Sustainability First – Briefing Paper

Tomorrow's World for Energy and Water - Workshop, 18 July 2017

This summary paper considers what the UK's future energy and water needs are likely to be up to 2030, and beyond. It covers socio-demographic trends, drivers of change for both sectors, and future scenarios, opportunities and challenges. The paper focuses on households and small & medium-sized enterprises.

It offers background context for the joint 'Tomorrow's World' workshop being held by Sustainability First and the National Infrastructure Commission as part of the **New Energy and Water Public Interest Network (New-Pin)** programme. The workshop will explore what customers and citizens need and want from future energy and water systems, and what changes are required for their expectations to be met.

1. Socio demographic trends for the UK

The National Infrastructure Commission has considered future demographic trends and implications for infrastructure as part of National Infrastructure Assessment (NIA)[1] work.

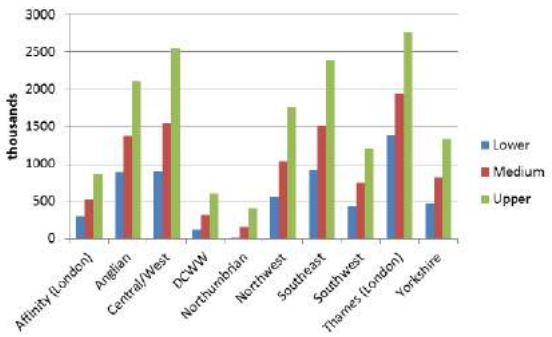
Population growth – increase by 7.3% by 2025 to 69 million[2]. The impact will not be even, concentrated in urban southeast and big cities – highest in London. Resulting increased customer demand for energy and water[3].

Ageing population – Over 60s will make up 26.1% of UK population in 2024 (18.1 million)[4], an increase from 23.1% of UK population (14.9 million) in 2014. One in 12 people will be aged over 80 by 2039. People will live longer but with multiple health issues (incl. dementia) and greater care needs[5]. As people get older, usage patterns change (e.g. less energy use during after-work peak[6], but potentially more overall[7]) and carers may take more decisions.

Modest economic growth – anticipated over the next 5 years (OBR, IFS). Brexit has exacerbated uncertainties. Average growth of Gross Domestic Product (GDP) per capita of 1.7% per year[8]. As people get richer, they demand more infrastructure services.

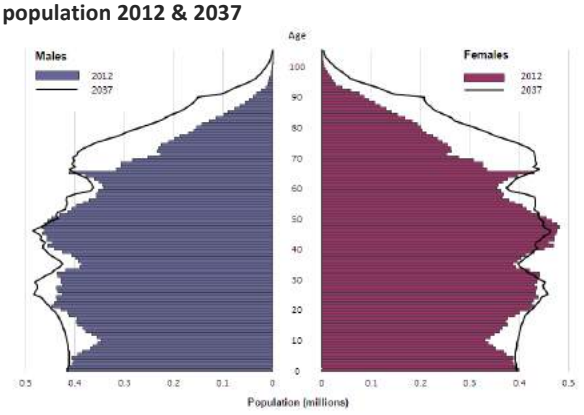
Projected increase in inequality – real after housing cost incomes expected to fall between 2014-15 and 2020-21 for poorest 15% on average[9]. Questions of 'fairness' within *and* between generations (housing, pensions, tuition fees etc.).

Figure 1: Population growth by region 2016 to 2040



Source: WaterUK (2016) *(NB DCWW= Welsh Water)*

Figure 2: Estimated & projected age structure of UK population 2012 & 2037



Source: ONS (2012)

Essential services: limited room for manoeuver – There is relatively low elasticity of energy/water consumption to income or energy/water prices[10]. Price elasticity varies within the population e.g. people on lower incomes are likely to be more responsive to changes in prices and incomes than people on higher incomes.

More households, smaller size – number households in England is projected to increase to 28.0 million in 2039 from 22.7 million in 2014 – with an average growth equivalent to 210,000 per year[11]. Average household size projected to fall to 2.21 in 2039, or by 6%, from 2.35 in 2014. Larger households use less energy on a per person basis[12].

Squeezed incomes – house prices have continued to rise. Household spending and debt to income ratio has increased (OBR). Utility bills have risen. Energy/water bills will remain concern for consumers / politicians.

Uncertain benefits – shortfall between private rents & housing benefit could put 1m households at risk of homelessness by 2020[15].

More private renters – **additional 1.8 million households become private renters by 2025** in England and Wales**.** Almost **1 in 4 of UK households** and more than half of 20-39 year olds will be renting privately [13]. There will be more private renters than people in social housing. With shorter leases / less space, more difficult to install efficiency measures?

Working remotely – currently, at least one-third of the UK labour force works remotely all or some of the time[14]. The trend for remote working is expected to increase. Impact on energy and water usage patterns.

Efficiency and technology – higher levels of efficiency (supplies, usage, appliances) and new technologies may help offset increased demand.

2. Behavioural trends for future consumers – changing expectations

Data and personalisation – enables consumer segmentation & targeting of new/responsive products that are more reflective of individual costs (supply at peak) and needs.

The Institute of Customer Service 'Customer of the Future' report - changes for consumers to 2025:

1. Convenience - have less time & patience. Despite cyber wars, prepared to share personal data in return for ease of use.
2. Rising regulatory scrutiny.
3. Artificial intelligence.
4. Increasing power of customers.
5. Gov. financial challenges.
6. Increasing speed of change.
7. Network economy.
8. Pluralisation of society.
9. Sensors / monitors.
10. Ethics / values significant[16].

Engaging Tomorrow's Consumer Sustainability messaging needs: quality/durable services; simplicity; and appeals to social conscience[17].

Fair switching? – switched on consumers tend to be from higher socio-economic groups[18]. Issues with 'sticky' energy customers not switching – despite savings to be made. Possible future concerns re. algorithms and automatic switching.

Figure 3: Consumer engagement segments & social grades

Social Grade	Unplugged	On standby	Tuned in	Switched on
AB	14%	22%	27%	39%
C1	27%	32%	34%	33%
C2	23%	21%	20%	17%
DE	35%	25%	19%	12%

Source: Ofgem (2016)

Sharing economy – car sharing may increase with modest income growth / driverless cars – so electric vehicles may not need to be charged at home. Other community schemes popular (e.g. local PV or flood prevention measures).

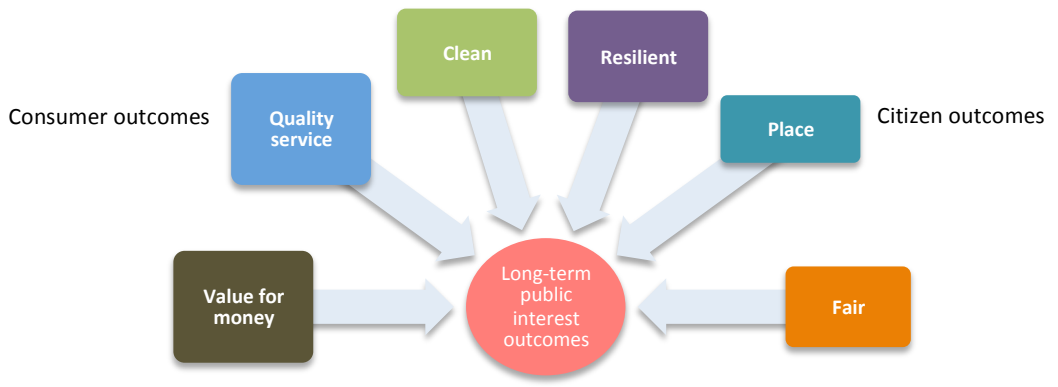
3. Drivers of change & New-Pin desirable outcomes for energy and water sectors

The socio demographic trends of increased population, urbanization and affluence will lead to increased demand in both sectors. Other major drivers of change include:

Drivers	Implications	Energy / water response
Climate change & the environment		
Carbon reduction, resilience and environmental protection.	If emissions not reduced, 2°C av. temperature rise in SE England by 2040[19] compared to 2014. Unpredictable weather; wetter winters, drier summers, higher winds. Risk of flooding, drought and heat waves[20]. Changes to groundwater levels - some water tables rise some fall. Networks vulnerable to extreme weather (storms).	Sectors under pressure to reduce carbon footprint. In water, high environmental standards and increased carbon emissions (to meet treatment standards)[21]. Some standards impact on energy/ water usage profiles. Potential new approaches post-Brexit. Different regional challenges for water. Increased air conditioning demand.
Technology & digital innovation		
New technologies and upgrading / modernising existing infrastructure.	Smart metering & networks. Increased appliance efficiency. Digital communications. Smart demand. Technology can: reduce need for new infrastructure, create demand for additional infrastructure, lead to vulnerability (e.g. system failure, cyber attacks, increased electricity dependency)[22].	Improved customer service and accuracy of billing. Water metering is still not universal. For smart meters need to consider ease of use, interoperability, robust data handling and cyber security. Demand flexibility can help to reduce costs and overall demand: in energy, winter evening peaks; in water, summer peaks – and through partnering with different groups of people e.g. growers.
Customer expectations		
Digitally empowered customers. Trust is an issue – particularly for energy.	Cost reflective billing. Personalized services. Responsive local & community led services. Multi-utility services. New social reach: channels / platforms (Google, Apple, Facebook, Amazon); influencers; experiences (e.g. gamification); drivers (passion)	Energy and water companies, and their regulators, want to see a shift from passive customers to active participants, through to collaboration and co-creation[23]. Changing market structures and new business models emerging in both sectors.

New-Pin desirable long-term outcomes

Figure 4: New-Pin 'Dash-board' of desirable long-term public interest outcomes for energy & water



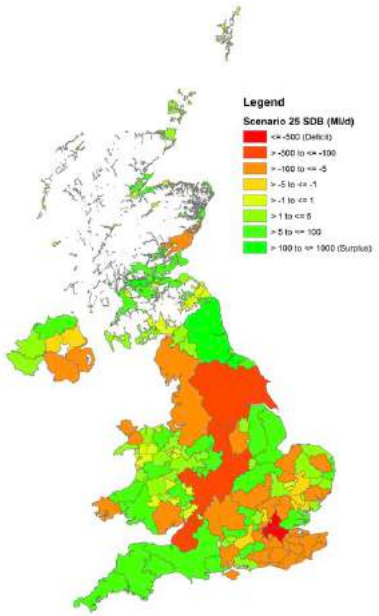
Source: Sustainability First (2017)

4. Future outlook for water supply and flooding

Total water supply & demand: a varied picture - UK total public water supply currently exceeds demand by a little more than 10%[24]. There is an uneven distribution of population / resources[25]. Some water zones have modest deficits (where demand is > supply) presenting a risk of drought within the short to medium term.

Water deficit predicted to be between 5% and 16% by the 2050s – resulting in widespread deficits across many water resource zones if no adaptation interventions. Significant variability - London and the South East most at risk of deficits followed by Central, West and Yorkshire. Uncertain future picture – eg WaterUK report for England and Wales has range of 36 different future scenarios[26]. Others (eg NIC) estimate smaller deficits.

Figure 5: Example 2050s supply-demand balance for current water resource systems – a varied picture



Source: NIA (2017)

Drought and scarcity – range of predictions. 12% chance of 'severe' drought in East / South East over a 25 year period[27] (rare event worse than any seen in Twentieth Century with standpipes, rationing etc for 2-3 months). Droughts increase risk of subsidence that could impact pipes and other assets. Thames Water now has a desalination plant to reduce risk.

Metering: getting there - around 40% of households now have a water meter – the majority should have one around 2020. Customers with a meter on av. use ~123 litres p.p. per day, customers without ~153 litres[28]. Reduced water usage in showers etc can also reduce energy usage and bills. Southern has a 'green doctor' home audit / retrofit scheme and Thames a smart metering programme.

Water quality – Increased abstraction can impact on quality, environment standards & aquatic environment. But National Environment Programme could also control / reduce abstractions.

Leakage – Accounts for an average of 22% of total water supply in most water resources zones (despite recent reductions)[29]. New technologies better at detecting and fixing leaks?

Flooding – 1.8 million people in the UK currently live in properties at significant risk of flooding (greater than 1 in 75 or 1.3% annual probability)[30]. 5 million properties at risk of flooding as of December 2013. 10% chance of a catastrophic flood in England within the next 20 years (one causing over £10 billion of damage)[31]. Need for catchment measures[32]. Environment Agency's estimate of replacement value of its flood defence assets is £24bn[33] - in major cities there are also approx. £12bn of defences in private ownership.

Affordability & value for money – Remain a concern in the future, with differing pictures between regions & for household and business customers. Incentive on customers to pay water bills when other costs on up weakened by ban on household disconnections.

5. Future outlook for the energy sector

Energy sector is changing rapidly. National Grid has set out four possible scenarios to 2030 – most figures below are based on this[34]. Many global projections are more ambitious about low carbon uptake[35].

Uncertain electricity demand – rising or stable? Energy consumption in 2030 likely to be different from today. Uncertainty due to technological change. Under 'gone green' scenario, total demand could increase to 346TWh in 2030, from 334TWh in 2015. Or remain at a similar level at 331GW for 'consumer power' view.

A smart meter in every home by 2020? Energy landscape for consumers changing rapidly - digital, smart tech in homes, big data and new firms and business models[36]. Cost reductions will vary by technology.

Demand side flexibility – 'Smart power' – interconnection, storage and flexible demand – could save consumers up to £8bn a year by 2030[37]. The Association for Decentralised Energy estimates potential for demand side response of 9.8TWh by 2020[38]. Storage capacity / batteries set to increase from 3GW to 4-11GW by 2030.

Electric vehicles on the up –uptake of 4 million electric vehicles by 2030 / 60% new sales?[41]

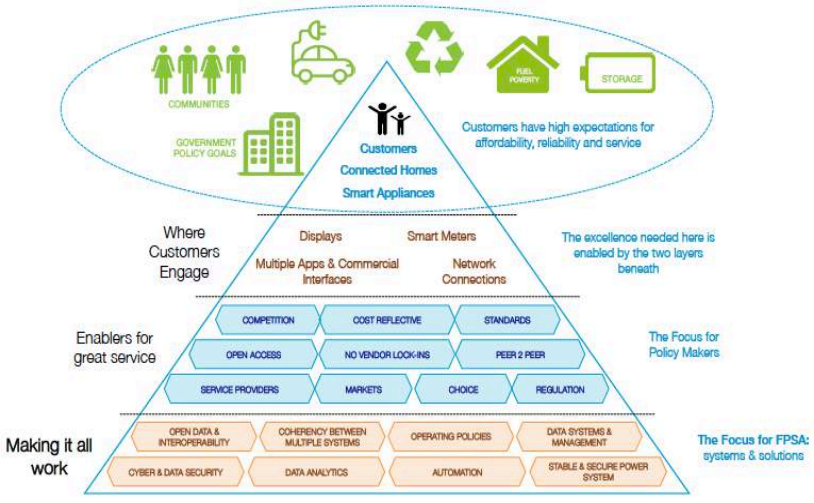
Affordability & value for money – costs to consumers likely to increase, & bills will become more cost reflective. Who pays for decommissioning /consumers leaving grid - undecided

Decarbonisation – target to cut greenhouse gas emissions to 80% below 1990s levels by 2050. Traditional sources of supply are being replaced with an ever-divergent mix. Decline of fossil fuels, increased electricity storage, increased renewable energy. By early 2020s 40% of generation could come from wide range of renewable sources.

Electrification of heat leads to falling gas demand / heating - under consumer power scenario there will be 1 million heat pumps by 2025 – mainly in new build? Need to change behaviours / expectations to get uptake?

Energy efficiency – of homes, transport and appliances continues to increase. Domestic energy demand has fallen by 19% since 2000**,** despite a 12% increase in number of households & a 10% rise in population[39]. UK government estimates that, in 2014, average energy efficiency (SAP) rating of English dwellings was 61 – up from 45 in 1996, implying a 25% fall in modelled energy usage[40].

Figure 6: The elements of a low carbon future



Source: Future Power System Architecture Project (2017)

6. Conclusion – opportunities for water and energy?

There is future uncertainty for both energy and water users due to: population growth, demographics, economics, household usage changes & behaviours; and the major drivers of change – climate change, technology & customer expectations. The sectors face many similar challenges & opportunities, including:

- **Collaboration and 'fair' approaches to sharing risks and rewards** – eg catchment management in water where Water Framework Directive encourages partnerships to improve water environment.
- **New innovative technology** – eg smart metering and predictive asset maintenance.
- **Smart & integrated utility services** – potential to control all utility services from one app. Billing could be linked to the customer (smart phone) not the meter – e.g. EV charging with Ubitricity[42].
- **Decentralised approaches** – eg in electricity, micro-generation and battery storage equipment. In water, local slow water and rainwater harvesting schemes. In both, demand side response.
- **Prosumers** – With distributed energy generation, micro-grids, ultra energy efficient buildings & electric vehicles – consumers could be more self-sufficient, offering services back to the system.
- **New finance systems** – eg blockchain[43] could enable energy users to trade on peer-to-peer basis, without need for 3rd parties[44]. Crowd sourcing of funds for local initiatives possible in both sectors.

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[1] NIC is analysing the UK's long-term economic infrastructure needs, setting out a strategic vision over a 30-year time.
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[3] NIC (2016) The impact of population change and demography on future infrastructure demand.
[4] ONS statistics (2014) National Population Projections UK mid-2014 to mid-2114.
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[9] IFS (2017) Living standards, poverty and inequality in the UK, 2016-17 – 2021-22.
[10] NIC (2017) Economic growth and demand for infrastructure services.
[11] NIC (2016) The impact of population change and demography on future infrastructure demand.
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[13] PwC (2015) UK Housing Market Outlook: The Continuing Rise of Generation Rent.
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[16] The Institute of Customer Service (2016) The customer of the future.
[17] World Economic Forum (2014) Engaging Tomorrow's Consumer.
[18] Ofgem (2017) Future Insights Series - The Futures of Domestic Energy Consumption.
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[26] WaterUK (2016) Water Resources long term planning framework (2015-2065).
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[31] WSP, Parsons Brinckerhoff & Business in the Community (2015) The UK in 2030 – key trends for the built environment.
[32] EFRA select committee (2016) Future flood prevention Second Report of Session 2016–17.
[33] National Audit Office, Defra and the Environment Agency (2014) Strategic flood risk management.
[34] National Grid (2016) Future Energy Scenarios: *Gone Green* – wealthy, environmental sustainability top priority; *Slow Progression* – long-term environmental strategy; *Consumer Power* – wealthy, market-driven; *No Progression* – low-cost solutions.
[35] For example, https://about.bnef.com/blog/global-wind-solar-costs-fall-even-faster-coal-fades-even-china-india/
[36] Ofgem (2017) Future Insights Series - The Futures of Domestic Energy Consumption.
[37] NIC (2016) Smart Power.
[38] ADE (2016) Flexibility on demand: Giving customers control to secure our electricity system.
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