This publication was withdrawn on 17 June 2025.

This document has been replaced by the National Framework for Water Resources 2025: water for growth, nature and a resilient future.

Appendix 5: Future non-public water supply demand

Water resources national framework

16 March 2020

Version 1

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Future non-public water supply demand

We have worked with Defra and a team of sector experts led by Wood plc to examine the key drivers for and uncertainties in future water demand outside the water industry. This has focused on direct abstraction rather than water supplied by water companies and has prioritised a range of water-using sub-sectors.

The main findings of this work have been summarised in the Water Resources National Framework. They are written up in full in the report: 'Understanding Future Water Demand Outside of the Water Industry'[1] produced as part of the project. This document expands on the elements that have been summarised in the national framework document and is intended to supplement that information for those with a deeper interest in this area.

Developing projections of future non-water company demand is not straightforward. Demand within each business or sub-sector, and for individual users, depends on many factors including water availability, product market forces, economics, policy and regulation. This means there is considerable uncertainty associated with the results. However they represent the best information we have available at this time. The work considered the following water uses:

- spray irrigation
- livestock
- protected edible crops and ornamental plants
- food and drink manufacturing
- electricity production
- paper and pulp
- chemicals manufacturing

The sectors were prioritised because they cover a large proportion of current water use. Together, these 7 water uses are estimated to account for in excess of 60% of total consumptive freshwater direct abstraction arising from outside the water industry. The results show potential changes to spray irrigation, electricity production, paper and pulp, chemicals and food and drink based on standard growth estimates across England with no regional variations. More work is required to assess the potential changes in demand for other uses, particularly livestock and commercial production of ornamental plants and protected edible crops, so these have not had specific growth estimates applied.

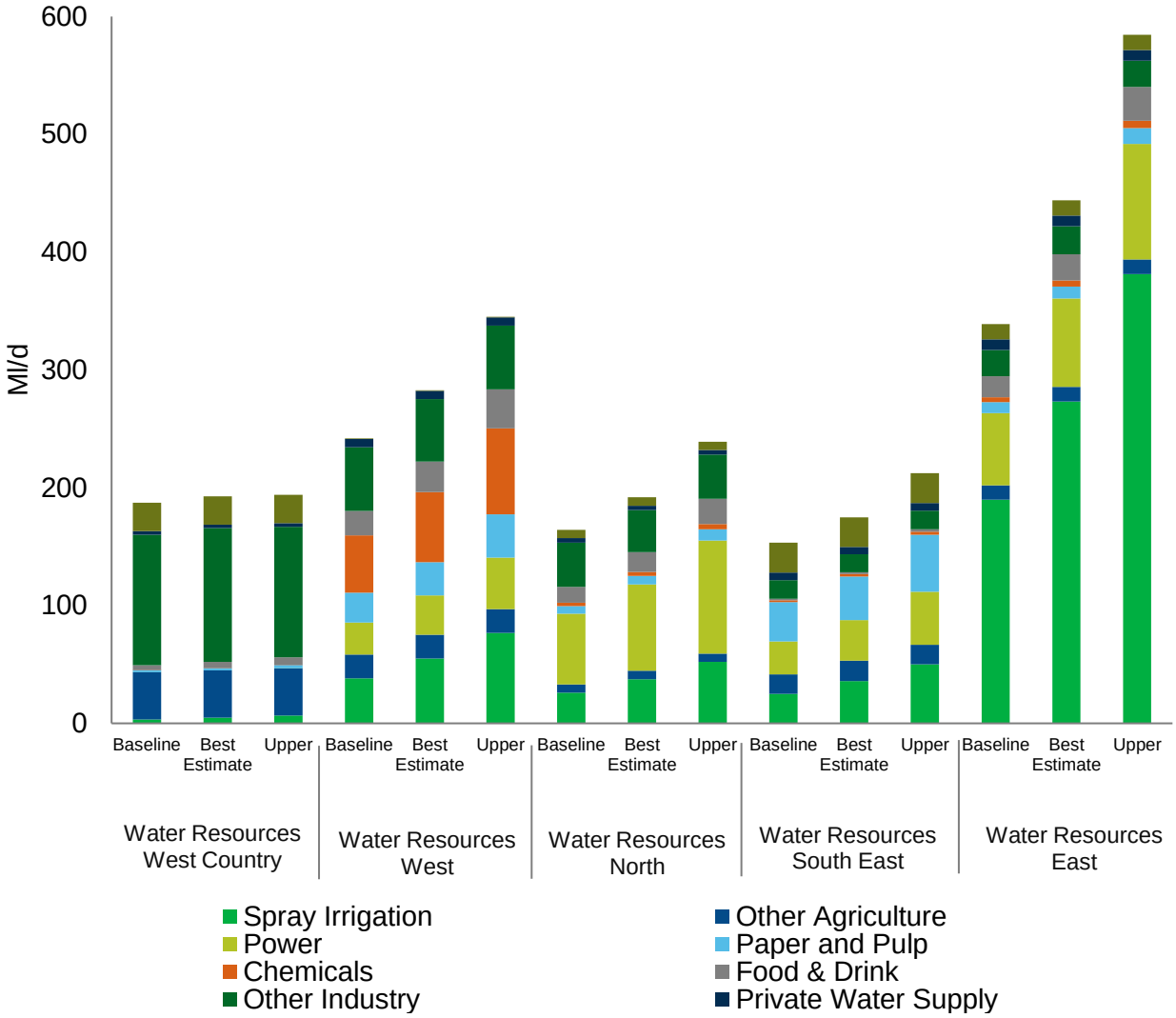
Scenarios were used to explore possible changes to water consumption up to 2050. These varied the factors that affect current and future water use, looked at pressures on individual uses and used this to develop an assessment of how demand could change.

Figure 1 shows the potential changes in water consumption for different sectors to 2050. The graph shows 3 scenarios. Baseline, which equals recent actual abstraction (2010 to 2015), best estimate and upper quartile to illustrate a reasonable range of possible water consumption. Overall it shows that there is likely to be an increase in demand for water not supplied by water companies. This could be an increase of 73.2 million cubic metres per year (200.5 Ml/d) under the best estimate and 178.6 million cubic metres per year (489.3 Ml/d) under the upper estimate. In all sectors examined in detail, the potential increase in demand remains lower than the fully licensed quantities at a national level. However

[1] 'Understanding Future Water Demand Outside of the Water Industry, Defra (2020)

demand for water from electricity production in the north and paper and pulp in the south east and east could exceed licensed quantity under the upper scenario. For the non-priority sectors there is no upper estimate so the higher levels of water consumption use baseline (recent actual) use.

Figure 1: The potential range of changes to non-public supply use by region under the baseline, best estimate and upper scenarios to 2050.



Uncertainty

The uncertainty associated with estimates of water use for food and drink, chemicals, paper and pulp, spray irrigation and power generation is illustrated in Figure 2. The box and whiskers represent the 25th and 75th percentile (lower and upper growth estimates) and the 5th and 95th percentiles (lower and upper range of uncertainty) respectively with the exception of the power box which represents 25th and 75th percentiles only as the range of uncertainty has not been quantified for this sector. The best estimate is the grey triangle. The range of uncertainty is particularly great for spray irrigation and food and drink industries.

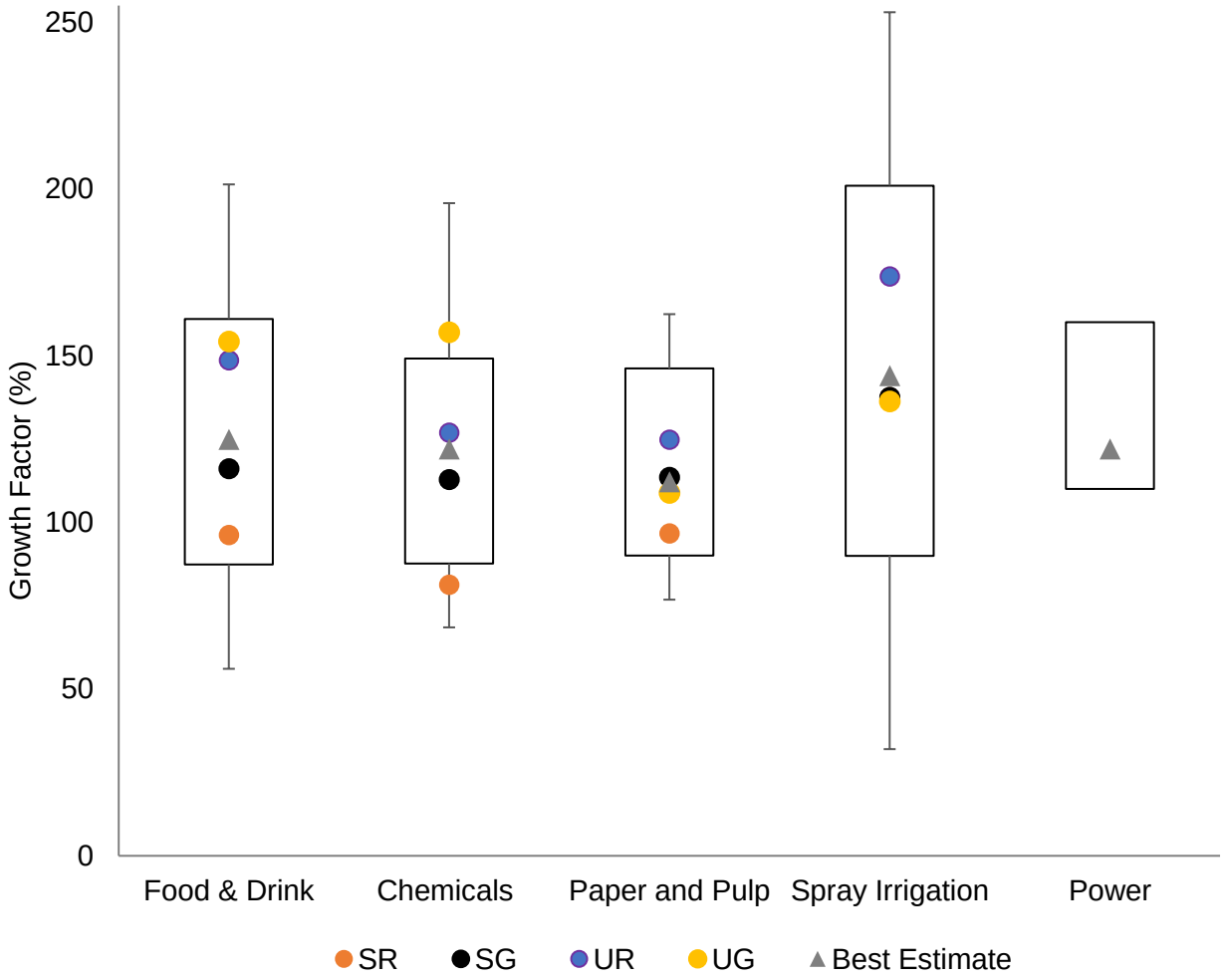
The work led by Wood plc looked at 4 growth scenarios to understand the range of likely future water needs. These are explained in the Wood plc report. They are:

- Sustainable Regionalisation (SR)
- Sustainable Globalisation (SG)
- Uncontrolled demand Regionalisation (UR)

- Uncontrolled demand Globalisation (UG)

The high level of uncertainty means that planning for changes to non-water company water use is challenging and will need to be reviewed as plans progress. We expect regional groups to work with local business sectors that use non-mains supplies and to include these sectors in their regional plans. Note that for power there are only estimates of lower and upper quartile growth estimations, not the four scenarios.

Figure 2: The growth factors and uncertainty associated with the estimates of water use for food and drink, chemicals, paper and pulp, spray irrigation and power generation.



Agricultural demand - spray irrigation

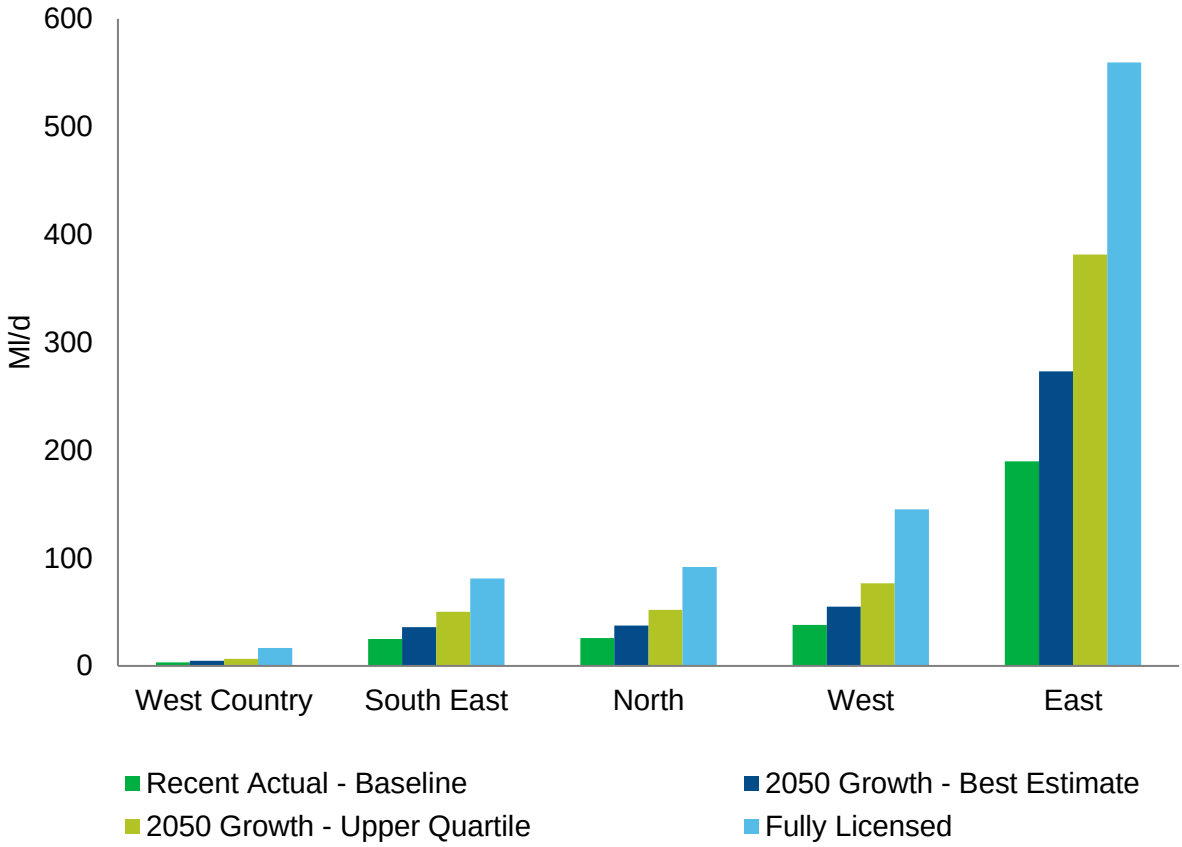
Spray irrigation includes irrigation of outdoor crops and grass. Most irrigation is used to supplement rainfall during the summer. The highest demand for spray irrigation is in the drier parts of England and where crops that are sensitive to water stress are grown. The theoretical demand varies from year to year with rainfall. However, in a dry summer, many farmers apply less water than the theoretical optimum either because they have insufficient equipment or other water resource constraints (limited by licence conditions on peak rates), or to reduce costs (the agronomic optimum does not always equate to the economic optimum).

There has been an underlying downward trend in irrigation since 1990, due possibly to tighter licence conditions, increased costs of irrigation (rising energy costs), increased efficiency and changes in cropping. Drivers of changing irrigation patterns include

cropping, consumer demand, crop yield and waste, the balance between imports and exports, irrigation practices and efficiency, weather and climate, costs and benefits of irrigation, sustainability standards and regulatory pressure such as sustainability changes.

Figure 3 shows possible changes in spray irrigation demand under the 3 simplified scenarios. This could range from the baseline of 103.0 million cubic metres per year (282 Ml/d) to 207.0 million cubic metres per year (567.1 Ml/d) with a best estimate of 148.3 million cubic metres per year (406.3 Ml/d). The greatest potential best estimate increase is in Water Resources East which could make up 99.7 million cubic metres (273.2 Ml/d) of the total best estimate, an increase of 30.5 million cubic metres per year (83.5 Ml/d).

Figure 3: The potential change to water demand for spray irrigation under the baseline and three simplified scenarios.



Food and drink manufacturing

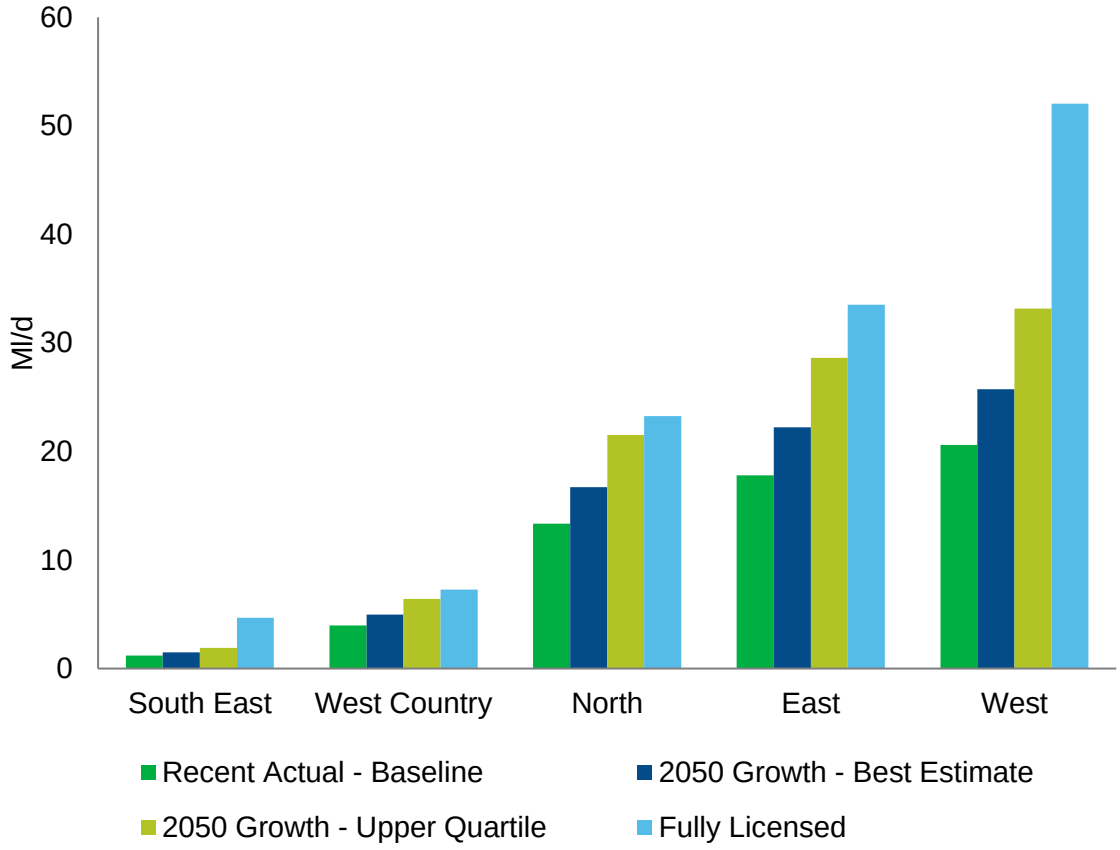
Food and drink manufacturing is a diverse sector including meat, seafood, baked goods, dairy, confectionary, ready meals, soft drinks, and alcoholic beverages. Food and drink is the largest manufacturing sector in the United Kingdom with output growing by over 21% since 1990. The sector is present across the whole of England with the north west, Yorkshire and Humber and East Midlands comprising the largest proportion of turnover and gross value added for the sector.

Although the industry has grown since 1990, overall water consumption (both public water supply and non-public water supply) has reduced due to a combination of economic conditions and a commitment by the industry to cut its water consumption. Factors affecting water consumption include consumer demand, diet and eating trends, food waste and improvements to processes and water efficiency. Also political and economic factors

such as import tariffs, regulations and standards. Population growth as well is likely to play a part in increased consumption of food and associated water use.

Figure 4 shows possible changes in demand for direct abstraction by the food and drink industry under the 3 simplified scenarios. This could range from the baseline of 20.8 million cubic metres per year (56.9 Ml/d) to 33.4 million cubic metres per year (91.6 Ml/d) with a best estimate of 26.0 million cubic metres per year (71.1 Ml/d). The greatest potential best estimate increases are in Water Resources West at 1.9 million cubic metres per year (5.1 Ml/d) and Water Resources East at 1.6 million cubic metres (4.4 Ml/d). The smallest increase is predicted to be in the south east.

Figure 4: The potential change to water demand for food and drink manufacturing under the baseline and three simplified scenarios.



Electricity production

The electricity sector involves many operators and there are complex links between commercial, policy and technical drivers of change. We have considered water used in thermal power generation and its consumptive use of freshwater. There is a growing range of electricity generating technologies, some of which require no water to operate such as wind and solar photovoltaic generation, but the sector is still dominated by thermoelectric generation (including gas, nuclear and thermal renewables).

Thermoelectric power stations use water for a range of purposes but most is used for cooling the exhaust heat from the generators. For this reason, the UK power station fleet has developed in clusters driven in part by access to available water (rivers, estuaries and coastal regions). The amount of water used by power stations depends on the technology they use. For water cooled plants, the gross water usage significantly outweighs the consumptive process requirements.

For the electricity production sector, evaporative cooling forms the largest consumptive use of water directly abstracted; 40% of this is located in the Water Resources East region, 28% in Water Resources North, 19% in Water Resources South East, and 13% in Water Resources West. This water is taken at 14 sites. A review of recent evidence indicates that 4 of these sites have been closed (either temporarily or permanently) meaning that water use may be significantly reduced at some sites, at least in the short-term.

Pressures on and reasons for changes to the sector's water use include political and market drivers, economic, social, environmental and technological changes. Demand for electricity, the mix of electricity generation plants and technology will also affect the amount of water consumed. All scenarios developed recently point to a significant increase in electricity demand over the coming decades resulting from a range of factors, but importantly decarbonisation targets play a major role.

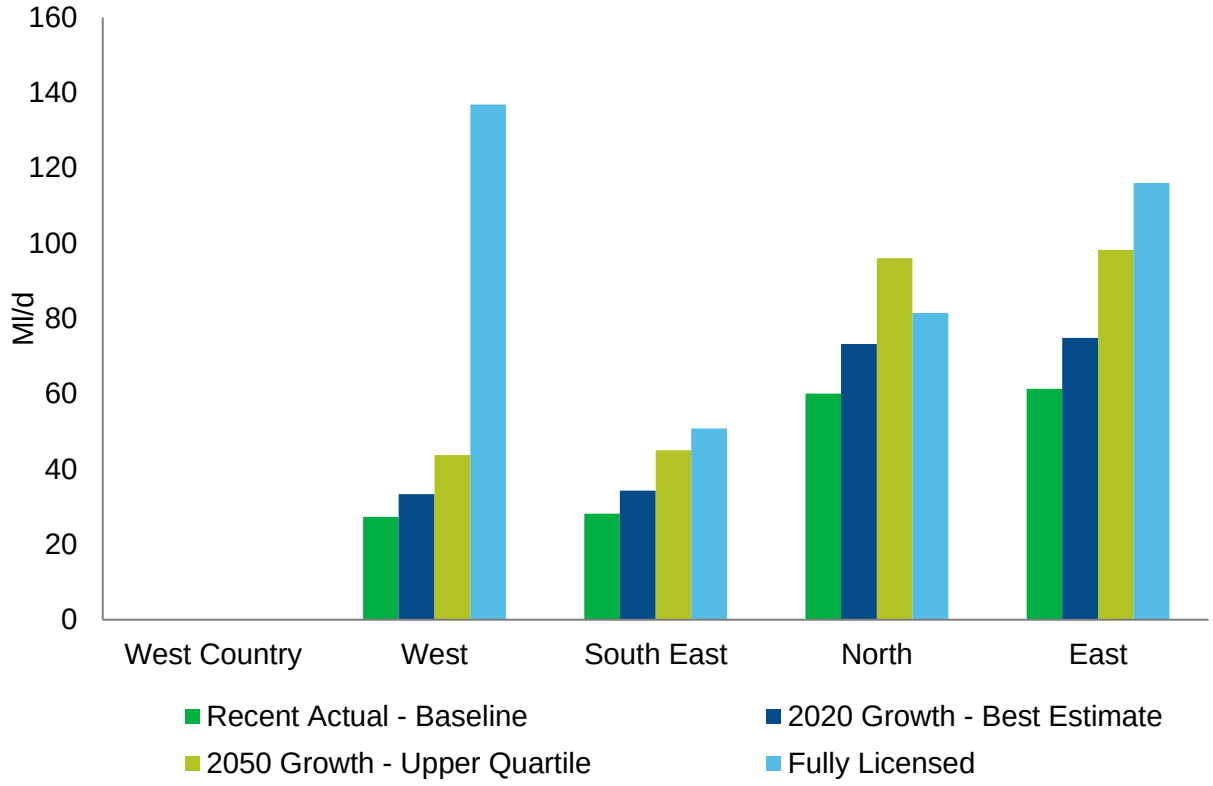
Figure 5 shows possible changes in demand for non-public water supply water for power generation under the 3 simplified scenarios. The scenarios indicate that consumptive water use for power generation could range from the baseline of 64.6 million cubic metres per year (177 Ml/d) to an upper range of 103.4 million cubic metres per year (283.2) with a best estimate of 78.8 million cubic metres per year (215.9 Ml/d).

The greatest potential increases are in Water Resources East at 4.9 million cubic metres per year (13.5 Ml/d) and Water Resources North with a best estimate at 4.8 million cubic metres per year (13.2 Ml/d). If the upper range of demand increase occurs in the north, it could exceed current licensed volume.

There is greater uncertainty associated with these estimates than with the other sectors. This is why we have used the term 'upper range estimate'. This uncertainty is because freshwater demand will be governed by the mix of sources and the use of other technologies such as carbon capture and storage which could change water use considerably. Hydrogen could also play a key part in a decarbonised energy world, either produced from natural gas alongside carbon capture utilisation and storage (CCUS) or by electrolysis using surplus renewable generation. More work will be needed in future to improve the understanding of the impacts these new technologies will have on the demand for water.

The sector is due to be producing its own forecasts over the next 6 months based on recently published energy scenarios so it will be necessary to review the potential demand in the near future.

Figure 5: The potential change to water demand for power generation under the baseline and three simplified scenarios.



Paper and pulp

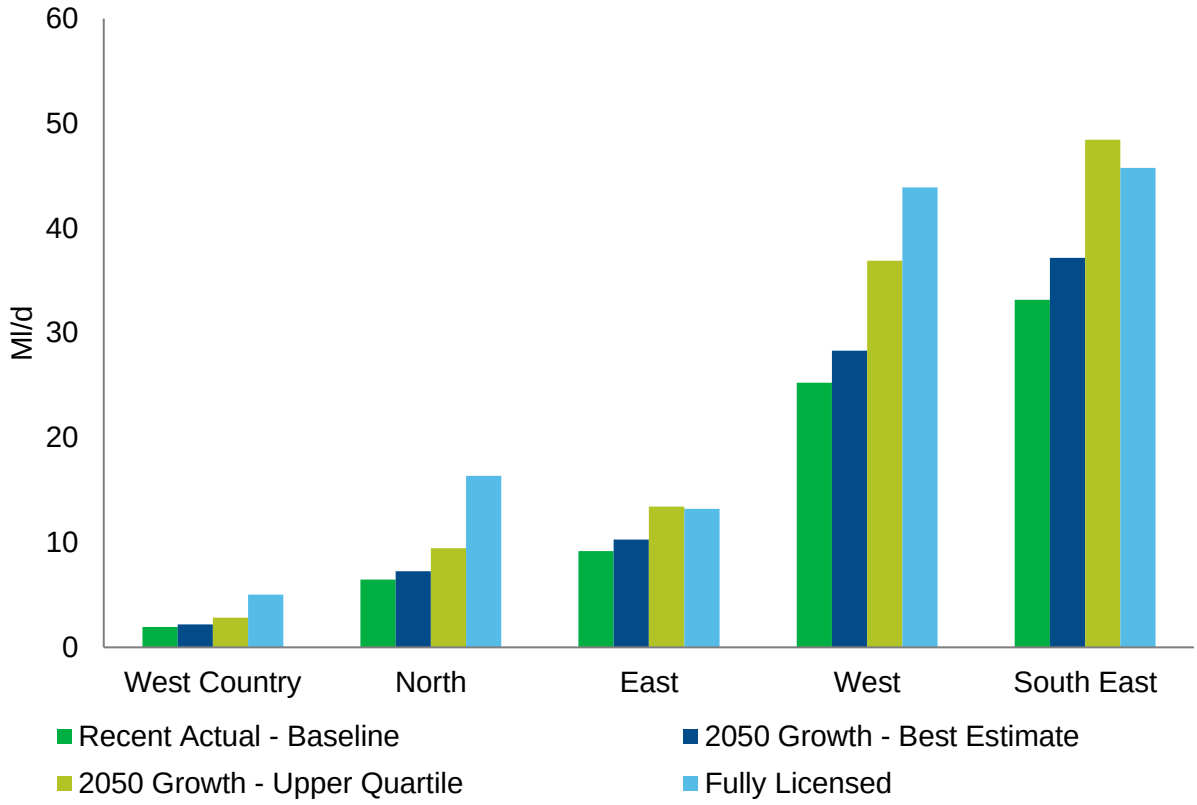
The primary water use within the paper and pulp sector is paper production (paper mills). Paper mills are located across England with the biggest clusters in the south east (north Kent) and north west (Greater Manchester). Mills are also dispersed across the south west, Lake District, Northumberland and the midlands. Water is vital for the paper industry. It is used directly in papermaking and to cool down the mill equipment. The significant water involved in the process is either taken from surface water or groundwater abstraction (41% in 2009) or mains supply (59% in 2009). In 2015 the Confederation of Paper Industries reported that 77 million cubic metres of abstracted water was used by the UK paper industry. The majority (86%) of this water is recirculated and returned to the environment following treatment.

The period between 2001 and 2010 saw a significant decrease in UK paper production with a decrease of over 40%. Production increased by just under 5% during 2017, to 3.85 million tonnes, the first growth in output for four years. Recent trends in water use show a general reduction from 12.5 million cubic metres in 2009, to 10 million cubic metres in 2015. This is in line with a reduction in production. Changing products, a declining newsprint market and increasing demand for speciality paper, which has potentially high water use intensities, could also have an impact on water use. Improvements in environmental performance, efficiency and improving sustainable practices are likely to have contributed toward a downward trend in water use.

Factors affecting consumption include: consumer demand; sustainability, recycling and plastic use trends; process improvements and technology; political, legal and economic factors; social attitudes and environmental awareness and pressure.

Figure 6 shows possible changes in direct abstraction for paper and pulp manufacturing under the 3 simplified scenarios. This could range from the baseline of 27.8 million cubic metres per year (76.1 Ml/d) to 40.5 million cubic metres per year (111.1 Ml/d) with a best estimate of 31.1 million cubic metres per year (85.2 Ml/d). The greatest potential best estimate increase is in Water Resources South East at 1.5 million cubic metres per year (4.0 Ml/d) and Water Resources West at 1.1 million cubic metres per year (3.0 Ml/d). If the upper range of demand increase occurs in the south east and east, it could marginally exceed current licensed volume.

Figure 6: The potential change to water demand for paper and pulp manufacturing under the baseline and three simplified scenarios.



Chemicals manufacturing

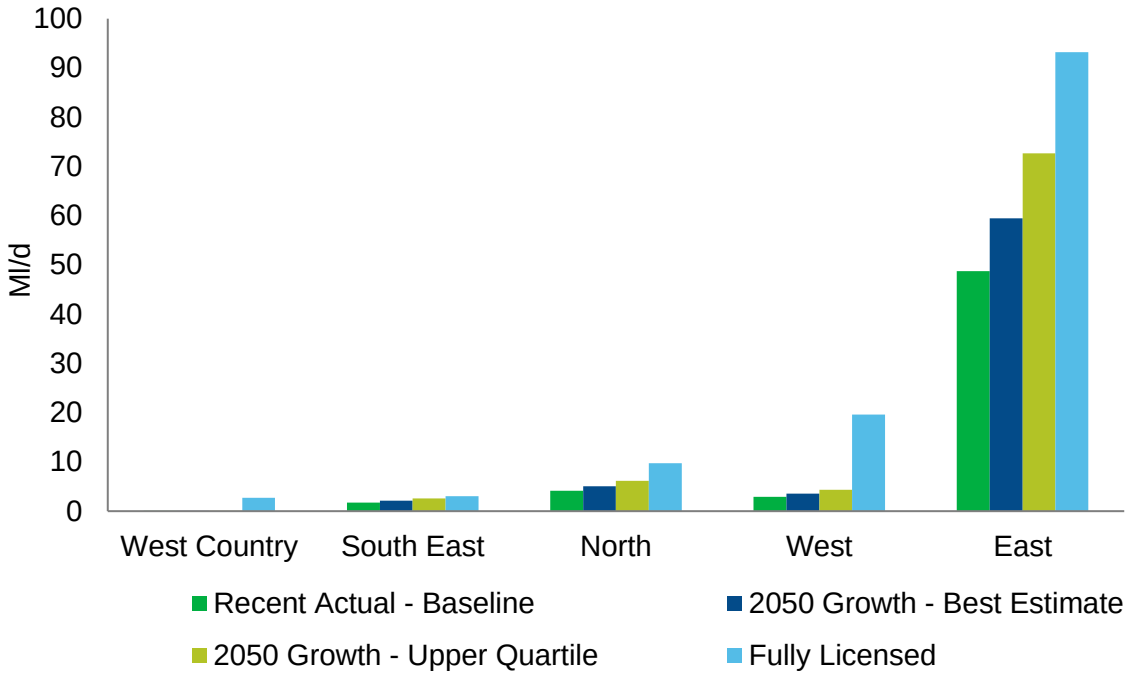
The chemicals manufacturing sector is large and complex. It is an integral part of UK manufacturing. It is highly diverse producing products from shampoos and soaps, to industrial products derived from petrochemicals and dyes. Around 45% of the goods produced are used in the chemical sector itself as well as other sectors' including rubber, plastics and automotive. Consumer products such as perfumes and cosmetics, paints and inks comprise a further 24% of final demand with around 31% of production exported. Chemical manufacturing output has grown by over 27% since 1990. Water consumption does not necessarily grow in proportion to output.

The sector is present across the whole of England. The clustering of sites is important as companies can be located close to their suppliers and end-users of their products. The main clusters in England are located in the north west, Humberside and Teesside. There is little recent data on the total water consumption by the sector or predictions of future demand. It is estimated that around 75% of consumption comes from mains water.

Factors and pressures affecting water consumption include consumer demand for chemicals and related products such as plastics, energy prices, process improvements, social, economic and political changes, exports, changes to manufacturing locations, as well as environmental and technological changes. A report by the Chemistry Council predicts a 50% increase in chemical production in the United Kingdom between 2016 and 2030.

Figure 7 shows possible changes in demand for non-public water supply water by the chemicals industry under the 3 simplified scenarios. This could range from the baseline of 21.0 million cubic metres per year (57.6 Ml/d) to 31.3 million cubic metres per year (85.8 Ml/d) with a best estimate of 25.6 million cubic metres per year (70.3 Ml/d). The greatest potential best estimate increase is in Water Resources West at 3.9 million cubic metres per year (10.7 Ml/d). There is considerable uncertainty associated with these estimates.

Figure 7: The potential change to water demand for chemical manufacturing under the baseline and three simplified scenarios.



The full report 'Understanding Future Water Demand Outside of the Water Industry' provides more detailed information, data and insights into current water uses across the sectors discussed in this summary. It also includes details of the analysis used to produce the information on projected future water needs and the development of the growth factors.

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