London Plan topic paper: Energy

December 2017

1. This report outlines the key issues of relevance to the policies for zero carbon development, energy infrastructure and energy efficiency in the new draft London Plan and summarises some key external research reports which were commissioned by the GLA as part of the development of these policies.

2. Research was carried out in 3 keys areas:
    a. Energy efficiency
    b. Future of heat
    c. Carbon pricing for offset funds

Context

3. The Mayor is committed to London becoming zero carbon by 2050. Making London zero carbon will require economy-wide decarbonisation. This will involve changes to the way in which Londoners travel, work and live. It will also require changes to improve the energy efficiency of the buildings in London and changes to the way energy is used and generated.

4. Buildings are responsible for around four-fifths of London's total greenhouse gas emissions and 70 per cent of final energy use. It is essential that new buildings constructed today are designed for a zero carbon future, minimising the need for significant, costly retrofit in future decades and saving households and businesses money on their future energy bills. The London Plan provides the framework to deliver on this ambition, through the principles of the energy hierarchy and its supporting policies.

Climate and energy policy in the UK

5. A range of international, EU and domestic policy drives decarbonisation and energy efficiency improvements to existing and new buildings in the UK. The United Nations Paris Climate Agreement is a climate change accord agreed by nearly 200 countries in December 2015. The historic agreement commits world leaders to keeping global warming below a threshold of 2° C, and to pursue a tougher target of 1.5° C. The agreement also has a long-term goal for net zero greenhouse gas emissions, which would effectively phase out the combustion of fossil fuels. The UK government ratified the Paris Agreement in November 2016 and is now obliged to meet this target, which goes beyond the ambitions of the UK's own 2008 Climate Change Act.

6. At the EU-level, the Energy Performance of Buildings Directive (2010/31/EU) and the Energy Efficiency Directive (2012/27/EU) are the main EU legislation covering the reduction of energy consumption in buildings. They promote the production of Energy Performance Certificates and aim to drive all new buildings to be nearly zero energy by 31st December 2020 (public buildings by 31st December 2018).

7. EU Member States must set minimum energy performance requirements for new buildings, for the major renovation of buildings, and for the replacement or retrofit of building elements (heating and cooling systems, roofs, walls, etc.). This was transposed into the UK National Energy Efficiency Action Plan in 2014.

8. At the UK level, the Climate Change Act 2008 commits the UK government to reducing greenhouse gas emissions by at least 80 per cent of 1990 levels by 2050. It sets legally-binding 'carbon budgets' capping the amount of greenhouse gases emitted in the UK over a five-year period. The budgets are designed to reflect a cost-effective way of achieving the UK's long-term climate objectives. The first five carbon budgets have been put into legislation and run up to 2032.

9. In London, the Mayor's draft strategies including the London Environment Strategy, Mayor's Transport Strategy and London Plan set out policies and proposals for addressing climate change. In 2014, London's greenhouse gas emissions were estimated at around 38 MtCO2e (million tonnes of carbon dioxide equivalent), approximately seven per cent of the UK's total emissions. London's emissions are reducing, having fallen by 16 per cent since 1990, largely due to reduced gas consumption and decarbonisation of the national electricity grid. To achieve the Mayor's zero carbon target by 2050 the rate of emissions reduction must be increased threefold over progress to date since 1990.

National Building Regulations

10. Part L of the Building Regulations sets the required baseline carbon emissions for a set of notional new building types in the UK. All new developments in England and Wales must show compliance against this baseline. Successive iterations to Part L of the Building Regulations have improved the required performance of buildings under this baseline, with the intention to ratchet standards up over time to reflect improvements in technology and building practises.

11. In practice, this successive improvement has not been realised in recent years on a national level, so the London Plan retained its trajectory towards zero carbon[1], including a target for a 35 per cent improvement beyond Building Regulations to continue to drive forward performance standards in London. This London specific target has been successful in raising the standard of new buildings in London when compared to national requirements. Annual monitoring of the energy policies in the London Plan shows that developments are consistently meeting the carbon reduction targets. In 2016, developers committed to an average of 35.7 per cent carbon reductions beyond 2013 Building Regulations. This policy has driven technology and product development and professional design services. It also sets the tone and culture within the industry, with many companies keen to outperform the minimum standards set by policy.[2]

The role of the London Plan and its implementation

12. Under the 2007 amendments to the Greater London Authority Act 1999, the Mayor has a duty to contribute towards the mitigation of, or adaption to, climate change in the United Kingdom. Through the London Plan, the Mayor is able to ensure that major new developments and major refurbishments requiring planning consent are designed to help mitigate against climate change and are resilient to its impacts.

13. Technical experts at the GLA work with developers and the London Boroughs to implement and ensure compliance with the London Plan carbon reduction and energy

[1] In line with the Government's policy at the time
[2] Aldersgate Group (2017)

policies. Training and workshops are held to ensure implementation remains up to date and relevant should any changes be made to the Building Regulations or other relevant legislation. Performance against the carbon reduction targets and energy policies is reported annually through the Energy Monitoring Report, which also provides case studies of schemes demonstrating good performance in reducing carbon emissions[3].

The energy hierarchy

14. London Plan policy has set a trajectory to zero carbon development since its publication in 2011 with a zero carbon target being applied to domestic developments since 1 October 2016. The new draft London Plan policy SI2 'Minimising greenhouse gas emissions' requires all major development, including non-domestic development, to meet the zero carbon target.

15. The energy hierarchy allows the target to be met through a combination of energy efficiency measures (be lean), efficient and low-carbon energy supply (be clean), renewable energy (be green) and offsetting of any residual emissions. The hierarchy requires a minimum level of onsite carbon reduction of a 35 per cent improvement over Part L of Building Regulations (2013) from be lean, be clean and be green measures, with a contribution into the relevant borough's carbon offset funds for any residual emissions. This 35 per cent target has been in place for major developments as part of London Plan policy since 2013. (This is equivalent to a 40 per cent improvement over the lower standards in the 2010 Building Regulations).

The rapid decarbonisation of electricity

16. In recent years, national Building Regulations (last published in 2013) have become increasingly outdated in relation to estimating the carbon emissions associated with buildings, in particular the carbon content of grid supplied electricity. The UK electricity grid has become significantly lower carbon in the four years since Building Regulations were last published, as a result of increased gas and reduced coal generation due to their relative fuel prices and rapid increase in renewable energy supply.

17. Following a consultation in 2016, the Government announced changes to the Standard Assessment Procedure (SAP). SAP is the tool used to measure the energy use and carbon emissions of new homes against the target set in the Building Regulations. A key part of this change will be updates to the emission factors associated with energy use to reflect the continuing decarbonisation of the electricity grid. Changes are also proposed to more closely reflect the real-world heat losses associated with district and communal heating systems. These changes are likely to have an influence on decisions in selecting energy systems and technologies to meet carbon targets. In November 2017, the Government responded to the consultation stating that new greenhouse gas emission factors will be included in the next Building Regulations update; however the timeline for this is currently uncertain.

18. The anticipated changes to the carbon content of grid electricity have been considered in the development of the new draft London Plan policies to ensure they are

[3] Annual Energy Monitoring Reports: https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/energy-planning-monitoring

futureproofed. The on-site carbon reduction target will be reviewed and updated as necessary when Building Regulations are updated.

1) Research on energy efficiency

19. Energy efficiency is the first step of the energy hierarchy, and is often the most cost-effective way to decarbonise buildings. It also saves households and businesses money on their energy bills. That makes it one of the key ways to help ensure that the poorest and most vulnerable households are able to heat their homes affordably.

20. To date, the 35 per cent London Plan target has been effective at driving overall carbon reduction, however, its impact on driving energy efficiency has been limited, with the vast majority of savings being delivered through energy supply rather than energy efficiency.

21. The GLA commissioned Buro Happold to undertake additional research into the feasibility and viability of introducing a new target focused on the 'be lean' element of the energy hierarchy in order to increase energy efficiency levels. The study looked at the level of energy efficiency achieved in past applications and estimated the technical and economic feasibility of achieving higher levels of energy efficiency in domestic and non-domestic buildings.[4]

22. The study found that:

- A review of referable development applications since 2014 found the average 'Lean' savings, or carbon savings from energy efficiency alone, to be 3.5% over Building Regulations for residential, 11.6% for non-residential and 6.3% for mixed-use buildings.
- 37% of residential projects achieved at least a 5% lean CO_2 reduction with 13% achieving a 10% reduction.
- A domestic lean CO_2 target of 5% would be generally achievable without significant technical changes.
- A domestic lean CO_2 target of 10% is technically achievable and would help lock in long-term carbon reductions through improved building fabric rather than shorter-life heat generation technologies.
- A non-domestic lean CO_2 target of 15% is technically achievable in many cases, however there is significant variance across non-domestic building types.
- The construction industry will need to raise performance to meet higher energy efficiency standards. Strong aspirational targets can help drive significant innovations in the wider energy efficiency sector.

23. Following this study, AECOM were commissioned to undertake a detailed evaluation of the implications of introducing an energy efficiency target for six case studies (three common domestic development types[5] and three common non-domestic development types[6]). For each case study, AECOM identified a fabric approach (focusing on elements such as higher performing windows and insulation), a services approach (focusing on building systems such as ventilation with heat recovery) and a blend of the two to determine expected performance against the proposed targets.

[4] Driving Energy Efficiency Savings Through the London Plan – Buro Happold https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/evidence-base
[5] A low rise residential block/terraced housing, a 5-7 storey residential block, a 40 storey residential tower.
[6] An office, a hotel and a school.

24. For domestic developments, the 10 per cent improvement was achieved for all three case studies. For most buildings, this could be achieved through current best practice, with the exception of tall residential developments with a high proportion of glazing and curtain walling. For these buildings types, triple glazing may be required to meet the proposed target (rather than double glazing which is current standard practice).

25. For non-domestic developments, performance against a 15 per cent target was more varied, reflecting the wider range of development types. The air-conditioned office development typology easily met the target whereas the school development achieved just under the target. The hotel development typology fell significantly short of the 15 per cent target, due to the hot water demand assumptions associated with hotel modelling.

26. The costs associated with achieving a 10 and 15 per cent reduction for domestic and non-domestic development respectively were deemed to be viable for most development types in London following viability testing. 'Lean' targets of 10 and 15 per cent reduction for domestic and non-domestic respectively have therefore been included within the broader 35 per cent target within the new draft London Plan. These targets will drive building design towards greater consideration of energy efficiency and on-site emissions reductions as per the energy hierarchy.

27. As noted in both studies, the ability of certain building types to meet these targets in the short term will vary. The GLA will consider this on a case by case basis in particular for specific non-domestic typologies, like hotels, that can clearly demonstrate how and why this target cannot be met. Other buildings types will be expected to go beyond this target (e.g. offices).

2) Research on future heating options

Energy systems & the heating hierarchy

28. In addition to reducing the energy use of buildings in London, there is a need to transform the energy system so that energy used in buildings is generated from clean, low carbon and renewable sources, such as solar and waste heat.

29. District heating schemes enable a range of different energy sources and technologies to connect to different building types. Aggregating a range of heat users can create a diversity of heat demand and therefore better utilisation of energy system capacity.

30. District heating also allows waste heat (e.g. from the Tube) to be used in London, reducing the use of fossil fuels. Schemes that use local energy sources can also contribute to a more secure energy supply with less dependence on imported energy. These networks can be supplied by low carbon heating sources, allowing them to provide low carbon and renewable heat to large number of buildings in future. In the longer-term they may be combined with large scale heat storage, reducing the impact of electric-based heating on peak electricity demand.

31. The London Plan plays an important role in catalysing the development of heat networks through the future-proofing of building designs for communal heating and

the requirement to identify decentralised energy opportunities as part of all energy masterplans (Policy SI3).

32. The decarbonisation of the grid, and the change in the relative carbon content of electricity and gas, will mean that other technologies, such as low carbon heat pumps, can increasingly serve as the heating source for district heating, offsetting more traditional systems such as gas engine CHP. As well as greater carbon savings in the medium to long term, heat pumps have no adverse air quality impacts. In some areas with lower heat demand, heat networks may not be appropriate; in these cases, solutions such as individual heat pump systems may provide an appropriate alternative approach.

33. The draft new London Plan reflects this by introducing two new considerations; heat network priority areas and a revised heating hierarchy. These additions are outlined below.

Heat network priority areas

34. Where the 2016 Plan required developments to consider communal heating systems in all areas in London, the new draft London Plan introduces flexibility in areas of London where heat networks are not expected to offer a significant contribution to future decarbonisation. Major developments in all areas are still required to meet a minimum 35 per cent on site reduction as part of the zero carbon target through energy efficiency and the use of lower carbon heating, but this flexibility allows developments in less dense areas to consider other innovative approaches, (such as Passivhaus schemes).

35. Schemes developed in district heating priority areas should be designed to allow connection to district heating networks. This enables both low carbon solutions to be implemented today and crucially, the ability to convert district heating schemes to zero carbon supply by 2050, without the need to retrofit individual buildings.

36. The geographic extent for heat network priority areas are illustrated in the draft London Plan (Figure 9.3) and will be developed as a live layer on the London Heat Map[7] to reflect changes throughout the lifetime of the Plan. These areas are based on regions prioritised for heat networks by local authorities, areas identified for growth and regeneration and areas with high heat densities.

The heating hierarchy

37. The 2016 consolidated London Plan promotes connecting to existing or planned networks in the first instance, then using site-wide combined heat and power (CHP) systems and lastly communal heating and cooling. However, real-world decarbonisation of the electricity grid now also favours electric heat pumps, which to date have not played a significant role in heating strategies for development. This is not currently reflected in Building Regulations.

38. The proposed new heating hierarchy (Policy SI3.D) supports a broader range of technologies and considers air quality to a greater extent than the 2016 London Plan. It promotes the use of waste and low temperature heat ahead of heat generation and

[7] https://www.london.gov.uk/what-we-do/environment/energy/london-heat-map

requires systems to demonstrate emissions equivalent or lower than an ultra-low NOx gas boiler in areas that exceed legal air quality limits.

39. The choice of heating technology will also be important to achieve long term carbon savings. To explore the impact of grid decarbonisation on future choices on low carbon heating, the GLA commissioned Buro Happold to assess the impact of the proposed revised emission factors, looking at the carbon intensity and the cost of different types of heat generation.

40. Buro Happold's report, "The future role of the London Plan in the delivery of area-wide district heating"[8], considers an increasingly decarbonising electricity grid up to 2020, any resulting changes in the carbon emissions associated with communal and individual heat supply technologies and the implications for the London Plan 35 per cent target. This work was framed around a scenario where Building Regulations were updated to reflect either the proposed 2016 or 2019 electricity grid carbon factor. The study also considered the impact of increasing the heat losses of communal heating systems to more closely reflect reality.

41. The key findings of the report are summarised below:

- As the national electricity grid decarbonises, the carbon benefit of gas CHP diminishes as gas becomes more carbon intensive relative to grid electricity
- Using 2019 carbon emission factors, gas engine CHP is expected to provide lower carbon savings over its lifetime than gas boilers - Building Regulations calculations do not currently reflect this and require updating.
- Heat pump technologies show increasingly greater carbon savings with future grid emissions factors, but far less than gas engine CHP when using the carbon factors in current Building Regulations
- Updating Building Regulations to reflect 2019 emission factors would allow heat pump systems to meet the 35% target, however if they were only updated to 2016 levels this would create a halfway transition where neither gas CHP nor heat pumps would typically meet the 35% target.[9]

42. The GLA recognises there will continue to be uncertainty caused by outdated emission factors until they are updated by Government in the next revision of Building Regulations. Further guidance on the use of appropriate emissions factors will be set out in the Mayor's Energy Planning Guidance to help provide certainty to developers on how these policies are implemented.

3) Research on carbon pricing

43. The 2016 London Plan includes a London-wide zero carbon standard for major residential development which has been implemented from October 2016. This includes a minimum 35% on-site carbon reduction target beyond Building Regulations with the shortfall being made up as a cash-in-lieu payment to the relevant planning authorities' offset fund. The annual shortfall is determined by subtracting the overall regulated carbon dioxide savings from the target savings. The result is then multiplied by 30 years

[8] The Future Role of the London Plan in the Delivery of Area-Wide District Heating – Buro Happold https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/evidence-base

[9] This report focused on heating system choice, it did not consider where improvements could be made to meet the 35% target from either improved energy efficiency measures or additional renewable technologies on-site.

to give the cumulative shortfall, which is multiplied by the carbon dioxide offset price to determine the required cash-in-lieu contribution.

44. The majority of boroughs have established a carbon offset fund or are in the process of setting one up. The recommended GLA price of carbon has, to date, been based on the nationally recognised non-traded price for carbon of £60 per tonne, which was tested through the viability assessment of the Minor Alterations to the London Plan (MALP) in 2013 and shown not to challenge the viability of housing delivery.

45. To ensure the GLA's recommended carbon offset price continued to be appropriate and viable, AECOM were commissioned to carry out a study of possible carbon offset prices, considering both published carbon prices and the cost of undertaking various carbon reduction projects in London.[10]

46. The report involved the analysis of 18 possible carbon offsetting measures and the associated installation cost, carbon saving and cost of carbon saving. This covered a range of retrofitting measures to homes and non-domestic buildings and showed the broad variability in the cost of carbon savings of different types of projects. The report also highlighted the opportunities that arise from using co-payments (eg contributions from home owners or using other grants or funding programmes like ECO) alongside offset funds to undertake more expensive offsetting measures. Allowing for co-payments reduces the cost per tonne of carbon of projects funded by offset payments, increasing the amount of carbon savings and broadening the range of measures that can be funded. A consequence of this approach is that the cost per tonne of carbon savings for offsetting projects is not fixed on the total cost and carbon savings of projects, and the level of co-payment.

47. Given the wide variability in costs and carbon savings for potential projects across London, combined with the uncertainty in levels of co-payments that may be secured for projects, it would be difficult to calculate a robust London-wide cost per tonne of carbon based on the costs of different types of projects. The study therefore recommended that the GLA continue to use a nationally recognised carbon pricing mechanism.

48. A nationally-recognised non-traded carbon price of £95 per tonne was tested as part of the overall viability assessment of the draft London Plan. Various factors were taken into consideration in selecting this price including; the current £60 per tonne price being significantly lower than the cost of delivering most carbon offsetting projects in London, the aim to encourage a greater level of on-site carbon reduction (beyond the minimum 35% required) in new developments, and the overall need to consider development viability and delivery.

49. The draft London Plan continues to recommend that boroughs should use a nationally recognised price (such as the £95 recommended GLA price which has been tested for viability) or a locally-determined price based on the cost of offsetting measures in the borough, where they could be higher due to higher delivery costs in London. The recommended GLA offset price will be reviewed regularly and further guidance will be produced to help boroughs implement offset funds.

[10] London Carbon Offset Price (March 2017) AECOM https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/evidence-base

Conclusion

50. Taking into account the evidence outlined in this report and the wider context of energy and climate change policy, the proposed policies presented in the draft London Plan are considered to be an appropriate approach to addressing the Mayor's responsibilities and ambitions in respect of energy and climate change.

51. It is considered that these policy requirements strike a reasonable and appropriate balance between driving up standards for development in London whilst taking into account technical feasibility, financial viability and flexibility in technology selection.