to social, leisure and cultural activities. Large-scale investment in well-designed infrastructure will promote better quality public space.  Better infrastructure should facilitate development of urban housing, improving affordability of housing, reducing commute times and reducing the need for building on greenfield sites.

### Fiscal remit

Average annual public capital (£ million, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
<b>Recommendations</b>						
Devolved cities	3,300	3,600	4,600	5,400	6,100	6,800
Non-urban local transport	2,700	2,900	3,400	3,800	4,200	4,700
<b>Of which baseline</b>						
Devolved cities	3,080	3,240	3,880	4,220	4,720	5,260
Non-urban local transport	2,600	2,800	3,250	3,560	3,980	4,440
<b>Transport for London</b>	2,600	2,900	2,200	2,000	2,200	2,400
<b>Urban Major Projects</b>	500	400	2,400	3,100	3,500	3,900

Baseline expenditure is derived from historic estimates of local transport expenditure.<sup>11</sup> These have been rolled forward by the Office for Budget Responsibility’s GDP deflator. Devolved cities expenditure includes maintenance as well as enhancements.

Between 2020/21 and 2049/50, the Commission recommendations represent an average annual 26 per cent uplift against baseline expenditure for cities outside London, and a 5 per cent average annual uplift for non-urban local authorities.

### **Impact on bills and public sector resource spending**

Delivering improved urban and local transport is likely to require some additional revenue funding from central government for local authorities.

Increased investment in urban transport will require more work by city authorities on planning and development. Currently city authorities (outside London) spend around £200 million revenue per year on transport planning and co-ordination. It could also increase the costs of providing subsidised public transport fares. Currently city authorities spend around £800 million per year on subsidies, including statutory concessions and discretionary subsidies.<sup>12</sup>

**Uncertainty:** High confidence.

Funding allocations to cities are likely to be spent as allocated. However, there is some uncertainty about how much funding local authorities will raise and spend in addition to central government allocations.

Estimates for urban devolved enhancements, non-urban enhancements and local road maintenance are based on actual figures for current levels of spending.<sup>13</sup>

### **Distributional Impacts**

Regional	Supporting growth in city-regions supports balanced growth across the UK, as cities provide employment and a range of specialist services across a whole region and all regions have growing, infrastructure constrained, cities.
Winners	Increased urban capacity allows more people who want to move to cities to do so, improving their work and leisure opportunities. Additionally, people who already live in cities benefit from increased productivity, better quality transport and support for new housing development.
Losers	Reallocating limited road space to higher density public transport can increase total accessibility, but may create winners and losers between people with different modal preferences.
Vulnerable/protected groups	Better public transport may be more likely to help young and old people (less likely to own a car) and disabled people (new infrastructure likely to be more accessible than existing).



## Indirect effects

Improved transport in cities, especially city centres, may encourage businesses to locate in cities and employ more people there, and may also encourage people to locate in or around cities. Existing residents in cities may benefit from higher densities and the cultural and leisure offers that go with it.

## Risks

Low = the recommendation is “no regrets” and is robust to a range of future scenarios.

Medium = some future scenarios could affect the optimal choice of variant or timing.

High = some future scenarios could make the recommendation unviable or obsolete.

Driver	Risk	Description
Economic growth	Low	<p>In the short run, transport demand is responsive to economic growth. Fast growth can be choked off through congestion impacts.</p> <p>Productivity benefits accrue from increasing urbanisation, irrespective of the baseline. However, the faster the rate of economic growth, the greater benefits delivered by the policy.</p> <p>Robust across economic growth scenarios.</p>
Climate change	Low	<p>Need for better public transport independent of climate considerations.</p>
Technology	Medium	<p>Connected and autonomous vehicles could change travel patterns significantly. In the most likely scenarios this increases demand for road space and so higher capacity urban transport continues to be needed. However, there is much uncertainty over the scale and timing of these impacts.</p> <p>In principle, communications technology could provide a substitute for physical interactions, reducing demand for travel. To date, however, technological developments in communications have driven increases in demand for travel.</p>
Population and demography	Medium	<p>Demand for urban transport depends on continued population growth and urbanisation of the population – although given existing congestion in cities, investment will be high value even without future growth.</p> <p>Urbanisation is a well-established international trend but the value of investments could be affected if this were to reverse.</p>

Behaviour change	Medium	There is some evidence that travel demand per capita is reducing, and if this continues the need for investment may reduce. However, investment focused in urban areas is still likely to be needed given offsetting population growth and existing congestion.
Political change	Low	Political change unlikely to affect demographic trends that drive the need for better urban transport.

### Methodology and assumptions

Analysis undertaken for the Commission has assessed potential future employment growth in city centres and the costs of transport capacity to accommodate this growth. This has informed the assessment of how much funding is needed for urban major projects.

Funding for devolved urban enhancements, non-urban local enhancements, and local roads maintenance uses analysis of existing spending as a baseline, with scenarios considering variations on this baseline. This proceeds on the assumption that existing spending maintains transport networks at their current level of quality, and that increases would be needed to improve quality.

The Commission has had to make an assumption of the breakdown of local maintenance expenditure. Based on a five year historic average, 33 per cent of local road maintenance is assumed to take place in cities, with the remaining 67 per cent attributed to non-urban authorities.

---

<sup>9</sup> Duranton & Puga (2003) *Micro-Foundations of Urban Agglomeration Economies*

<sup>10</sup> Rice, Venables & Patacchini (2006)

<sup>11</sup> Ministry for Housing, Communities and Local Government, *Capital Estimate Returns*

<sup>12</sup> *Ibid.*

<sup>13</sup> *Ibid.*

## Energy (heat, energy efficiency and electric vehicles)

### Description and recommendations

Energy recommendations which are costed in this note are as follows:

1. Heat and energy efficiency recommendations:
  - Hydrogen trials at community scale (<500 homes) by 2021, and carbon capture and storage (CCS) trials alongside hydrogen production trials for 5,000-10,000 homes, funded from gas bills.
  - Increase the rate of installation of energy efficiency measures to 21,000 a week by 2020, which is a 'no regrets' option in all future heat scenarios. Targeting social housing, with the aim of increasing the energy efficiency rating to C or better by 2030 in England (energy efficiency is devolved to Wales, Scotland and Northern Ireland).
2. Electric vehicles recommendations:
  - a core national network of public rapid charging points, supported by government investment, to incentivise electric vehicle uptake and provide a basis for the market to develop.

### Objectives

Sustainable growth	No quantifiable impact on growth, although new power generation capacity will accommodate future population and economic growth. Lower cost of driving electric vehicles may support economic growth. Low carbon heat and transport will be essential to meeting the UK's climate change targets.
Balance across regions	No quantifiable impact on regional growth has been identified.
Competitiveness	No quantifiable impact on competitiveness or productivity. Low cost, secure and decarbonised energy and fast adoption of electric vehicle technology are both likely to support competitiveness. The UK has potential to develop expertise on cutting edge energy technology.
Quality of life	Health: Low winter temperatures in fuel poor households are estimated to lead to around 3,000 deaths a year. <sup>14</sup> Pollution: Where recommendations support the faster take up of electric vehicles this will lead to reduced local pollution and noise. User experience: electric vehicles may benefit drivers if they are easier to drive and maintain, as well as the cost benefits shown in the bills remit below.

## Fiscal Remit

Average Annual Exchequer Impact (£ million, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Energy efficiency for social housing	100	300	300	100	0	0
EV Charging	2*					

\*£10 million in 2020/21

## Impact on bills and public sector resource spending

The total bills impacts of the Commission's recommendations presented below show the cost of recommended heat trials and energy efficiency measures. The cost of the Commission's recommendations for power and electric vehicles are not modelled. Power is expected to be decarbonised at lowest cost, so there is no identifiable impact of the Commission's recommendations on electricity bills. Households will choose to buy electric vehicles rather than internal combustion engine vehicles if they decide that it benefits them. Because take up is voluntary, no impact on bills is estimated for electric vehicle recommendations.

The accompanying *Technical annex: Energy and fuel bills today and in 2050* compares total energy bills for power, heat and driving between 2017 and 2050.<sup>15</sup>

All values exclude VAT and duties.

## Aggregate impact of recommendations on bills, by sector

Annual total impacts relative to baseline: households, businesses & public sector (£ million, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50	
Heat and energy efficiency recommendations	Households	+108	+242	+161	+158	+156	+153
	Businesses	+4	+22	+22	+21	+21	+21
	Public sector	+1	+5	+4	+4	+4	+4
	<b>Total</b>	<b>+113</b>	<b>+269</b>	<b>+188</b>	<b>+184</b>	<b>+181</b>	<b>+178</b>

## Impact of recommendations on annual average household bills

This table shows the average annual cost per household of the aggregate impacts shown in the previous table.

Average impact on annual household bill relative to baseline (£, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Heat and energy efficiency recommendations	+£4	+£8	+£5	+£5	+£5	+£4

## Uncertainty of estimates and other impacts: Medium confidence.

While the long term costs and benefits of reforms to the energy system are highly uncertain there is reasonable certainty in the costs of incremental changes in the near term, such as running heat trials and installing the next wave of electric vehicle charging equipment and delivering energy efficiency improvements in social housing.

## Distributional Impacts

Regional	Heat trial recommendations will affect households and businesses in the trial area, although the trial may be set up to compensate those affected. Power generation construction projects may yield short term local economic benefits in jobs and earnings, which are unlikely to be sustained after construction.
Winners	Households that receive subsidised energy efficiency measures will benefit from lower heating bills.
Losers	None identified from recommendations.
Vulnerable/protected groups	Energy efficiency recommendations are being targeted at supporting social sector households.

## Indirect effects

The Commission's recommendations on electric vehicles aim to support faster take up, which will have significant consequences on the energy system: these are outlined in the Assessment.

## Risks

Low = the recommendation is 'no regrets' and is robust to a range of future scenarios.

Medium = some future scenarios could affect the optimal choice of variant or timing.

High = some future scenarios could make the recommendation unviable or obsolete.

Driver	Risk	Description
Economic growth	Medium	<b>Energy efficiency:</b> economic growth could alter the number of home energy efficiency measures undertaken privately, but energy efficiency measures remain a no regrets option. <b>Electric vehicles:</b> Recommendations to support fast uptake of electric vehicles are robust to faster than expected economic growth raising demand for electric vehicles above current expectations, but are low regrets in the event that slower economic growth reduces uptake.
Climate change	Low	<b>Electricity and heat:</b> The recommendations aim to keep the UK on track to meet its emissions targets: if these change due to policy or speed of climate change, faster action may be required.
Technology	Heat: low Electric vehicles: high	<b>Heat:</b> the recommendations do not decide now on a path to heat decarbonisation, but suggest no regrets investments in energy efficiency and scaling up trials of competing heat technologies to improve our information. <b>Electric vehicles:</b> the speed of technological change in electric vehicles increases the risk of obsolescence, but a useful life of 20 years for chargers means the risk is low and a market led approach

		for the capacity should minimise this risk. The Commission’s relatively optimistic projection for electric vehicle adoption means that the recommendation is robust to higher than expected demand, but could lead to some over provision of infrastructure if supply chain issues or slower than expected technology improvement slows the uptake rate. Connected and Autonomous Vehicles (CAVs) and Mobility as a Service (MaaS) could affect demand for ownership of vehicles in unexpected ways.
Population and demography	Medium	<b>Energy Efficiency:</b> A significant change in the number of social sector homes could affect the level of funding required; but energy efficiency measures remain a no regrets option. <b>Electric vehicles:</b> recommendations to support fast uptake of electric vehicles are robust to faster than expected population growth raising demand for electric vehicles above current expectations.
Behaviour change	Low	<b>Energy Efficiency:</b> Even in scenarios where consumers choose to keep their homes warmer, energy efficiency measures makes sense by reducing energy demand and carbon emissions. <b>Electric vehicles:</b> recommendations to support fast uptake of electric vehicles are robust to faster than expected switching to electric vehicles raising demand above current expectations. Lower car ownership would reduce the required density of parking and charging points.
Political change	Medium	<b>Heat:</b> Changes in government policy could impact the decisions on the future of heat, however this is unlikely to impact the specific recommendations. <b>Electric vehicles:</b> electric vehicles have cross party support, although short term risk that creating favourable conditions for electric vehicles, where ownership is initially high income households, is seen as regressive.

## Methodology and assumptions

The costs of these recommendations on hydrogen trials and energy efficiency are calculated relative to a baseline in which they do not occur.

The costs of small and medium scale hydrogen trials are estimated using component costs taken from existing external estimates including the *H21 Leeds City Gate* study and the *HyNet* study.<sup>16,17</sup> These component costs are scaled to the desired number of households as appropriate: property conversions were scaled in proportion with the number of households, and for fixed costs assumptions are made about the amount of infrastructure required. These hydrogen trial costs are recovered from the bills of all gas customers, consistent with a National Grid innovation fund. The bills impacts are calculated from costs assuming they are recovered from revenues, based on

straight line depreciation of the new assets over their lifetime and a Weighted Average Cost of Capital (WACC) of 3.8 per cent for the heat sector.

Element Energy estimated the costs of energy efficiency measures. These costs have been used to assess the cost of the energy efficiency programme in social housing. In addition, an illustrative energy efficiency programme for other households was estimated based on 1.5 energy efficiency measures per fuel poor household, assuming they are the first group targeted by government. £7.2 billion already announced by the government is subtracted from the total cost<sup>18</sup>, and the remaining cost averaged across household bills over a 10 year period to 2030/31.

The capex and opex costs of new charging infrastructure paid for in the fiscal remit are taken from Energy Systems Catapult modelling.

---

<sup>14</sup> John Hills (2012), Getting the measure of fuel poverty – final report of the fuel poverty review. Accessed at:

<https://www.gov.uk/government/publications/final-report-of-the-fuel-poverty-review>

Office for National Statistics (2017), Excess winter mortality in England and Wales. Accessed at:

<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/excesswintermortalityinenglandandwalesreferencetables>

Commission calculations.

<sup>15</sup> National Infrastructure Commission (2018), National Infrastructure Assessment technical annex: Energy and fuel bills today and in 2050

<sup>16</sup> Northern Gas Networks (2016), H21 Leeds City Gate. Accessed at: <https://www.northerngasnetworks.co.uk/wp-content/uploads/2017/04/H21-Report-Interactive-PDF-July-2016.compressed.pdf>

<sup>17</sup> Cadent (2018), HyNet. Accessed at: <https://cadentgas.com/media/press-releases/2018/thousands-of-jobs-set-for-north-west-with-plan-for>

<sup>18</sup> Department for Business, Energy & Industrial Strategy (2018), Clean Growth Strategy. ‘Support around £3.6 billion of investment to upgrade around a million homes through the Energy Company Obligation (ECO), and extend support for home energy efficiency improvements until 2028 at the current level of ECO funding.’ Accessed at:

<https://www.gov.uk/government/publications/clean-growth-strategy>

## Flood resilience

**Description:** Government aims for certain standards of flood resilience for England by 2050. Increase resilience from **river and sea flooding down to a 0.1 per cent annual chance of occurring in major cities, and 0.5 per cent everywhere else it is feasible**. Communities with higher resilience than this should be maintained at their current level).

Costs and benefits are shown for a 2°C increase in global temperatures: a higher temperature increase would require more expensive flood defences for the same level of resilience, but would also achieve greater benefits as a result.

### Objectives

Sustainable growth	No direct impact on economic growth.
Balance across regions	No direct impact on regional growth.
Competitiveness	No quantifiable impact on competitiveness or productivity, although business will benefit from reduced flooding damage and disruption.
Quality of life	<p>Increased flood resilience reduces the damage, disruption, stress and mental health consequences of flooding, and in extreme cases loss of life. In addition to the financial savings from reduced property damage shown in the impact on bills below, the extra resilience yields health benefits worth around £35 million a year by 2050.<sup>19</sup></p> <p>Improved resilience to large floods and to more minor everyday events.</p> <p>Improved service quality for all other infrastructure services through reduced disruption.</p>

### Fiscal remit

Average annual public capital £ million, 2018/19 prices	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Recommendation	600	700	900	1,300	1,300	1,300
<i>Of which:</i> Rolled forward expenditure	510	560	630	700	790	880

The recommendation is compared to 3 year average expenditure as a fraction of GDP between 2014/15 and 2016/17. This has been rolled forward by the Office for Budget Responsibility's central real growth estimate.



## Impact on bills and public sector resource spending

The impacts presented below show the effect of implementing the recommendation relative to a baseline household expenditure in which the current level of flood resilience is maintained.

Negative values denote savings.

Impacts across households, businesses and public sector (£ million, 2018/19 prices)		2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Increase resilience to 0.1 per cent in conurbations, 0.5 per cent elsewhere	Households	-72	-253	-434	-615	-795	-976
	Businesses	-7	-23	-39	-55	-72	-88
	Public sector	+21	+39	+50	+61	+73	+84
	<b>Total</b>	<b>-58</b>	<b>-237</b>	<b>-423</b>	<b>-609</b>	<b>-795</b>	<b>-981</b>
	Per cent change on baseline damages and costs	-3%	-13%	-23%	-31%	-39%	-46%

### Households

It is assumed the flood insurance market is competitive, so savings in expected annual damage to property are passed on in lower building and contents insurance premiums.

Average impact on annual household insurance premium, (£, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Increase resilience to 0.1 per cent in conurbations, 0.5 per cent elsewhere	-£2	-£8	-£14	-£19	-£24	-£29

**Uncertainty:** Medium confidence.

A model is used to estimate the flood resilience costs and expected annual damage for a range of resilience levels and scenarios. Although costs and benefits vary across resilience and climate scenarios, they are all of the same order of magnitude as the 0.1 per cent/0.5 per cent level of resilience illustrated above.

### Distributional Impacts

Regional	English cities outside of London should receive increased protection relative to today.
Winners	Flooding disproportionately affects lower household income groups. <sup>20</sup>
Losers	N/A
Vulnerable/protected groups	Several groups protected under the Equalities Act are more affected by flooding: children, older people and disabled people. <sup>21</sup>

### Indirect effects

None identified.

## Risks

Low = the recommendation is ‘no regrets’ and is robust to a range of future scenarios.

Medium = some future scenarios could affect the optimal choice of variant or timing.

High = some future scenarios could make the recommendation unviable or obsolete.

Driver	Risk	Description
Economic growth	Low	Recommendation is robust to economic growth being higher or lower than expected.
Climate change	High	Recommendation shown here is resilient to a 2°C increase in climate temperatures; a larger temperature increase will require greater resilience to maintain 0.1 per cent/0.5 per cent resilience.
Technology	Low	Flood resilience can be affected by technological change, eg new construction materials, but less so than other sectors.
Population and demography	Medium	The rate of population growth in different areas could alter the optimal distribution of flood resilience.
Behaviour change	Low	No identified impact.
Political change	Low	The occurrence of major floods can increase political support for spending on flood defences.

## Methodology and assumptions

The final bills reflect the relative costs and savings of the different recommendations. Key assumptions that determine how these costs and savings translate into a profile of future bills:

- As well as the modelled capital cost of flood resilience, an uplift is estimated for the costs of defending undefended areas not currently protected by community flood defences.
- The flood insurance market is assumed to be fair and competitive, so that any reduction in expected annual damages are passed on entirely as lower annual insurance premiums.
- Modelled total expected annual damage costs are allocated to households, business and the public sector as follows. The number of households from the Commission principal household scenario is compared to the number of local unit sites from the ONS publication ‘UK business: activity, size and location, 2017’ using data from the Inter-Departmental Business Register (IDBR). Total costs and savings are allocated in proportion between the two. The business costs and savings are then allocated between the private and public sector based on their relative Gross Value Added.
- In addition to expected annual damage to publicly owned property, the public sector incurs costs of operating and maintaining flood defences. Because these are resource rather than capital costs, they are included with the public sector cost in bills impacts, rather than the fiscal remit.

Changes to any of these assumptions would affect the forecast baseline or the impact of the Commission’s recommendations.

---

<sup>19</sup> Commission calculations

<sup>20</sup> Sayers, P.B., Horritt, M., Penning Rowsell, E., and Fieth, J. (2017), Present and future flood vulnerability, risk and disadvantage: A UK scale assessment. Accessed at:

[http://www.sayersandpartners.co.uk/uploads/6/2/0/9/6209349/sayers\\_2017\\_-\\_present\\_and\\_future\\_flood\\_vulnerability\\_risk\\_and\\_disadvantage\\_-\\_final\\_report\\_-\\_uploaded\\_05june2017\\_printed\\_-\\_high\\_quality.pdf](http://www.sayersandpartners.co.uk/uploads/6/2/0/9/6209349/sayers_2017_-_present_and_future_flood_vulnerability_risk_and_disadvantage_-_final_report_-_uploaded_05june2017_printed_-_high_quality.pdf)

<sup>21</sup> Sayers, P.B., Horritt, M., Penning Rowsell, E., and Fieth, J. (2017), Present and future flood vulnerability, risk and disadvantage A UK assessment. Neighbourhood Flood Vulnerability Index: Characteristics, indicators and support variables. Accessed at:

<http://www.climatejust.org.uk/sites/default/files/Sayers%20at%20el%202017%20-%20NFVI%20and%20Vulnerability%20Indicators.pdf>

## Full fibre

**Description:** Full fibre is expected to be delivered by the private sector without intervention in most locations. Recommend government subsidy for full fibre broadband to rural areas where provision is commercially unviable for any operator.

Supply side subsidised rural full fibre deployment, where capital expenditure is split between taxpayer (50 per cent) and network operator (50 per cent), replicating the approach used for the Broadband Delivery UK (BDUK) programme. A clawback mechanism could be employed to recoup money for the taxpayer where uptake passes a certain threshold.

### Objectives

Objective	Impact
Sustainable growth	<p>The potential benefits of investing in fibre are difficult to predict. Frontier Economics have estimated that by 2050 full fibre could deliver £15.7 billion (present value) of additional direct economic output compared to an incremental upgrade.<sup>22</sup></p> <p>Growth benefits from broadband tend to be highest in urban areas or close to urban areas, and in firms with higher skilled workers.<sup>23</sup> The impact on employment and business startups in rural areas is difficult to measure and is likely to be small in the context of overall GDP, but may be necessary to prevent rural growth from falling behind urban growth.</p> <p>Network externalities strengthen the case for faster rural broadband because creating a more consistent standard of performance benefits the whole network.</p>
Balance across regions	All regions of the UK will benefit, with regions that have a higher proportion of rural households and firms benefitting more from the subsidised provision.
Competitiveness	<p>Internet connectivity features in the World Economic Forum's Global Competitiveness Index, with fixed broadband internet subscriptions, internet bandwidth and internet access in schools all contributing to the overall score.<sup>24</sup></p> <p>The impact on labour and business productivity in rural areas is likely to be small in the context of overall productivity. As high quality broadband is a necessary but not sufficient condition for growth, higher productivity will depend on complementary investments. Fast and reliable broadband is expected to improve the effectiveness and efficiency of future infrastructure, for example by providing the foundation for 5G.</p>
Quality of life	<p>Full fibre is more resilient than copper to large shocks, such as flooding and storms, and to everyday weather events. It also performs much better than copper over the longer distances in rural areas.<sup>25</sup></p> <p>The policy principally benefits consumers and small and medium sized enterprises by giving them access to faster and more reliable broadband, whereas larger firms are more likely to already pay for their own full fibre connection. It connects rural areas to economic and</p>

	<p>social opportunities, with social research showing that good broadband access is increasingly seen as a basic right.</p> <p>The quality of public services in areas with low population density, and the cost of providing those services, could fall if improved broadband provision allows specialised services to be provided online.</p>
--	---

### Fiscal Remit

Average Annual Exchequer Impact (£ million, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
50 per cent subsidised rural full fibre	400	300	100	0	0	0

### Impact on bills and public sector resource spending

Other than the subsidy to the hardest to reach rural areas, it is assumed that costs of installing, maintaining and operating full fibre are recovered through the bills of customers who choose to buy a fibre broadband package. By choosing to buy fibre broadband, these customers would be expected to be making a decision that benefits them. Because these costs do not lead to an involuntary increase in bills for existing broadband users, no impact on bills is estimated for the full fibre recommendation.

**Uncertainty:** Medium confidence.

Numbers are based on published research for the Commission, however long term forecasting in the digital sector is challenging.

### Distributional Impacts

Regional	<p>Around 20 per cent of UK premises are in rural areas. All regions of the UK will benefit, with regions that have a higher proportion of rural households and firms benefitting more from the subsidised provision. A large proportion of rural areas are in Scotland, Wales and Northern Ireland.</p> <p>The rural areas that do not currently have superfast broadband will benefit the most, followed by the rural areas with no incremental upgrade path from superfast broadband.</p>
Winners	Rural households and businesses that benefit from faster and more reliable broadband.
Losers	Depending on how broadband providers price their services, rollout of full fibre could be paid for by broadband users more generally.
Vulnerable/protected groups	Faster and more reliable broadband will improve access to online services for vulnerable customers who live in isolated rural areas.

## Indirect effects

Full fibre in rural areas may have an impact on decisions to locate away from cities. This impact is not captured in the analysis above, and is one of many location decision factors.

Rural full fibre could pave the way for further improved technology such as 5G. It could also allow costly alternative services such as the copper network to be switched off, which would yield significant cost savings nationally.

## Risks

Low = the recommendation is 'no regrets' and is robust to a range of future scenarios.

Medium = some future scenarios could affect the optimal choice of variant or timing.

High = some future scenarios could make the recommendation unviable or obsolete.

Driver	Risk	Description
Economic growth	Low	The recommendation is the preferred option in all future economic growth scenarios.
Climate change	Low	Full fibre is more resilient to adverse weather conditions than copper or wireless technologies.
Technology	High	In a scenario of fast technological change, higher connection speeds will be necessary to meet demand. The recommendation would be the most resilient option in this case.  However, if wireless technology improves or becomes cheaper, it could make the final fibre to the premises physical connection redundant.
Population and demography	Low	Greater concentrations of the population in city centres would reduce the benefits of rural full fibre relative to further investment in urban broadband.
Behaviour change	Medium	Demand for data is driven by the younger generations. It is uncertain whether they will continue to demand data in the same way as they age, and whether new generations will continue to increase demand for data.  If critical services are increasingly delivered online, the benefits to rural areas of a consistent and high quality connection would be much greater, so the rural full fibre recommendation is resilient to this.
Political change	Low	There is widespread political support for broadband.

## Methodology and assumptions

Capex and opex costs of installing full fibre broadband to the 20 per cent hardest to reach premises in the UK are taken from external modelling undertaken by Tactis for the Commission.<sup>26</sup>

Tactis estimate the nominal capex and opex costs for 100 per cent full fibre (Fibre to the Premises) in the UK, for each of 6 'geotypes' (areas classified by their urban/rural mix). They also provide a list of

network lengths needed to reach the 20 per cent hardest to reach Optical Sub-loop Cabinets (OSCs), by geotype.

To estimate the relevant costs of providing full fibre to the 20 per cent hardest to reach OSCs, the proportion of the each geotype's total network length that falls under the 20 per cent hardest to reach network is applied to the 100 per cent full fibre capex and capex refresh costs for each geotype. Capex is therefore scaled to the network length of the 20 per cent hardest to reach OSCs, which is around 40 per cent of the total network length. Opex is scaled by the number of hardest to reach OSCs in each geotype, rather than hardest to reach network length, following Tactis advice.

Once the capex and opex costs for the 20 per cent hardest to reach premises/OSCs have been estimated in this way, they are converted to fiscal remit impacts. The initial capex expenditure is spread across the first 12 years of the project, with some capex renewals occurring once every 8 years. 50 per cent of capex costs for original network construction (not including renewals or premises connection costs) are paid through the fiscal remit as a government subsidy.

---

<sup>22</sup> Frontier Economics (2017) Benefit analysis of future digital infrastructure

<sup>23</sup> What Works Centre for Local Economic Growth (2015) Evidence Review 6 – Broadband

<sup>24</sup> World Economic Forum (2017) The Global Competitiveness Report 2017–2018

<sup>25</sup> Tactis, Prism (2017) Costs for digital communications infrastructures. Accessed at:

<https://www.nic.org.uk/publications/costs-digital-communications-infrastructures/>

<sup>26</sup> Ibid

## Waste

**Description:** A package of measures to improve the environmental impact of the waste sector. The recommendation is to (1) increase to a 65 per cent recycling rate and 75 per cent for plastic packaging, (2) commit to separate collection of food waste services (3) move to a mandatory, two-mark recycling system, requiring consistent local authority collection practices (4) restrict hard to recycle plastic polymers from packaging.

Recommendation (4) serves as a proxy for the bills impact of increasing the ‘recyclability’ of consumer packaging.

The recommendation also includes £300 million of transitional capital for containers between 2020/21 and 2022/23.

## Objectives

Sustainable growth	<p>This package brings greenhouse gas emissions down against a continuation of the current infrastructure mix through a number of channels: turning food waste into biogas provides a substitute for natural gas; increasing recycling reduces the volume of fossil content (plastic) that is incinerated; clear labelling should reduce contamination, meaning less food will go to landfill and less plastic to energy from waste plants.</p> <p>In total, the recommendation saves a total of 156 megatonnes of CO<sub>2</sub> equivalent (MtCO<sub>2</sub>e) between 2020 and 2050. In 2025, 1.5Mt is saved annually, rising to 8Mt annually by 2050. These figures represent both short and long cycle emissions (i.e. biogenic and fossil-based).</p> <p>The recommendations are not expected to have any impact on economic growth.</p>
Balance across regions	There are no region specific impacts to this recommendation. The policy will apply equally across England.
Competitiveness	There is no clear impact on competitiveness as a result of this recommendation.
Quality of life	<p>There are second order environmental benefits to this package of recommendations. Reducing the quantity of waste that is landfilled can limit environmental harm: there is limited hard evidence, but poorly managed landfills can leak which may enter water systems.</p> <p>Energy from waste facilities do produce local pollutants, which can be a cause of opposition, but these emissions are tightly controlled by European emissions directives. Modern well managed incinerators make only a small contribution to local concentrations of air pollutants for which health effects, if they exist, are likely to be very small.<sup>27</sup></p>



## Fiscal Remit

Average Annual Exchequer Impact (£ million, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
<b>Recommendation (total)</b>	<b>600</b>	<b>500</b>	<b>500</b>	<b>500</b>	<b>500</b>	<b>500</b>
Memo: Fiscal baseline	490	500	510	520	520	530

Recommended expenditure is higher than the fiscal baseline in 2020-25 because of the £300 million transitional capital fund.

## Impact on bills and public sector resource spending

The impacts presented below show the cost of implementing the recommendation relative to a 'baseline' counterfactual state of the world. In this baseline, no new infrastructure is built in England to deal with residual waste and landfill is assumed to be available to fill the gap. Recycling infrastructure expands to deal with growing arisings based on current recycling policy targets. The baseline also assumes that current levels of hard to recycle plastic polymers continue to be used in packaging.

### Total bills remit cost

Increasing the recycling rate and separating food waste collection affects the cost to local authorities of providing waste services, and the cost to businesses of paying for waste services. Although private sector waste processing businesses are directly affected, it is assumed that this market is competitive, so any costs or savings are passed through to their customers. The customers are local authorities who collect household waste, and commercial/industry firms who produce waste. No estimate is made of how local authorities manage changes to their costs through adjustments to taxes or spending.

Restricting difficult to recycle plastic polymers from packaging would increase business costs for producers and users of packaging, but it is assumed that all these costs are passed through to households in higher product prices. This can therefore be considered an upper bound estimate of the cost to households.

Annual total impacts: households, businesses & public sector (£ million, 2018/19 prices) (Negative values indicate net savings compared to the baseline)		2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
High recycling rate, separate collection of food waste, and polymer restriction	Households	+162	+169	+175	+181	+185	+189
	Businesses	-9	-27	-58	-88	-103	-117
	Public sector	-10	-30	-65	-100	-117	-133
	<b>Total</b>	<b>+143</b>	<b>+112</b>	<b>+53</b>	<b>-8</b>	<b>-34</b>	<b>-61</b>
	<i>Per cent change on baseline total waste costs + annual cost of packaging</i>	+1.4%	+1.1%	+0.5%	-0.1%	-0.3%	-0.6%

### Households and businesses

Increasing the recycling rate and collecting food waste separately would increase the amount of time and effort required from households and businesses to prepare and sort their waste. This would incur a time cost to households and an operating cost to businesses. However, these costs are not modelled here.

Average impact on annual household spending, (£, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Restrict hard to recycle polymers in packaging	+£6	+£6	+£6	+£6	+£6	+£6

Like local authorities, businesses make savings as the cost of waste services falls in the high recycling scenario, driven by the higher revenues available from recyclates.

Impact on annual business costs (£ million, 2018/19 prices)	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
High recycling rate, separate collection of food waste, and polymer restrictions Impact of recommendation	-9	-27	-58	-88	-103	-117

**Uncertainty:** Medium confidence.

Modelling of the costs of higher recycling is comprehensive and based on industry and local authority data. Data on the materials costs of replacing hard to recycle packaging is weaker, and the transition costs have not been estimated. Future prices for secondary materials are uncertain, which makes forecasting revenue streams challenging, although sensitivity tests were performed as part of the consultancy modelling.

### Distributional Impacts

Regional	There is no clear trend to the regional impact of this recommendation: cost and savings will differ according to current local authority recycling practices in England.
Winners	Local authorities with advanced recycling practices and businesses which use easy to recycle packaging will face the lowest transition costs.
Losers	Local authorities with limited recycling services will face the largest transition costs, though the recommendation includes funding for these.
Vulnerable/protected groups	No impacts identified.

### Indirect effects

England’s reliance on virgin material should decrease. Increased recycling rates rely on behavioural change by households to separate their waste.

## Risks

Low = the recommendation is ‘no regrets’ and is robust to a range of future scenarios.

Medium = some future scenarios could affect the optimal choice of variant or timing.

High = some future scenarios could make the recommendation unviable or obsolete.

Driver	Risk	Description
Economic growth	Medium	Waste growth is loosely coupled with economic growth. In a high growth scenario, the infrastructure needs (and costs) will increase. Otherwise, the mix and type of infrastructure is constant across the range of growth scenarios.
Climate change	Low	No impact.
Technology	Medium	Advances in sorting technology may replace the need for households to separate waste. This would call for a reconfiguration of collection services and increase the demand for sorting infrastructure.
Population and demography	Medium	Waste growth is strongly coupled with population growth and household size. A high population scenario will call for more waste infrastructure of all types.  Waste growth is also coupled with household formation: on average, smaller households produce more waste per capita.
Behaviour change	Medium	Recycling rates are driven by the public’s willingness to engage with the collection system. Evidence from other countries suggest recommended targets are achievable.
Political change	Low	Unlikely to have a major impact.

## Methodology and assumptions

### Higher recycling rate and segregated food waste

The costs of a 65 per cent recycling rate and separate collection of food waste are based on modelling by Anthesis Ltd of the capital cost, operational cost and revenue implications of these policies.<sup>28</sup> The costs and revenues are modelled in two phases. Phase 1 is collection and sorting, which is assumed to be operated by local authorities. Waste from Phase 1 is passed onto Phase 2, treatment and disposal, which is assumed to be operated by the private sector.

It is assumed that the treatment and disposal market is competitive, so any cost and revenue impacts in Phase 2 are passed entirely through to their customers: local authorities and businesses.

Capital costs from Phase 1 are added directly to the fiscal remit, as they are incurred by local authorities. Other capital costs are recovered from gate fees through a combination of:

- Straight line depreciation over a 30 year asset life

- a real Weighted Average Cost of Capital of 7 per cent which rises in line with expected future increases in the risk free interest rate.

The high recycling rate and food waste costs and revenues shown above are based on the midpoint of two scenarios: high economic and population growth, and low economic and population growth. These were taken from the Commission's drivers papers.<sup>2930</sup>

Impacts are modelled relative to a business as usual baseline, in which current waste infrastructure and practices are maintained, and recycling rates do not improve.

Commercial and Industrial (C&I) businesses are required to pay for the full cost of collecting, sorting, treating and disposing of the waste they produce. The percentage of net costs attributed to businesses is assumed to be the same as the percentage of total tonnes of waste which are produced by the C&I sector in Anthesis assumptions. The remainder of net costs are paid for by local authorities who fund the disposal of residential waste. The costs for businesses of sorting their own waste for segregated collection has not been modelled, and neither has the time spent by households sorting their waste.

For the fiscal remit, the modelled impacts are small. They do not take into account the associated costs of recycling plant infrastructure and new vehicles needed to achieve consistent collections. Recycling plant infrastructure is largely run in the private sector (and hence impacts on public sector resource spending, rather than capital). Vehicles can be replaced as they reach the end of their service lives. Of local authorities' capital expenditure on waste management 20 per cent is on vehicles. A growth factor of 1.3 per cent has been applied to account for waste growth.

#### Restrict hard to recycle plastic polymers from packaging

As a proxy for the replacement of hard to recycle polymers in packaging, the material costs of polystyrene, expanded polystyrene and PVC are compared to the cost of corrugated cardboard and PET which are considered to be appropriate packaging substitutes.

Data on packaging material costs and densities are used to estimate the costs of replacing polystyrene and PVC with the equivalent volumes of corrugated cardboard and PET.

If the design of new packaging with recyclable materials is more difficult and expensive, there may be additional costs that are not captured by the materials volume comparison. Nevertheless, these extra costs are likely to diminish over time as new manufacturing and logistics processes become more embedded.

100 per cent of the additional costs of more recyclable packaging are assumed to be passed through to households. In reality, businesses may choose to absorb some of the additional costs.

---

<sup>27</sup> Defra (2014) Energy from Waste: A Guide to the Debate. Accessed at:

<https://www.gov.uk/government/publications/energy-from-waste-a-guide-to-the-debate>

<sup>28</sup> Anthesis (2018) National Infrastructure Assessment: Waste Infrastructure Analysis for England

<sup>29</sup> National Infrastructure Commission (2017) Economic growth and demand for infrastructure services. Accessed at:

[https://www.nic.org.uk/wp-content/uploads/2906219-NIC-Technical-Paper-Economic-Driver-v1\\_oA-WEBACCESSIBLE.pdf](https://www.nic.org.uk/wp-content/uploads/2906219-NIC-Technical-Paper-Economic-Driver-v1_oA-WEBACCESSIBLE.pdf)

<sup>30</sup> National Infrastructure Commission (2017) The impact of population change and demography on future infrastructure demand. Accessed at: [https://www.nic.org.uk/wp-content/uploads/2906064-NIC-Population-and-Demography-Document-v1\\_1w.pdf](https://www.nic.org.uk/wp-content/uploads/2906064-NIC-Population-and-Demography-Document-v1_1w.pdf)

## Water

**Description:** A package of measures to improve resilience by increasing efficiency of water use and expanding water supply capacity. The recommendation is to (1) build new supply infrastructure, (2) improve water efficiency, and (3) require more leakage reduction.

The package modelled here is **50 per cent leakage reduction and reduced demand to 118 litres per person per day** by 2050, with a **transfer network and additional supply** by the 2030s. This increases capacity by 4,000 megalitres (Ml) per day over current levels, achieving **resilience to a 0.2 per cent annual likelihood drought** in all regions. This is for a scenario of high population growth and dry climate change, and therefore represents a high estimate of likely required resilience and costs.

### Objectives

Sustainable growth	<p>The recommendation saves 1 megatonne (Mt) of CO<sub>2</sub> annually by 2050 from abstracting, pumping and treating less water, and save 28 Mt of CO<sub>2</sub> in total between 2020 and 2050.</p> <p>The recommendation will provide capacity to accommodate future population and economic growth, although this impact is not quantifiable.</p>
Balance across regions	No quantifiable impact on regional growth.
Competitiveness	No quantifiable impact on competitiveness or productivity, although industrial water users are expected to benefit from improved resilience.
Quality of life	<p>Droughts have a substantial negative impact on those affected, with health and environmental consequences as well as the expense and inconvenience of responding to the drought. Reducing drought risk improves quality of life by preventing these costs from arising.</p> <p>The recommendation provides resilience to costly droughts that have no more than a 1 in 17 chance of occurring before 2050 (equivalent to 0.2 per cent annual likelihood). Based on current resilience levels these droughts would cost £40 billion in emergency response measures (expected present value, including the costs of maintaining the current level of resilience), higher than the £21 billion (present value) cost of building resilience to them.</p> <p>The recommendation would also improve operational resilience to day to day supply interruptions.</p> <p>2 per cent more water left in the environment relative to the baseline improves water quality, habitats and the ecosystem.</p>

**Fiscal Remit:** no impact

### Impact on bills and public sector resource spending

The impacts presented below show the cost of implementing the recommendation relative to a 'baseline' counterfactual state of the world in which resilience to a 1 per cent annual likelihood drought is maintained. Due to population, environmental and climate pressures, this baseline would require extra capacity of 3,000 Ml/day in England by 2050, in addition to current capacity.

The Commission's recommendation is expected to increase capacity by 4,000 MI/day in 2050, which should provide resilience to a drought with a 0.2 per cent annual chance of occurring. The bills remit impacts below represent the cost of the extra 1,000 MI/day of capacity needed to raise capacity from the baseline 3,000 MI/day to the recommended 4,000 MI/day in 2050. This cost is different to the £21 billion (present value) stated above, which represents the total cost of 4,000 MI/day extra capacity, i.e. the baseline + recommendation.

#### Total bills remit cost

Annual total impacts: households, businesses & public sector (£ million, 2018/19 prices)		2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Resilience to 0.2 per cent drought with 50 per cent leakage reduction, relative to the baseline	Households	+240	+496	+216	+218	+218	+217
	Businesses	+57	+118	+51	+52	+52	+52
	Public sector	+12	+24	+11	+11	+11	+11
	<b>Total</b>	<b>+308</b>	<b>+638</b>	<b>+278</b>	<b>+281</b>	<b>+281</b>	<b>+280</b>
	Per cent change on baseline	+2.5%	+4.8%	+2.1%	+2.1%	+2.1%	+2.0%

#### Households

As well as the impacts relative to the future baseline, changes in household bills are also shown relative to current average bills in 2018/19 prices. This acknowledges that in addition to the impact of the Commission's recommendation, there are expected trends in the baseline which will affect the overall cost of future water bills compared to today.

Average annual household bill (£, 2018/19 prices)	Average bill in 2018/19	Average bill 2020-2050	Average difference from 2018/19 bill, 2020-2050	Average difference from the baseline, 2020-2050
Resilience to 0.2 per cent drought with 50 per cent leakage reduction	£388	£382	-£6	+£10

Average impact on annual household bill, (£, 2018/19 prices)		2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Resilience to 0.2 per cent drought with 50 per cent leakage reduction, relative to the baseline	Impact of recommendation	+£9	+£18	+£8	+£8	+£7	+£7
	Expected change in bills from 2018	-£6	+£14	-£10	-£13	-£19	-£22

#### Businesses

As well as the impacts relative to the future baseline, total water bills as a percentage of total business operating costs are also shown to indicate whether water expenditure is expected to significantly affect business cost pressures. Total business costs are assumed to grow in line with GDP.

Impact on annual business costs (£ million, 2018/19 prices)		2020-25	2025-30	2030-35	2035-40	2040-45	2045-50
Resilience to 0.2 per cent drought with 50 per cent leakage reduction, relative to the baseline	Impact of recommendation	+57	+118	+51	+52	+52	+52
	Total costs (per cent of operating costs)	0.08%	0.08%	0.07%	0.06%	0.06%	0.05%

**Uncertainty:** Medium confidence.

Detailed information about water company assets and costs are available from Ofwat, Price Review determinations and water company annual reports. The decline in the baseline projection of water bills is broadly aligned with Defra’s published water bills forecast *Cumulative impact of regulation & policy on future water bills* (2015). The trend and path of water bills are quite sensitive to the regulatory assumptions listed at the end of this note.

### Distributional Impacts

Regional	The south east and east of England benefit most from recommendations as the regions with the biggest water deficits, but will also pay the most because of the regional organisation of water companies. Central and north England will benefit less than the south east and east, and the additional cost they face will be proportionately smaller.
Winners	Some households that reduce consumption after switching to a metered tariff could benefit from lower water bills.
Losers	Bills will rise in households that already have smart water meters and households where it is not possible to install a water meter, although they will still benefit from improved resilience. Larger households who would struggle to reduce their water use are also more likely to see their bills rise where companies choose to roll out compulsory metering.
Vulnerable/protected groups	Policies are in place to help vulnerable households afford their water bills. Smart metering can enable these tools to reach more vulnerable customers and be better targeted.

### Indirect effects

Lower leakage and water demand will reduce the amount of new water supply infrastructure needed, which is captured in the modelling. Lower consumption partly relies on a behavioural response to the installation of smart water meters.

The bills impacts shown above do not capture non-monetary impacts of reduced water use such as lower consumer welfare. They also do not capture the emergency costs of droughts that are prevented by the additional resilience, because these costs would only arise in the event that a serious drought occurs.

### Risks

Low = the recommendation is ‘no regrets’ and is robust to a range of future scenarios.

Medium = some future scenarios could affect the optimal choice of variant or timing.

High = some future scenarios could make the recommendation unviable or obsolete.

Driver	Risk	Description
Economic growth	Low	Recommendation is robust to higher economic growth; lower growth would cause excess capacity which would improve resilience to more extreme droughts.

Climate change	Low	Recommendation is robust to a drier climate; wetter climate would cause excess capacity which would improve resilience to more extreme droughts.
Technology	Medium	If cost of leakage reduction is higher than expected, the optimal level of leakage reduction would be lower than recommended.
Population and demography	Low	Recommendation is robust to higher population growth; lower population growth would cause excess capacity which would improve resilience to more extreme droughts.
Behaviour change	Low	Reduced consumption is based on a conservative assumption on behavioural change, so per capita water consumption could reduce even more than expected. However, behaviour change is inherently uncertain, so could be less than expected.
Political change	Medium	Changes to the ownership of the water industry would not affect the choice of recommendation, but might affect its delivery and the impact on household bills.

### Methodology and assumptions

The bills impacts shown above are derived by applying the current water regulation framework to the estimated costs and savings of the recommendation. Baseline future water bills in a high cost leakage reduction and metering scenario are aligned to the forecast decline in water bills by 2050 from Defra's 2015 publication *Cumulative impact of regulation & policy on future water bills*, and then adjusted to allow for lower cost leakage reduction and demand. The costs of reducing demand are proxied by the costs of rolling out smart meters. The impacts of the recommendation are added to this baseline to estimate final bills.

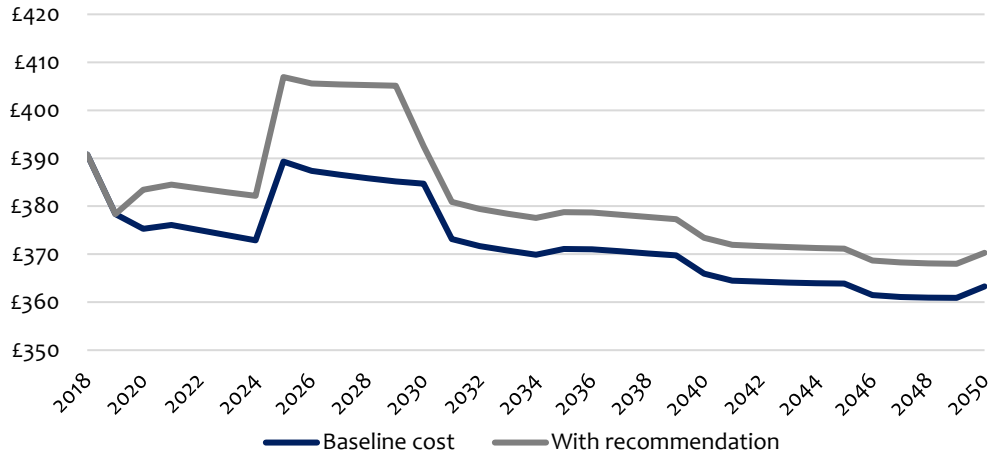
As would be expected, the final bills reflect the costs and savings from different components of the recommendation. There are some key assumptions that determine exactly how these costs and savings translate into a profile of future bills:

- The Weighted Average Cost of Capital (WACC) for the water sector, and its forecast future path which is largely determined by expected future changes to the risk free rate. (Assumed 3.4 per cent until 2024, 4.2 per cent until 2029, and 4.4 per cent from 2030 onwards).
- The 'pay as you go' proportion of total expenditure which is passed directly through to current bills instead of being added to the regulated capital stock (assumed 60 per cent, the average for the PR14 price control period).
- Asset life assumed for cost recovery purposes (assumed 31 years, the average for the PR14 price control period).
- The proportion of wholesale revenues allocated to household vs non household consumers (assumed 78 per cent to households, the current average allocation reported by water companies).

Changes to any of these assumptions would affect the forecast baseline of water bills or the impact of the Commission's recommendation.



**Projected average annual household bill, 0.2% drought resilience,  
50% leakage reduction, high population & dry climate  
(£ 2018/19 prices, magnified y axis)**



**Projected average annual household bill, 0.2% drought resilience,  
50% leakage reduction, high population & dry climate  
(£ 2018/19 prices)**

