SP Energy Networks 2015–2023 Business Plan

Updated March 2014

Annex

Heat pump and energy efficiency scenarios

Frontier Economics

January 2014

SP ENERGY NETWORKS

Heat pump and energy efficiency scenarios

A REPORT FOR SCOTTISHPOWER

January 2014

Heat pump and energy efficiency scenarios

This report sets out heat pump and energy efficiency scenarios for use in Scottish Power's Transform modelling for business planning. While there is clearly a huge degree of uncertainty over future developments in these areas, these scenarios aim to represent a reasonable view of heat pump uptake and domestic energy consumption from lighting and appliances, based on the assumption that Government remains committed to meeting carbon targets.

Heat pump scenarios

We have designed a number of scenarios for cumulative installations of heat pumps to 2030. The uptake numbers associated with these scenarios were estimated by Element Energy using their heat pump uptake model[1].

We varied three main factors across scenarios.

- **Policy.** Because of the relatively high costs of heat pumps, policy intervention is likely to be required to drive their uptake. In all our scenarios, we assume that current policies (the RHI and tightened carbon standards for new homes from 2016) apply until 2030. In some scenarios, we added further policies beyond 2020, focussing on those policies that may represent cost-effective means of rolling out heat pumps (information campaigns and carbon standards for homes off the gas grid).

- **Fuel and electricity prices**. Fuel prices, in particular, the relativity between gas and electricity prices, will affect heat pump uptake, as consumers will generally be comparing the price of heat pumps to their incumbent technology (and the most common incumbent technologies are gas boilers). We looked at fuel and electricity price scenarios based on DECC's low, central and high fuel prices.[2]

- **Hassle costs.** Installing a new heating system may entail inconvenience for consumers, including for example, the time associated with heating system refurbishment, loss of space for hot-water cylinders, and disruption in the

1 This heat pump uptake model underlies the policy scenarios presented in the recent CCC publication: Frontier Economics and Element Energy (2013), *Pathways to high penetration of heat pumps,* http://www.theccc.org.uk/wp-content/uploads/2013/12/Frontier-Economics-Element-Energy-Pathways-to-high-penetration-of-heat-pumps.pdf .

2 DECC (2013), *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal, Tables 1-20,* https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal These projections have been updated since our 2013 work for CCC.

garden for ground source heat pumps. In one of our scenarios, we apply a hassle cost of £1,000 per installation to represent this inconvenience[3].

Based on varying these factors, we have developed five scenarios for cumulative installations of heat pumps to 2030.

- **Scenarios A-C**. For the first three scenarios we assume that current policies are pursued to 2020. Beyond 2020, we assume two new policies associated with positive net benefits[4] are introduced. Scenarios A-C vary only in terms of the underlying fuel prices. No hassle costs are included. Our view is that these scenarios represent a reasonable view of heat pump uptake to 2030, assuming a continued commitment to meeting climate targets.

- **Scenario D**. Scenario D represents a less optimistic view of heat pump uptake. Under this scenario, current policies are extended to 2030, but no additional policies are introduced. Given Government's commitments to meeting carbon targets, this represents a highly cautious view. Scenario D is based on central DECC fuel prices and no hassle costs are included.

- **Scenario E**. Scenario E represents the most cautious view of the future. Policy assumptions are the same as in scenario D, but it is additionally assumed that consumers face a hassle cost of £1000 per installation.

The scenarios are described in **Table 1**, and presented alongside the DECC and rough estimates of the original Scottish Power scenarios in **Figure 1**. In **Figure 2**, we zoom in on the period to 2020, to show the impact of varying fuel prices in the earlier years more clearly.

These figures represent cumulative installations of heat pumps (in line with the original DECC scenarios)[5].

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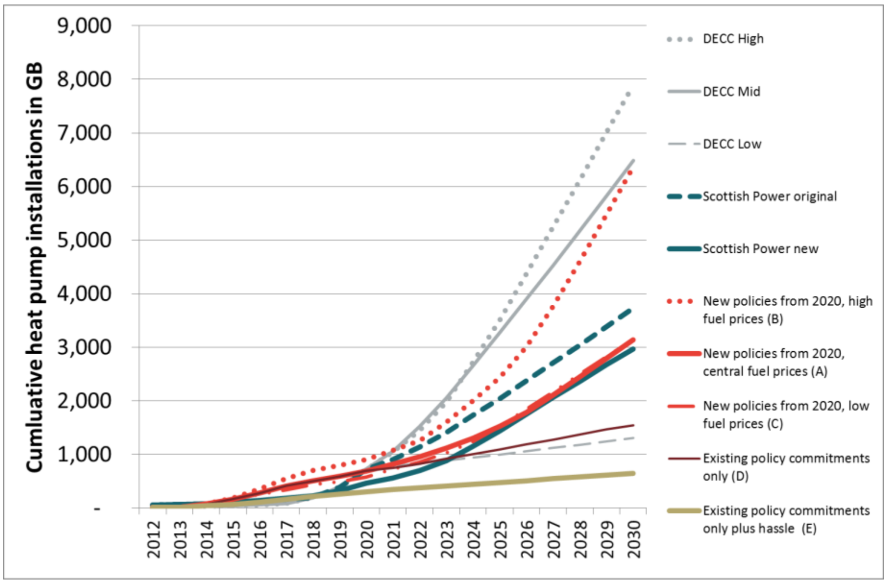
3 This is consistent with an assumption made in our recent work for the CCC. It is based on Element Energy (2008), *The growth potential for Microgeneration in England, Wales and Scotland*, http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file46003.pdf

4 Our analysis (with Element Energy) for the CCC in 2013 suggests that these two policies could be associated with net benefits.

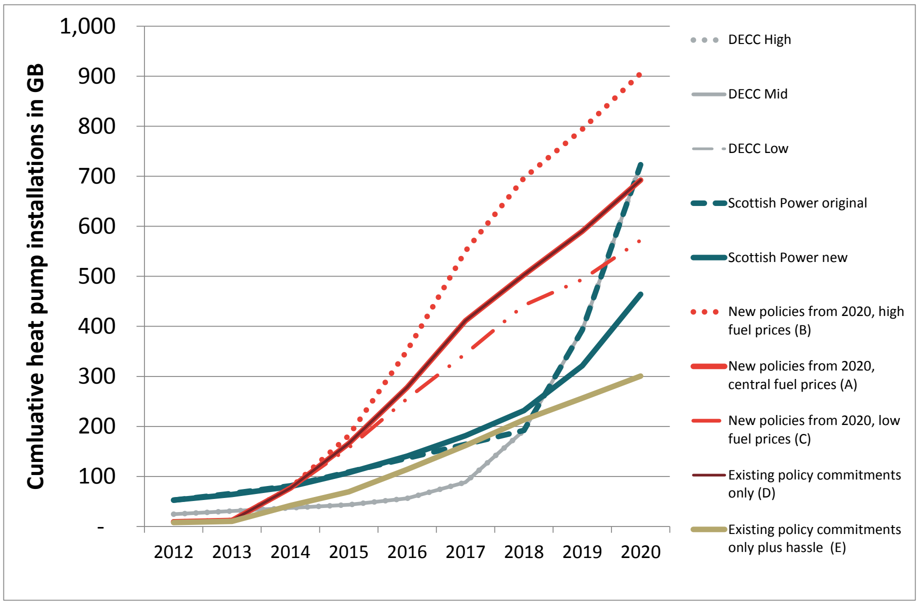
5 Heat pumps have a limited lifetime (around 15 years), so cumulative installations in later years will be higher than the stock of heat pumps in the system in that year. The original DECC scenarios are presented in EA Technology et al (2012), *Assessing the impact of low-carbon technologies on GB distribution network,* Appendix F, https://www.ofgem.gov.uk/ofgem-publications/56824/ws3-ph2-report.pdf

Figure 1. Cumulative installations of heat pumps to 2030



Source: DECC scenarios: DECC, cited in EA Technology et al (2012), *Assessing the impact of low-carbon technologies on GB distribution network;* Scottish Power scenarios: estimated based on area specific data sent provided by Scottish Power in December 2013; Scenarios A-E: Frontier, based on Element Energy's heat pump uptake model,

Figure 2. Cumulative installations of heat pumps to 2020



Source: DECC scenarios: DECC, cited in EA Technology et al (2012), *Assessing the impact of low-carbon technologies on GB distribution network;* Scottish Power scenarios: estimated based on area specific data sent provided by Scottish Power in December 2013; Scenarios A-E: Frontier, based on Element Energy's heat pump uptake model,

Table 1. Summary of heat pump scenarios

<table>
<tr><th></th><th>Policies before 2020</th><th>Policies after 2020</th><th>Fuel prices</th><th>Hassle costs</th><th>Heat pump uptake in 2020 (1000s)</th><th>Heat pump uptake in 2030 (1000s)</th></tr>
<tr><td>A</td><td rowspan="3">• Renewable Heat Incentive (RHI)
• Carbon standards for new homes from 2016 of 10-14kgCO_2/m2/year from 2016[6]</td><td rowspan="3">• RHI and carbon standards as before 2020
• Information campaign[7] from 2021
• Carbon emissions standard on heating system replacement for off gas grid homes[8]</td><td>Central</td><td>0</td><td>692</td><td>3137</td></tr>
<tr><td>B</td><td>High</td><td>0</td><td>906</td><td>6366</td></tr>
<tr><td>C</td><td>Low</td><td>0</td><td>572</td><td>3158</td></tr>
<tr><td>D</td><td colspan="2">• RHI
• Carbon standards for new homes from 2016 of 10-14kgCO_2/m2/year from 2016</td><td>Central</td><td>0</td><td>692</td><td>1545</td></tr>
<tr><td>E</td><td colspan="2">• RHI
• Carbon standards for new homes from 2016 of 10-14kgCO_2/m2/year from 2016</td><td>Central</td><td>£1000 per installation</td><td>300</td><td>645</td></tr>
</table>

6 Government is currently consulting on this level: DCLG (2013) *Next steps to zero carbon homes*, https://www.gov.uk/government/consultations/next-steps-to-zero-carbon-homes-allowable-solutions

7 This would include requirements on training of heating installers as well as training of consumers by installers. It is one of the policies modelled in our recent work (with Element Energy) for the CCC.

8 This would replace the current energy efficiency requirement on boilers with a requirement that the average lifetime carbon intensity of new heating systems is less than 180gCO_2/kWh on properties off the gas grid, as in the policy scenarios run for the CCC in 2013.

Energy Efficiency scenarios

We have developed six energy efficiency scenarios, again, to represent a view of future energy efficiency improvements, under the assumption that Government remains committed to meeting climate targets. To do this, we have looked at the Government's published scenarios, and assessed:

- whether actual changes in energy use have diverged from projected reductions to date; and
- how other factors may affect domestic energy consumption from lighting and appliances.

Baseline: Government's published scenarios

The scenarios provided by Government are described in EA Technology et al (2013), *Analysis of Least Regrets Investments for RIIO-ED1 and supporting evidence.*[9] Throughout the rest of this note, we refer to these scenarios as the '2013 update'.

These scenarios are based on analysis carried out by Defra's Market Transformation Programme (MTP)[10]. Efficiency improvements for two groups of technologies are covered: domestic lighting and domestic appliances (including ICT, domestic appliances and consumer electronics). Energy efficiency improvements for commercial uses are not covered.

The MTP programme provided three scenarios for improvements in each of these areas[11].

- **Reference**. The reference case is the base case, and includes existing policies.
- **Policy.** The policy scenario describes what would happen if a defined set of additional policies are implemented. The Transform modelling uses this scenario as a default[12].
- **Best Available Technology**. This is a projection of what will happen if the best available technologies on the current and future market are bought or installed from now on.

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9 https://www.ofgem.gov.uk/ofgem-publications/56819/annexes-4-6.pdf - from page 30.

10 http://efficient-products.ghkint.eu/

11 In the absence of a detailed description of the scenarios in EATL et al (2013), descriptions are taken from Defra (2009), *Saving Energy Through Better Products and Appliances*, https://www.gov.uk/government/publications/saving-energy-through-better-products-and-appliances

12 This is in line with DECC's approach in its Fourth Carbon Budget modelling.

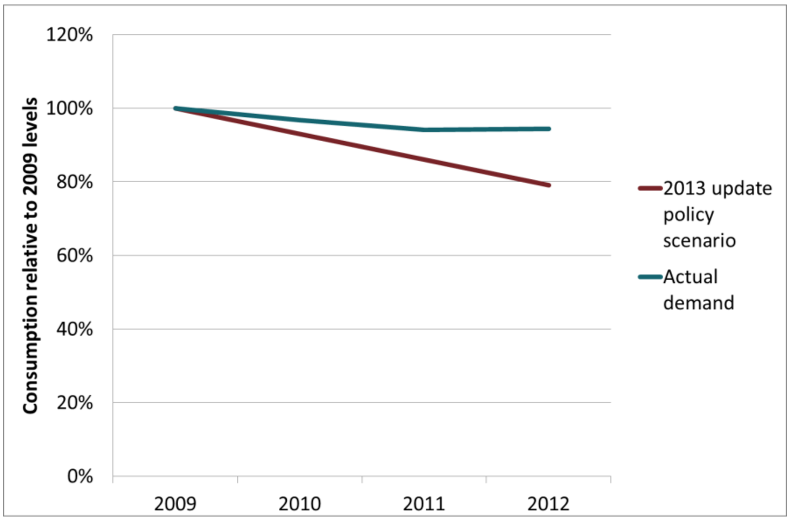
We assume that these figures relate to the overall change in electricity consumption from these technologies in the domestic sector, in line with the scenarios published by the MTP in 2009. This means that they encompass both the increase in efficiency in these technologies, and changes in their prevalence.

Alternative scenarios

To come up with revised energy efficiency scenarios, we have taken the following steps.

- We have used actual data for the period 2009 to 2012[13]. **Figure 2** and **Figure 3** show that actual changes in energy use diverge quite strongly from projected changes in energy use, especially for appliances.

Figure 3. Actual and projected changes in electricity consumption from lighting



Source: DECC (2013) *Energy Consumption in the UK (ECUK), Domestic data tables, 2013 Update* and EA Technology et al (2012), *Assessing the impact of low-carbon technologies on GB distribution network;*

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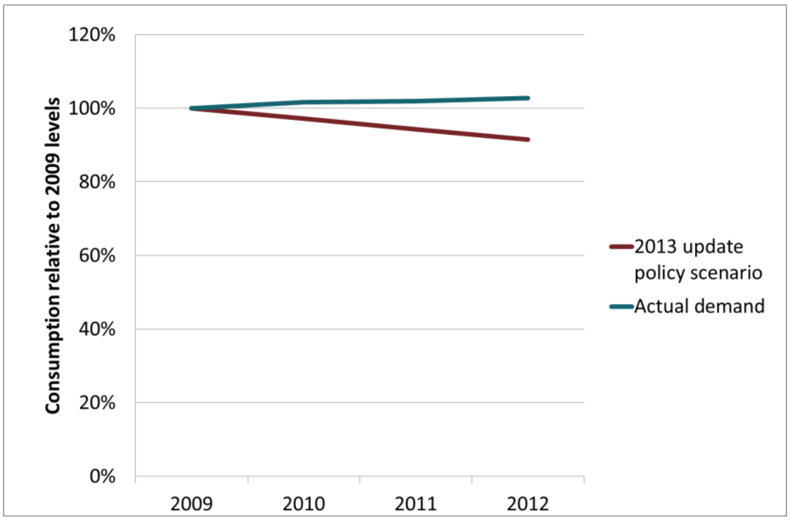
13 DECC (2013) *Energy Consumption in the UK (ECUK), Domestic data tables, 2013 Update*, Table 3.10: Total electricity consumption by household domestic appliances 1970 to 2012, https://www.gov.uk/government/collections/energy-consumption-in-the-uk

Figure 4. Actual and projected changes in electricity consumption from appliances



Source: DECC (2013) *Energy Consumption in the UK (ECUK), Domestic data tables, 2013 Update* and EA Technology et al (2012), *Assessing the impact of low-carbon technologies on GB distribution network;*

- We have applied percentage changes in energy consumption from the 2013 update scenarios for the period 2013 to 2030[14].
- There is evidence that fuel prices and income growth impact on domestic energy consumption[15]. We have therefore factored in variations in these to give ranges around the scenarios. We have not modelled the impact of fuel prices and economic growth to produce these scenarios. Instead, we have roughly estimated their impact, based on the impact found by DECC in their recent analysis of future energy demand[16]. Based on the DECC analysis, the impact of fuel prices and economic growth on demand appears to be small.

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14 On the basis of advice from EA Technology, we have used the cumulative series, rather than the yearly efficiency improvements from Table A3 in Annexes 4-6 of EA Technology et al (2013), *Analysis of Least Regrets Investments for RIIO-ED1 and supporting evidence.* This implicitly assumes that the yearly efficiency improvements are expressed as a percentage of 2009 consumption levels, rather than as a percentage of the previous year.

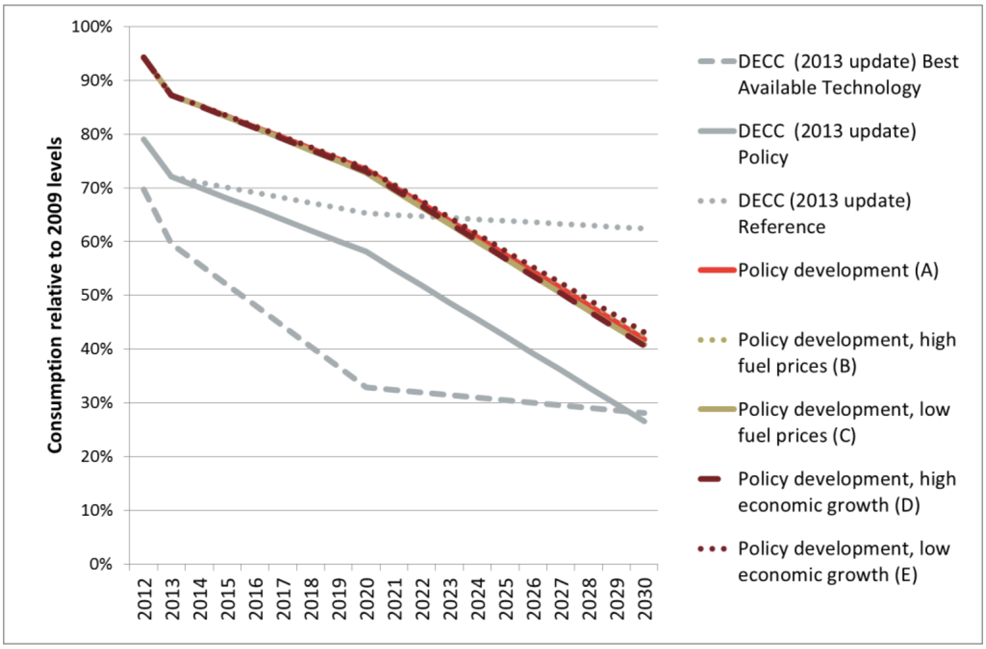
15 Hunt, L.C., Judge, G., Ninomiya, Y., 2003, Modelling underlying energy demand trends, in: *Energy in a Competitive Market: Essays in Honour of Colin Robinson*. pp. 140–174.; and Gottstein, M., Schwartz, L., 2010, *The Role of Forward Capacity Markets in Increasing Demand-Side and Other Low-Carbon Resources, Experience and Prospects*, The Regulatory Assistance Project, available at: http://www.roadmap2050.eu/attachments/files/PolicyBriefMay2010RM2050%5B4%5D.pdf

16 DECC (2013) *Updated Energy and Emissions Projections* , https://www.gov.uk/government/collections/energy-and-emissions-projections

However, we note that these scenarios do not encompass the full range of uncertainty over future fuel prices and economic growth[17].

The resulting scenarios are described in **Table 2** and presented alongside the 2013 update scenarios in **Figure 5** and **Figure 6**.

Figure 5. Lighting scenarios



Source: DECC scenarios: Defra MTP cited in EA Technology et al (2013), *Analysis of Least Regrets Investments for RIIO-ED1 - Annexes 4-6*; New scenarios: Estimated by Frontier, based on an analysis of the drivers underlying the Defra MTP scenarios .

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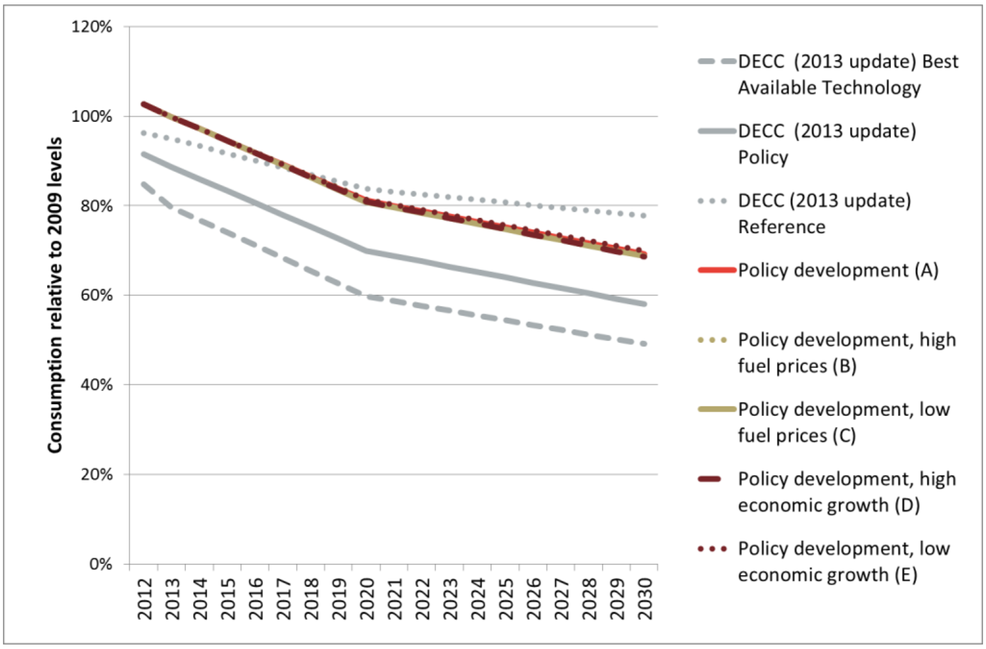
17 DECC's central, high and low fuel prices are used in these scenarios. Central economic growth estimates are based on the OBR's 2013 projections. High and low sensitivities are based on the assumption that growth is 0.25 of a percentage point higher or lower each year. See DECC (2013) *Updated Energy and Emissions Projections* , https://www.gov.uk/government/collections/energy-and-emissions-projections

Figure 6. Appliance scenarios



Source: DECC scenarios: Defra MTP cited in EA Technology et al (2013), *Analysis of Least Regrets Investments for RIIO-ED1 - Annexes 4-6*; New scenarios: Estimated by Frontier, based on an analysis of the drivers underlying the Defra MTP scenarios .

Table 2. Summary of energy efficiency scenarios

	Fuel prices	Economic growth	Change in energy consumption in 2020 (relative to 2009 levels)	Change in energy consumption in 2030 (relative to 2009 levels)
A	Central	Central	Lighting: -27% Appliances: -19%	Lighting: -58% Appliances: -31%
B	High	Central	Lighting: -26% Appliances: -19%	Lighting: -57% Appliances: -30%
C	Low	Central	Lighting: -27% Appliances: -19%	Lighting: -59% Appliances: -31%
D	Central	High	Lighting: -27% Appliances: -19%	Lighting: -59% Appliances: -31%
E	Central	Low	Lighting: -26% Appliances: -19%	Lighting: -57% Appliances: -30%