UK Power Networks

Business plan (2015 to 2023)

Annex 3: Core Planning Scenario

March 2014

"A reliable... an innovative... and the lowest price electricity distribution group."

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UK Power Networks
Delivering your electricity

Document History

Version	Date	Revision Class	Originator	Section Update	Details
1.0	10/03/2014		Adrian Searle	N/A	Added March 2014 resubmission front cover

Contents

1 Executive Summary

There is considerable uncertainty over how our network will need to grow to accommodate future load growth. At a macro level there are two key uncertainties which will influence this growth. They are:

- The speed of recovery of the UK economy
- The impact of the Government CO_2 emission targets

To help us develop our core planning assumptions we have worked with a specialist energy consultancy to develop a range of possible scenarios for the take up of low carbon technologies[1].We have consulted a range of stakeholders on these assumptions and based on their feedback, and our own internal analysis, we have settled on a range of core assumptions. This annex sets out the background analysis to support to the key assumptions. The key factors we have modelled are:

Population and economic – The key factors we utilise are predictions of future household information and regional GVA growth. These factors are used to help us determine the requirements for additional capacity on our network

Impact of transitioning to the low carbon economy – The UK Government has set ambitious targets for reducing CO_2 emissions. To achieve this reduction there will need to be significant volumes of alternative technologies such as heat pumps and electric vehicles adopted by both general public and businesses. These technologies, while beneficial in reducing overall emissions, will increase the need for additional capacity on our networks. The Government is also incentivising the switch from fossil fuel based generation to renewable based generation. Therefore, we expect to see growth in both small scale (principally photo-voltaic) and large scale (principally onshore wind) generation connected to our networks. In both of the areas above we have sought specialised advice to inform our assumptions and where appropriate we have tested them with stakeholders.

A key element of the Government's plan is the roll out of smart meters across the UK. This technology will have a direct impact on our operations. Initially the impact will be focused on resolving defects discovered as part of the rollout programme. We also expect to change our system and processes to make use of the data that smart meters will provide us. The costs and benefits of this are included in our plan. Our plan assumes that the smart metering rollout will be completed by 2020 in line with the latest Government proposals.

Connections market assumptions – The assumption on how much of the new connections market is important as it affects the total amount of load related expenditure. Our plan assumes that we will continue to lose market share as a result of increasing competition, particularly in the higher voltage market segments. On average we expect our market share to fall from a level of between 80%-90% to between 58% and 65%. This is illustrated in the table overleaf.

[1] Details of the background to the assumptions are contained within "Load growth Model: Definition of scenario assumptions", Element Energy, 3rd April 2013 attached to this annex

	EPN		LPN		SPN	
Connections market assumptions	12/13	22/23	12/13	22/23	12/13	22/23
Single service LV connection	100%	100%	100%	100%	100%	100%
Small project demand connection (LV)	100%	100%	100%	100%	100%	100%
Demand Connection – LV work	93%	80%	94%	80%	92%	80%
LV end connections involving HV work	73%	60%	76%	60%	75%	63%
HV end connections involving only HV work	73%	60%	76%	60%	75%	63%
Demand Connection – HV and EHV work	64%	60%	100%	63%	100%	50%
LV end connections involving EHV work	100%	80%	100%	50%	100%	50%
EHV end connections involving only EHV work	100%	80%	100%	50%	100%	50%
HV or EHV connections involving 132kV work	100%	80%	100%	50%	100%	50%
132kV end connections involving only 132kV work	100%	80%	100%	50%	100%	50%
Distributed Generation – LV work	63%	30%	100%	50%	100%	60%
DG connection at any voltage where HV is the highest voltage worked on	89%	30%	74%	50%	34%	30%
DG connection at any voltage where EHV is the highest voltage worked on	89%	30%	74%	50%	34%	30%
DG connection at any voltage where 132kV is the highest voltage worked on	89%	30%	74%	50%	34%	30%
Unmetered Connections – New LA (Local Authority) 1-100 work	77%	63%	93%	77%	74%	56%
Unmetered Connections – Other work	100%	81%	81%	73%	98%	80%
Average	88%	65%	90%	63%	82%	59%

We have also assumed that we will charge a margin of 4% on both regulated and unregulated connections, with the exception of single service LV and small demand connection projects (LV) where we will charge no margin.

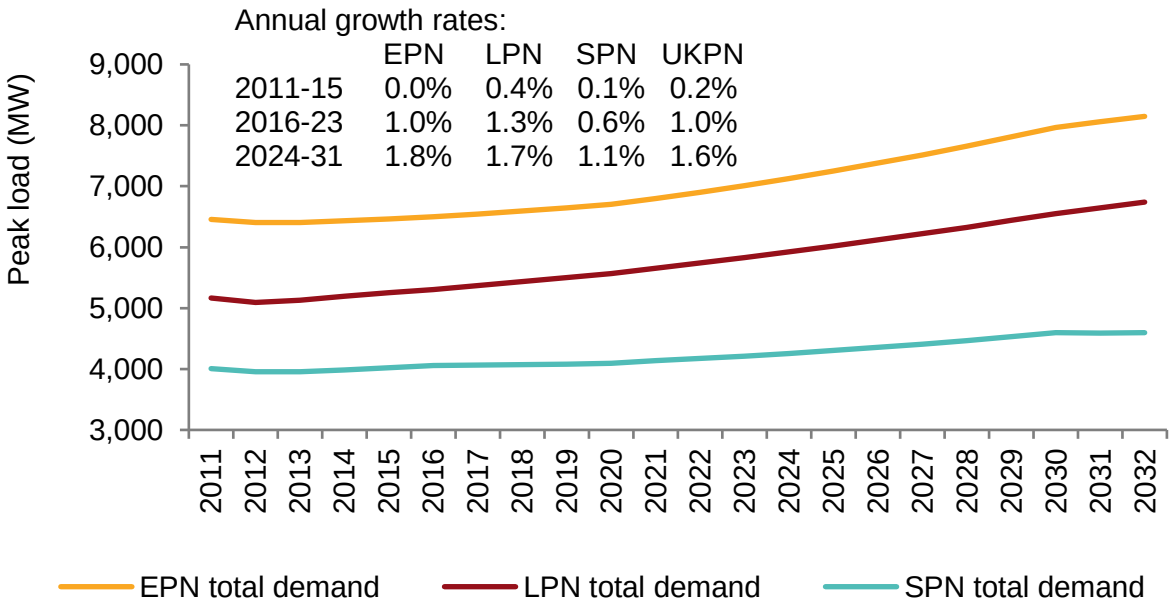
Impact on our network demand

The outcome of this process is the network demand forecast. The graphs below show how we anticipate our network demand to developing over the ED1 period. We expect:

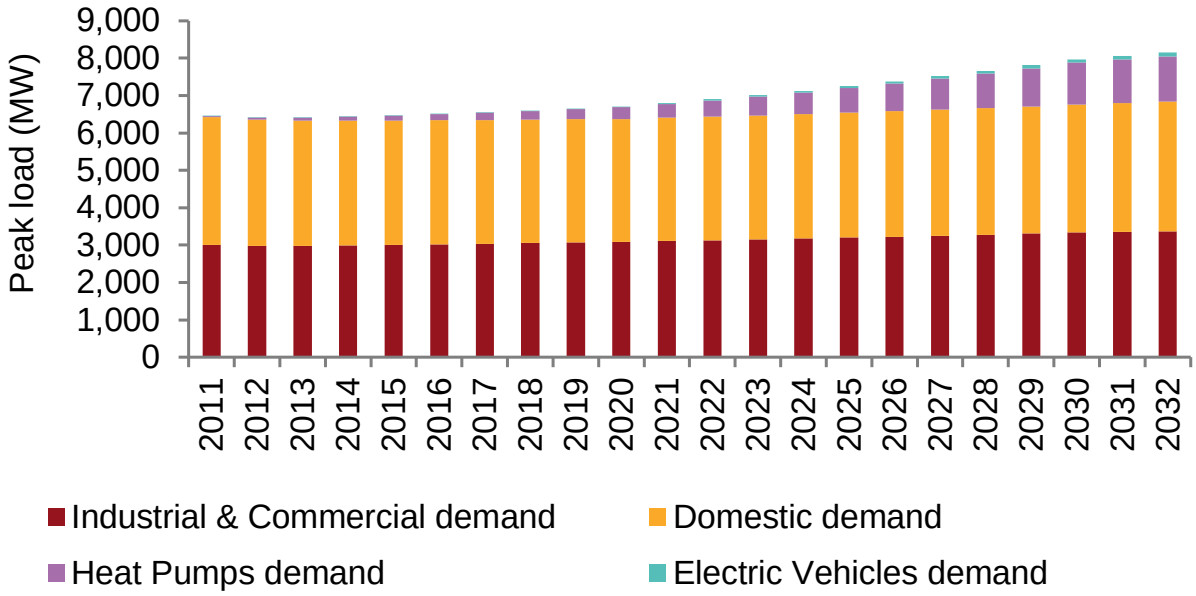
- Traditional domestic demand growth to remain broadly flat over ED1 as future growth is offset by energy efficiency improvements
- Industrial and commercial demand growth to return to historic levels from the end of ED1 as the economy recovers from the current downturn
- The penetration of low carbon technologies e.g. heat pumps to ramp up through the ED1 period

Figure 1 Element Energy Load Growth

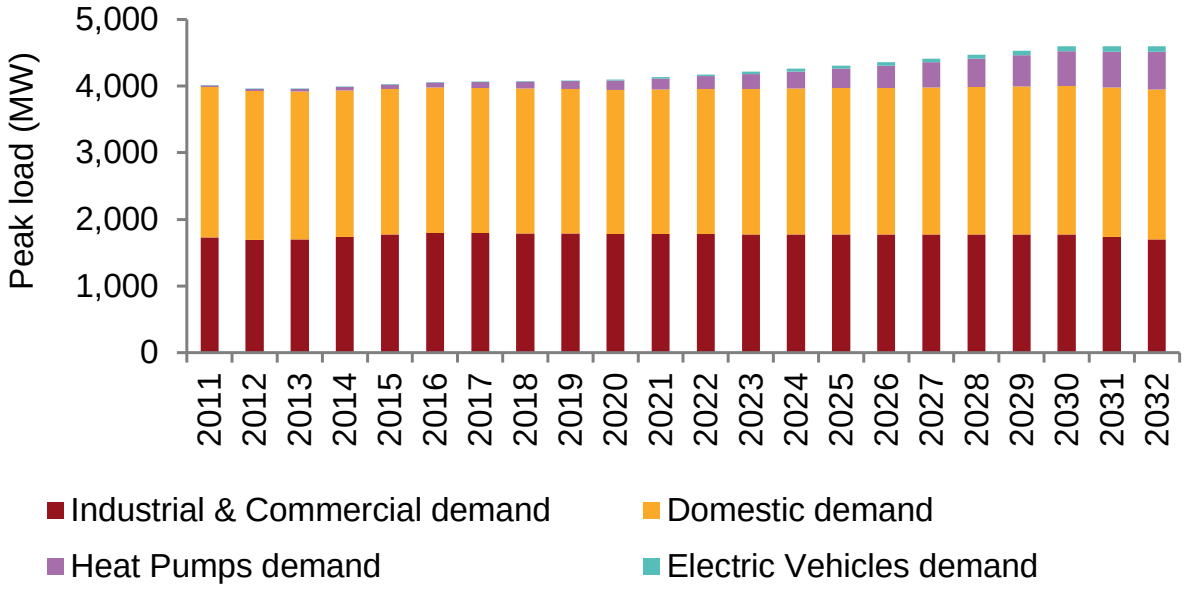
UKPN



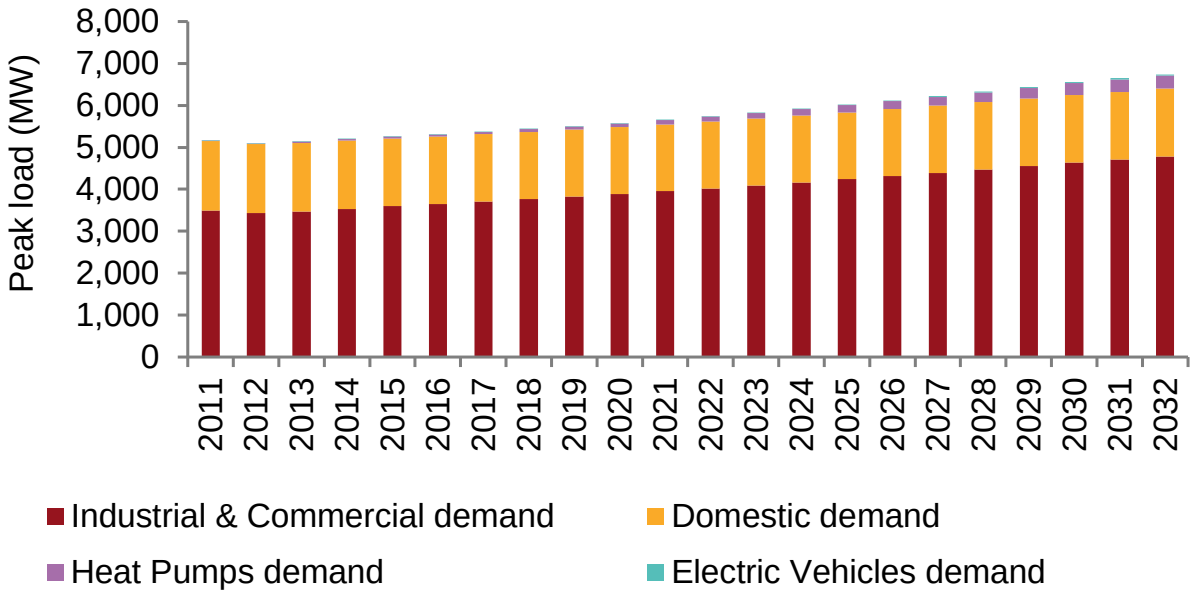
EPN



SPN


Peak load (MW)
5,000
4,000
3,000
2,000
1,000
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
Industrial & Commercial demand
Domestic demand
Heat Pumps demand
Electric Vehicles demand

LPN


Peak load (MW)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
Industrial & Commercial demand
Domestic demand
Heat Pumps demand
Electric Vehicles demand

2 Population and economic growth assumptions

2.1 Population growth assumptions

A key driver of demand growth is new household formation. We have not changed our core population assumption for our Business Plan submission. We continue to believe that utilising long run average data provides the best basis for forecasting future population.

The table below sets out the current Government forecasts for new household formation in England split by DNO[2].

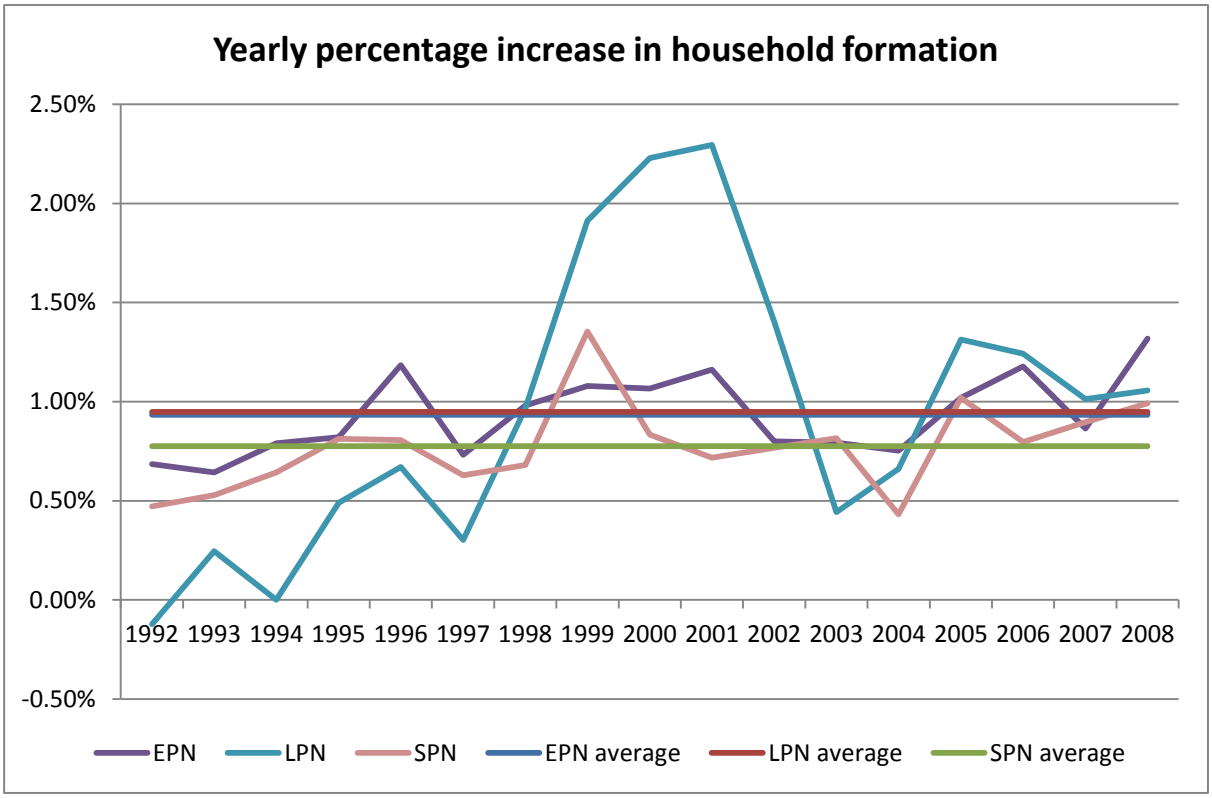
DNO	No of households 2013	No of households 2023	Aggregate household growth	Average % year on year growth	% of England total
WPD East Mid	2492	2777	285	1.1%	12%
WPD West Mid	2204	2392	188	0.9%	8%
WPD SWest	1358	1530	172	1.3%	7%
UKPN EPN	3263	3674	411	1.3%	17%
UKPN LPN	2015	2234	219	1.1%	9%
UKPN SPN	2040	2282	242	1.2%	10%
NPG NEDL	1478	1603	125	0.8%	5%
NPG YEDL	2126	2384	258	1.2%	11%
SP Manweb	1012	1077	65	0.6%	3%
SSE Southern	2766	3066	300	1.1%	12%
ENW	2117	2298	181	0.9%	7%
Total (England)	**22871**	**25317**	**2446**	**1.1%**	**100%**

The table shows that at an absolute level the EPN area has the highest forecast household growth and the growth across our three licence areas accounts for 36% of the total forecast household formation in England.

[2] UKPN analysis of "Table 406: Household projections1 by district England, 1991- 2033" published by the Department of Communities and Local Government

However, the graph overleaf shows the average percentage yearly increase in actual household formation over the period 1991 to 2008. This demonstrates that historically the actual levels of household formation have been below the proposed Government targets. We have therefore assumed that the yearly level of household formation, over the ED1 period, is equal to the historic long run average shown below for each of our licence areas. We believe that this strikes an appropriate balance between recognising that the number of households, and hence electricity demand will grow and the practical issues associated with delivering significant increases in house building in the South East.

Average annual increase in household formation	%
EPN	0.93
LPN	0.95
SPN	0.78



2.2 Economic growth assumptions

Economic growth is a significant factor in increasing demand for electricity and hence the required capacity of our networks. As with population growth we have not changed our assumption for the Business Plan and continue to believe that long run data represents the best estimate for future long run growth. The UK, the wider European and global economies are facing a significant period of continuing uncertainty. The rate of growth in the economy affects our network expenditure levels, as it drives both new network capacity requirements and new connections volumes. Our baseline assumption is that the economy recovers to long run average growth levels from the beginning of ED1. We utilise the regional Gross Value Added metric as our key driver as our key economic metric and our forecast is based on the compound annual growth rate (CAGR) over the period 1989 to 2009. The graph below details the year on year growth over the period in nominal terms.

The values used are shown below:

Annual forecast increase in regional GVA (nominal)	%
EPN	5.4%
LPN	6.1%
SPN	4.5%

The value for the SPN area is lower than the calculated value for the South East regional GVA. The reason for this is that the South East Government Office region covers significant parts of the SSE Southern region network. The area served by SSE contains a number of the high GVA sub regions in the South east area e.g. Bracknell, Oxford whereas the SPN network serves some of the lowest GVA sub region e.g. East Kent. Utilising the South East region CAGR produced a future year on year growth in system demand which was significantly above previous observed levels. The average annual GVA growth has been calibrated to ensure that future growth in maximum demand is in line with previous observed levels.

3 Transitioning to a low carbon economy

3.1 Impact of transitioning to a low carbon economy

The key uncertainty facing Distribution Network Operators is the impact of transitioning to the low carbon economy. The mass adoption of technologies such as electric vehicles, heat pumps and small scale generation are key to the Government achieving their carbon targets but all of these technologies will impact on the electricity distribution network. In order to understand the impact we have worked with Element Energy who are specialists in the low carbon technology arena and have produced technology take up forecasts for DECC, the Energy Savings Trust and the Committee for Climate Change.

In developing our forecasts we have looked at the particular regional factors that will affect take up rates. For example we have examined the housing stock in each of our regions to understand the likely penetration of heat pumps. The modelling also takes into account the impact of the current incentive mechanisms on customers' willingness to adopt new technologies. It should be noted that our forecast take up rates are not designed to achieve a specific carbon reduction target. Since the publication of our Business Plan in November 2012 we have revised a number of our low carbon technology assumptions to take into account improved modelling, feedback from stakeholders, and changes in the policy environment.

We have revised our modelling approach particularly in the area of heat pump take up forecasting since our July submission. The basis of our heat pump forecast was an analysis of the housing stock contained within each of our licence areas. The original 2012 analysis used data from the English House Condition Survey as its base. The house types where then aggregated into ten types to facilitate modelling. Each house type was assigned a heat pump suitability factor. As part of the development of our modelling approach we have used a more detailed analysis of the housing stock based on an Experian dataset. The outcome of this has been to increase the heat pump penetration in EPN but reduce it in both SPN and LPN. We acknowledge that some of our stakeholders felt that our original penetration rates seemed high. In EPN our current assumption would result in approximately 7% of the housing stock would have a heat pump by 2023. This was based on a Renewable Heat Incentive payment of 7.5p per kWh. The latter was the information available when we finalised our 2013 low carbon technology assumptions. However, since then a further consultation has been launched which has proposed upper tariff limits of between 11.5p/kWh and 17.3p/kWh (dependent on the technology type). These are generous incentives and if implemented for a sustained period would be expensive but result in higher take up rates than we have assumed. We therefore believe that our current assumption on incentive rates is a prudent long term view.

The feedback we received from our stakeholders was that our assumption on electric vehicles looked optimistic. We agree that the take up of this technology has been slow driven by the significant purchase price differential between electric vehicles and petrol/diesel equivalents and public concerns relating to ease of charging and range anxiety. We have therefore scaled back our assumptions in these areas.

Finally, as part of our analysis of the Smartgrid Forum Workstream 3 model we identified that we had not included any assumptions on the take up of commercial heat pumps. We have used the take up rates assumed in the Smartgrid Forum Workstream 3 model.

The tables below compare July 2012 key low carbon technology assumptions with our revised view for this plan.

EPN	July 2012 plan assumption	July 2013 plan assumption
Heat pumps – Domestic (#)	233k	222k

Heat pumps – Non domestic (MW)	Not included	155MW
Electric vehicles (#)	243k	129k
FIT eligible generation (#)	290k	195k
Onshore wind (MW)	724MW	625MW
Offshore wind (MW)	Beyond 2015 assumed to connect to offshore grid	Beyond 2015 assumed to connect to offshore grid

LPN	July 2012 plan assumption	July 2013 plan assumption
Heat pumps – Domestic (#)	61k	37k
Heat pumps – Non domestic (MW)	Not included	62MW
Electric vehicles (#)	130k	41k
FIT eligible generation (#)	93k	67k
Onshore wind (MW)	10MW	10MW
Offshore wind (MW)	N/A	N/A

SPN	July 2012 plan assumption	July 2013 plan assumption
Heat pumps – Domestic (#)	121k	84k
Heat pumps – Non domestic (MW)	Not included	82MW
Electric vehicles (#)	156k	111k
FIT eligible generation (#)	167k	113k
Onshore wind (MW)	214MW	145MW
Offshore wind (MW)	Beyond 2015 assumed to connect to offshore grid	Beyond 2015 assumed to connect to offshore grid

We have also included improvements in both domestic lighting and appliances in our forecasts. DEFRA had developed three views of future improvements in energy efficiency as part of its Market Transformation Programme. They are:

- Reference Scenario - The Reference Scenario is a projection of what is likely to happen to energy consumption of each product if no new policies are implemented. All agreed and formally signed-off policies are included in the Reference Scenario.
- Policy Scenario - The Policy Scenario is a projection of what would happen if a defined set of new product-specific and related cross-cutting policies were implemented. The policies in the Policy Scenario have not yet been agreed or funded but represent those policies which are expected to be introduced as well as likely future revisions to existing policies and, in some cases, novel policy options.
- Best Available Technology Scenario - The Best Available Technology (BAT) Scenario is a hypothetical projection of what would happen if the best available technologies on the (current and future) market were bought or installed from now on.

We believe that energy efficiency will have an impact on future energy requirements. Our modelling in July 2012 was based on the reference scenario, as it included those initiatives which were funded. We continue to believe that this is the most appropriate solution and hence have applied it in our 2013 forecast.

3.2 Analysis of alternative low carbon technology take up rates

The Smartgrid Forum Workstream 3 has developed four take up scenarios for low carbon technologies at a DNO level. A description of these scenarios is shown below:

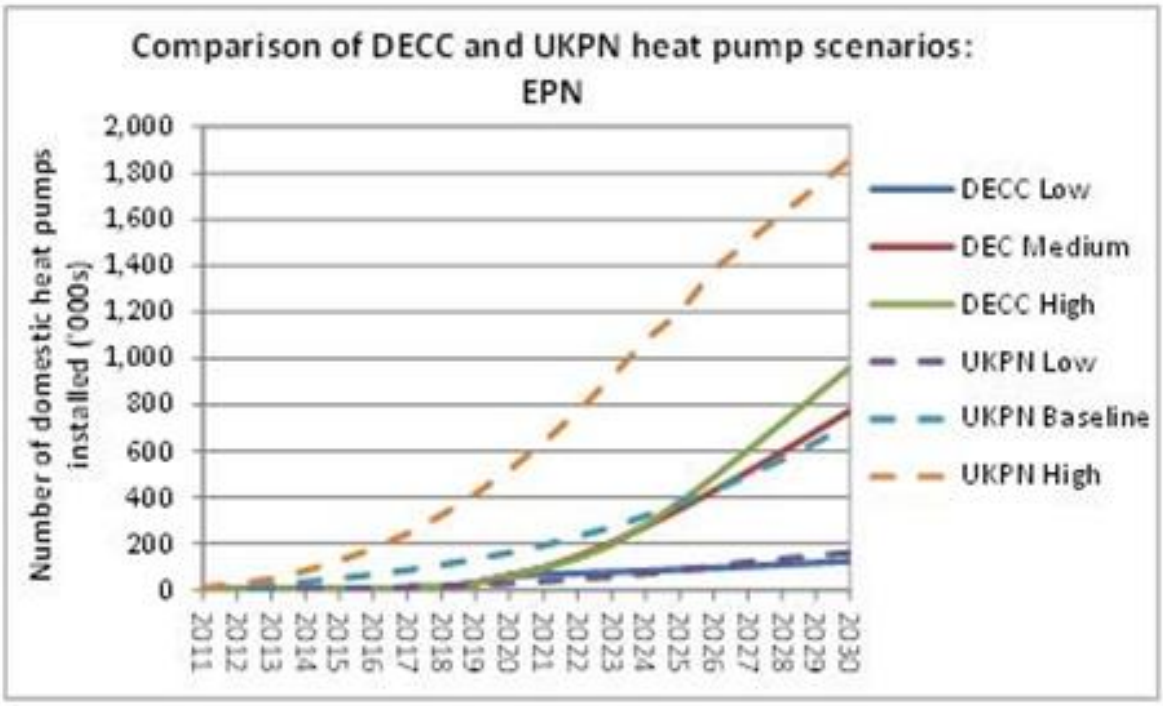
Scenario	Description
Scenario 1 – high abatement in low carbon heat	High level of emissions reductions from uptake of low carbon heat in buildings and industry (8 million installations) with significant emission reductions from transport (60g CO2/km) and significant thermal insulation of buildings (5million solid wall insulations).
Scenario 2 – high abatement in transport	High level of emissions reductions from transport (50g CO2/km), with comparatively lower reductions from low carbon heat (7 million installations) and significant thermal insulation of buildings (5 million solid wall insulations).
Scenario 3 – high electrification of heat and transport	This reflects a future where there is high electrification in heat and transport, with significant uptake of EVs and heat pumps (as in scenario 1 and scenario 2) and lower comparative levels of insulation (2.5 million).
Scenario 4 – credit purchase	Reflects a future where more than one key technology under-delivers, and carbon credits are purchased. It assumes 1.6 million low carbon heat installations, medium levels of insulation (4.5million) and fuel efficiency of 70g CO2/km.

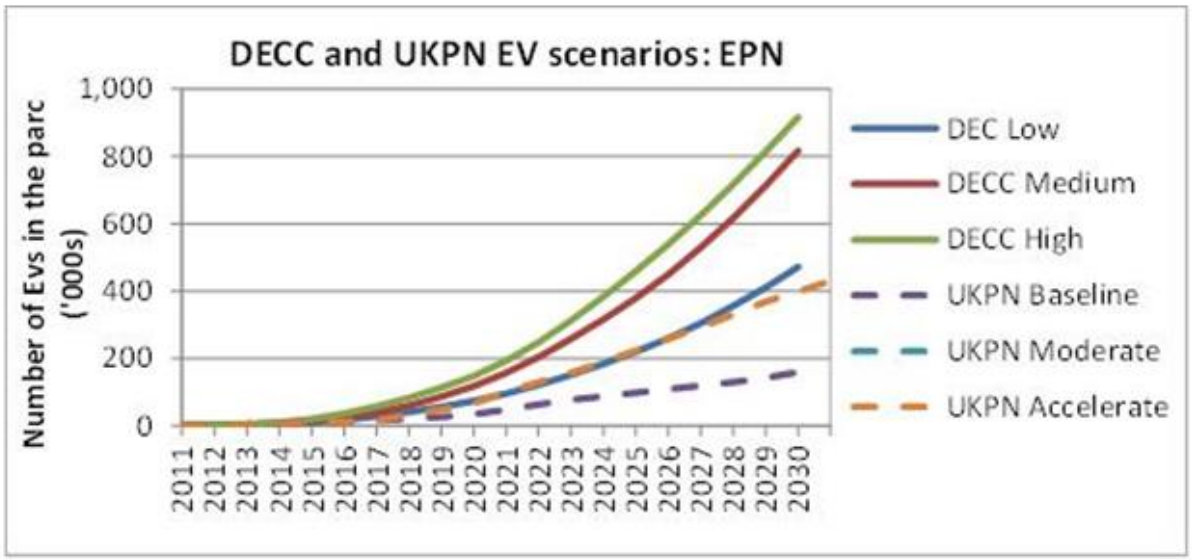
These forecasts extend to 2050 and with the exception of the low scenario have been designed to achieve the 4th Carbon Budget targets at a national level. The key technologies modelled in these scenarios are:

- Heat pumps
- Photovoltaic generation
- Electric vehicles
- Wind generation

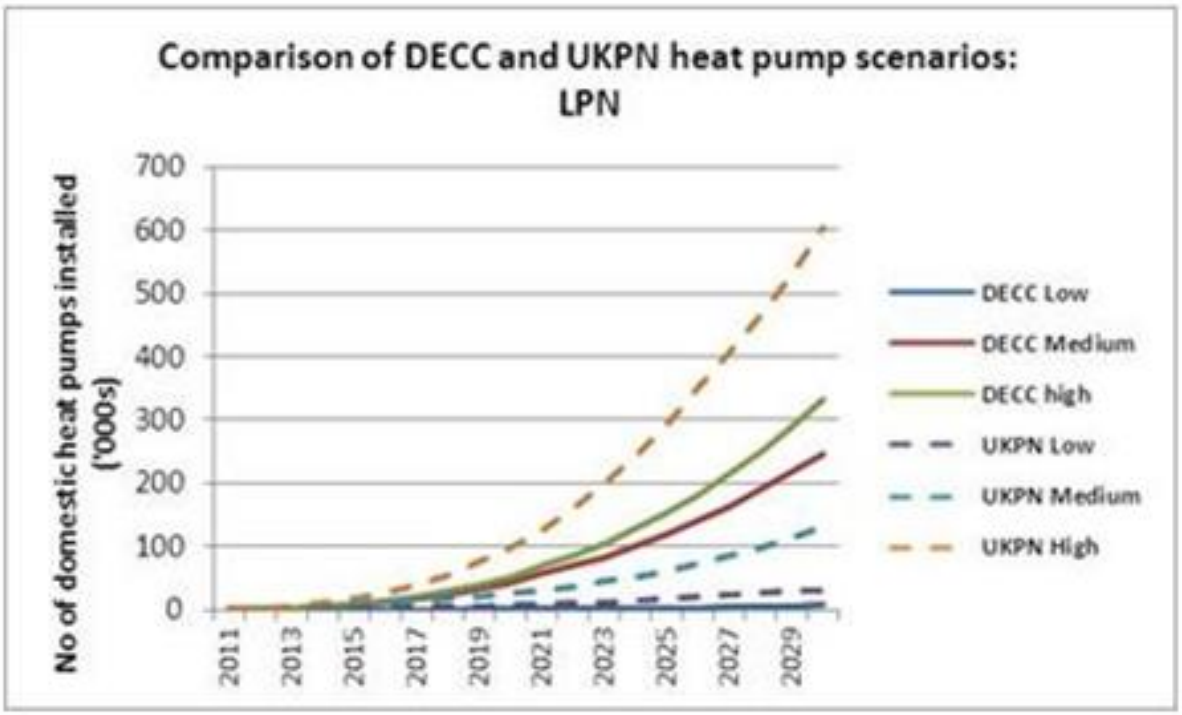
The graphs below compares the take up rates predicted under these scenarios compared to the UKPN scenario for the both heat pumps and electric vehicles. It is these two technologies which have the largest impact on network peak demand. The graph generally demonstrates that our current baseline uptake rates are towards the lower end of the DECC/Smartgrid Forum forecasts over the long term. Over the RIIO-ED1 period we would broadly be in line with the DECC/Smartgrid forum forecasts for heat pumps and significantly lower than the forecasts for electric vehicles. Our position is that our forecasts are based on what we believe the current incentive frameworks will deliver in our licence areas. However, a change in public perception and/or government policy could substantially alter these take up rates.

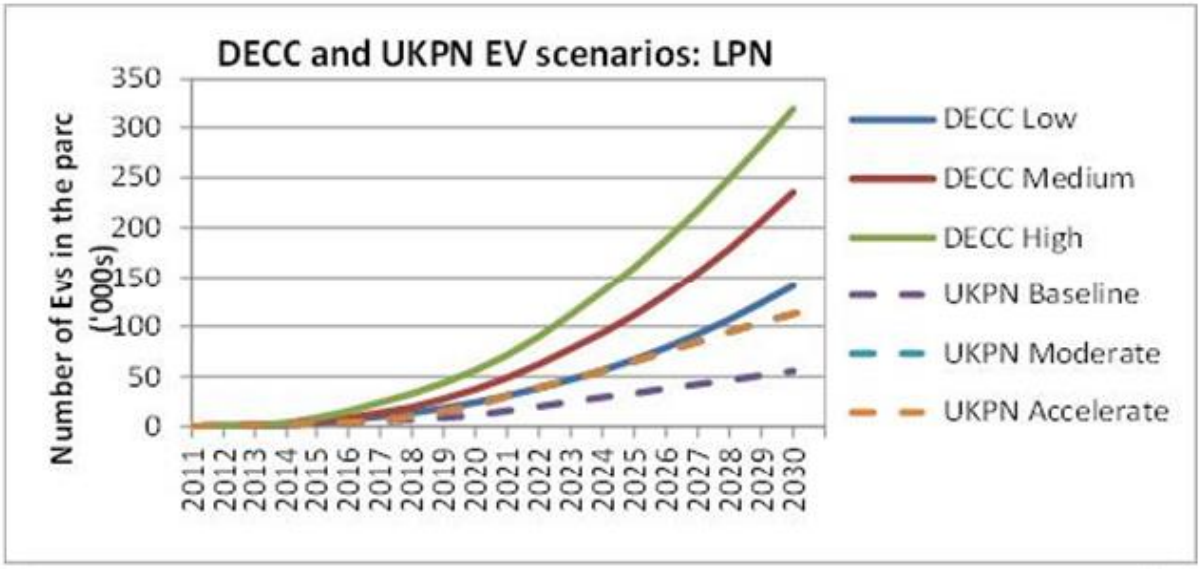
EPN


Comparison of DECC and UKPN heat pump scenarios: EPN
Number of domestic heat pumps installed ('000s)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
DECC Low
DEC Medium
DECC High
UKPN Low
UKPN Baseline
UKPN High

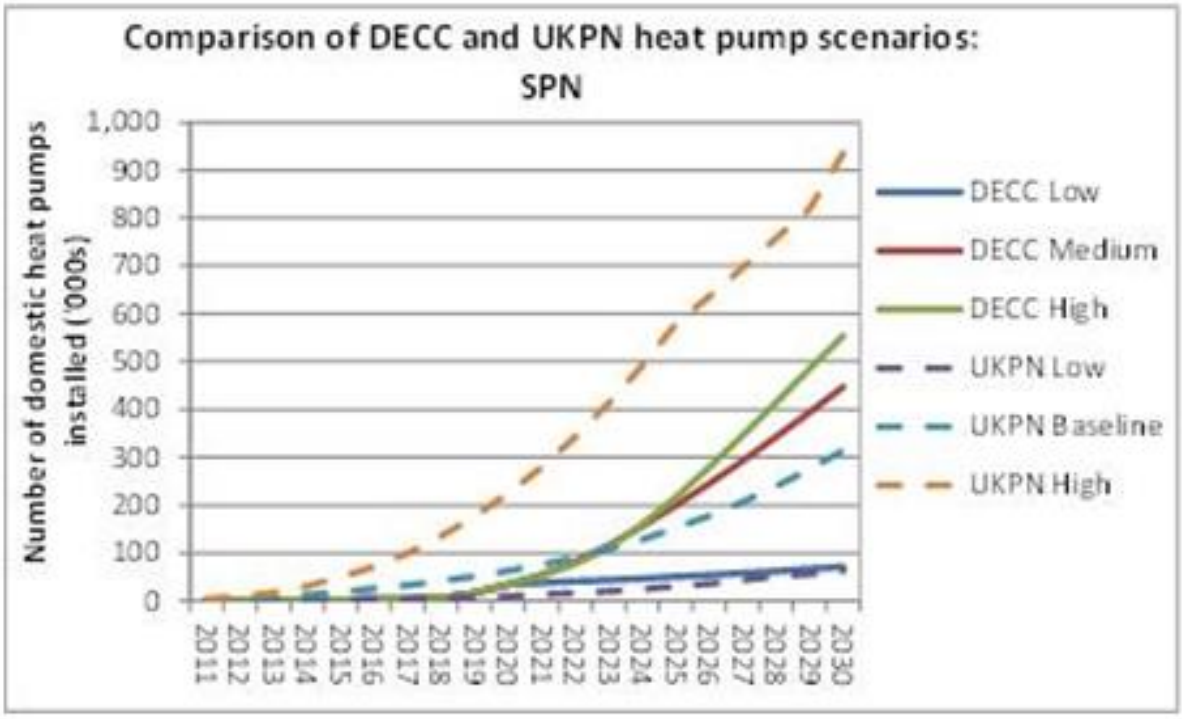

DECC and UKPN EV scenarios: EPN
Number of Evs in the parc ('000s)
1,000
800
600
400
200
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
DEC Low
DECC Medium
DECC High
UKPN Baseline
UKPN Moderate
UKPN Accelerate

LPN


Comparison of DECC and UKPN heat pump scenarios: LPN
No of domestic heat pumps installed ('000s)
700
600
500
400
300
200
100
0
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
DECC Low
DECC Medium
DECC high
UKPN Low
UKPN Medium
UKPN High


DECC and UKPN EV scenarios: LPN
Number of Evs in the parc ('000s)
350
300
250
200
150
100
50
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
DECC Low
DECC Medium
DECC High
UKPN Baseline
UKPN Moderate
UKPN Accelerate

SPN


Comparison of DECC and UKPN heat pump scenarios: SPN
Number of domestic heat pumps installed ('000s)
1,000
900
800
700
600
500
400
300
200
100
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
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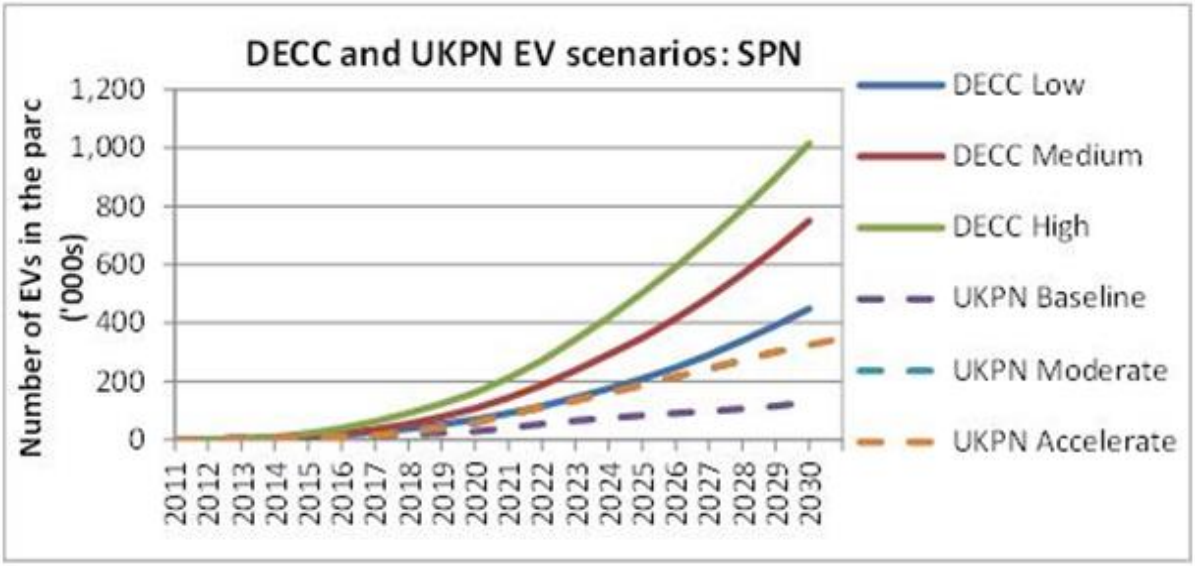
2026
2027
2028
2029
2030
DECC Low
DECC Medium
DECC High
UKPN Low
UKPN Baseline
UKPN High


DECC and UKPN EV scenarios: SPN
Number of EVs in the parc ('000s)
1,200
1,000
800
600
400
200
0
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
DECC Low
DECC Medium
DECC High
UKPN Baseline
UKPN Moderate
UKPN Accelerate

We therefore have to understand the impact on our investment requirements if these alternative scenarios where to arise. We have used both our own internal long range load forecasting tool and the Smartgrid forum workstream to develop this analysis. The output of this modelling is discussed in managing uncertainty annex alongside our proposals for how we would deal with this uncertainty.