

# MAYOR OF LONDON

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## Zero carbon London: A 1.5°C compatible plan

December 2018



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## What has London committed to?

The Mayor of London has some of the most ambitious plans to tackle climate change in the world.

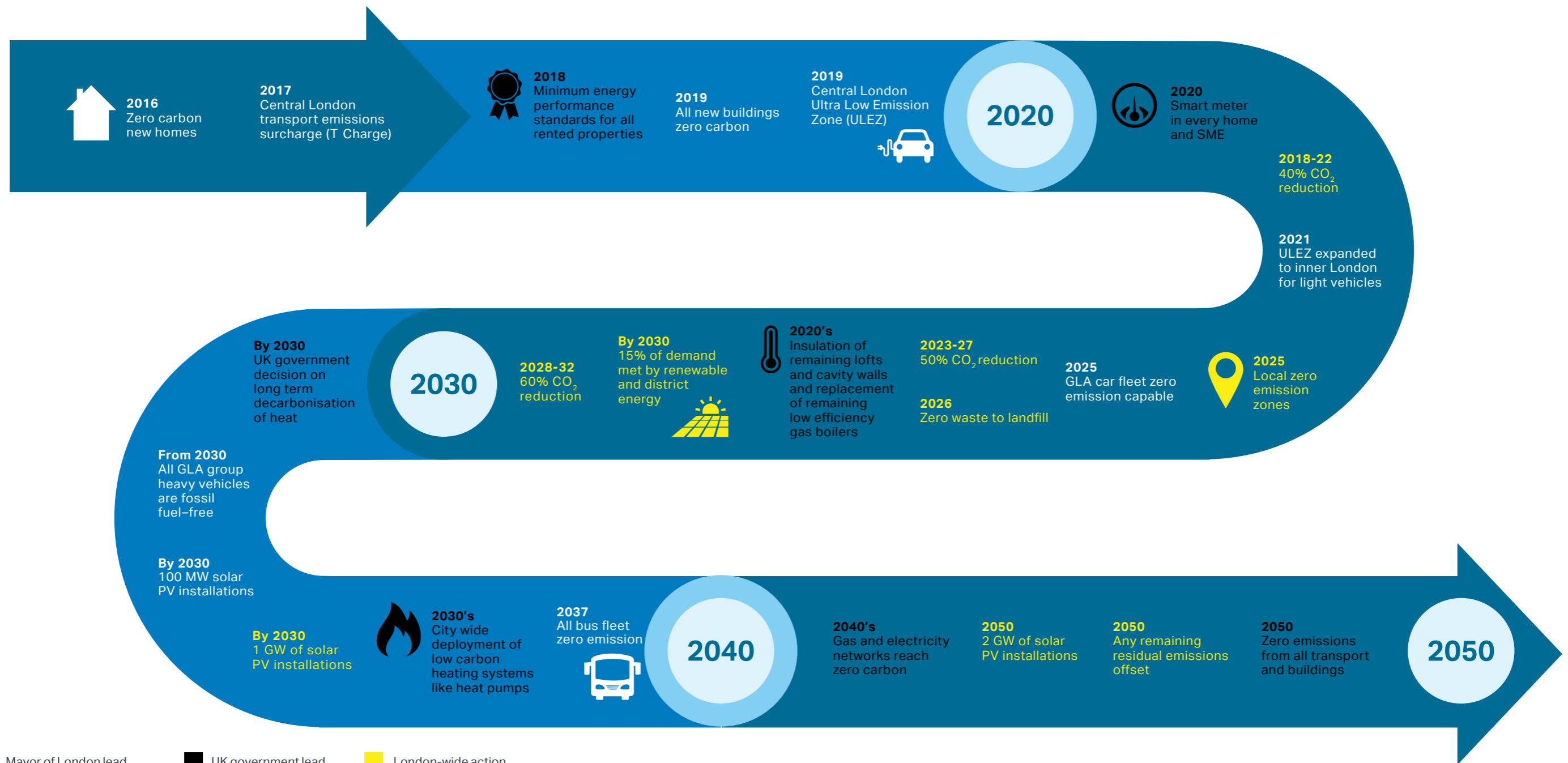
In 2015, the UK signed up to the Paris Agreement along with 178 other countries. The aim was to try to limit the global average temperature rise to 1.5C above pre-industrial levels. The **IPCC Special Report** highlighted the huge impacts there would be if average temperature increases exceed 1.5C. It would affect weather patterns, sea level rise, create food and water shortages, and affect human security and economic growth.

The world is now clearly in the midst of a climate emergency. The **Mayor's London Environment Strategy (May 2018)** was one of the first plans of any world city to be compatible with the highest ambition of the Paris Agreement. It commits London to being a zero carbon city by 2050. It sets out the actions the Mayor will take, within his powers, to get there as soon as possible.

Our research shows that to up the pace of action, the Mayor will need more powers and funding from national government. That is the only way to tackle this most urgent issue and protect Londoners both now and in the future.

# What is needed by 2050?

To make London a zero carbon city requires action from the Mayor, businesses, communities, boroughs and national government.

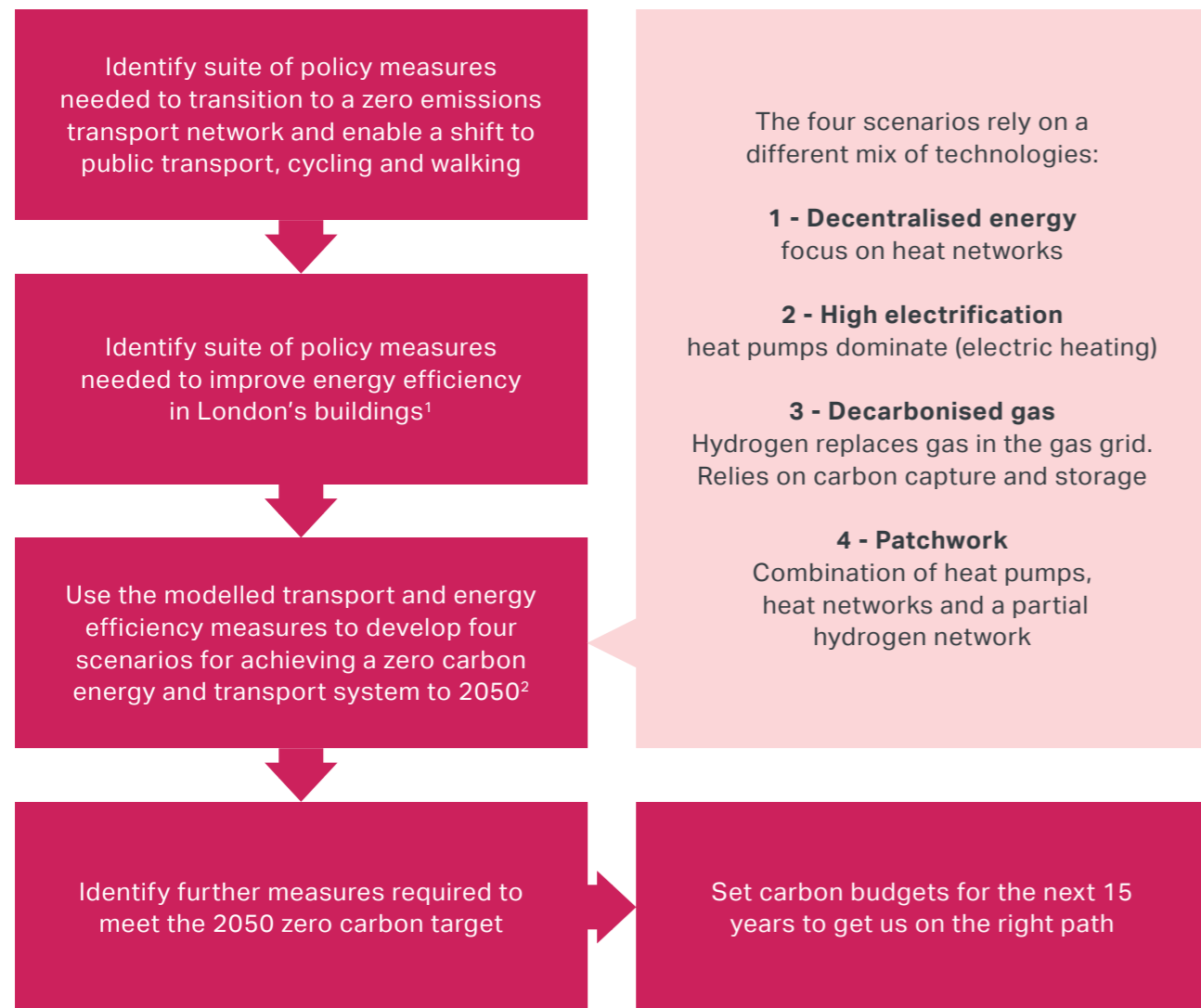


# How will we get there?

To understand how we'll meet our target, we did a detailed 'bottom-up' analysis. We used spatial models of London's buildings and energy systems to assess the impact of specific policies, as well as the cost implications.

We used the following approach:

## Modelling approach



All four scenarios achieve deep decarbonisation but some have higher cumulative emissions and are more risky. For example, the decarbonised gas scenario relies on carbon capture and storage to enable high volumes of hydrogen to be made from natural gas. This has not yet been proven at scale and there are no firm plans to roll this out nationally. In contrast, the Patchwork scenario used in our 1.5C pathway is less risky because it relies on a mix of technologies.

Understanding these different pathways has enabled us to set an ambitious emissions pathway in line with the IPCC recommendations. It will see London reduce its emissions by 60 per cent on 1990 levels by 2030 and by nearly 80 per cent by 2040.

Figure 1: London's projected emissions

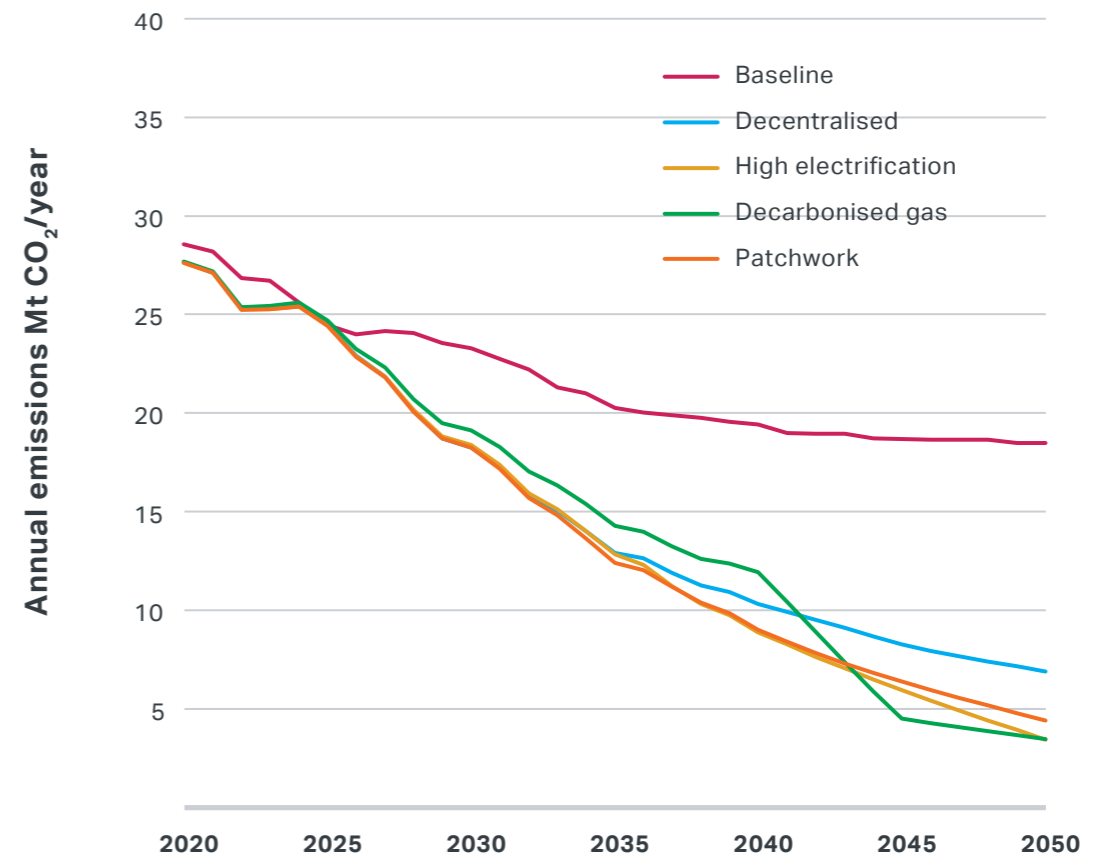


Figure 1: Element report, p9

1 Arup (2018) Zero Carbon Buildings Policies [london.gov.uk/zero-carbon-plan](https://london.gov.uk/zero-carbon-plan)

2 Element Energy (2018) Zero Carbon Energy Systems [london.gov.uk/zero-carbon-plan](https://london.gov.uk/zero-carbon-plan)

**Carbon budgets** place a recommended limit on London's carbon emissions over the next 15 years. London's carbon budgets are more ambitious than the national government's and set us on our way to be a zero carbon city by 2050.

Carbon budgets help London's businesses, communities, boroughs, the Mayor and national government manage the transition to zero carbon, so that we don't leave everything until the last minute, incurring greater cost.

Budgets spread over five year periods also help manage annual changes in energy demand due to factors like the weather. For example, heating emissions may go up in a cold winter.

Meeting the next three budgets will require strong action to improve energy efficiency and greater use of public transport and cycling. This should be followed by a big increase in the electrification of heat and transport.

Figure 2: London's carbon budgets

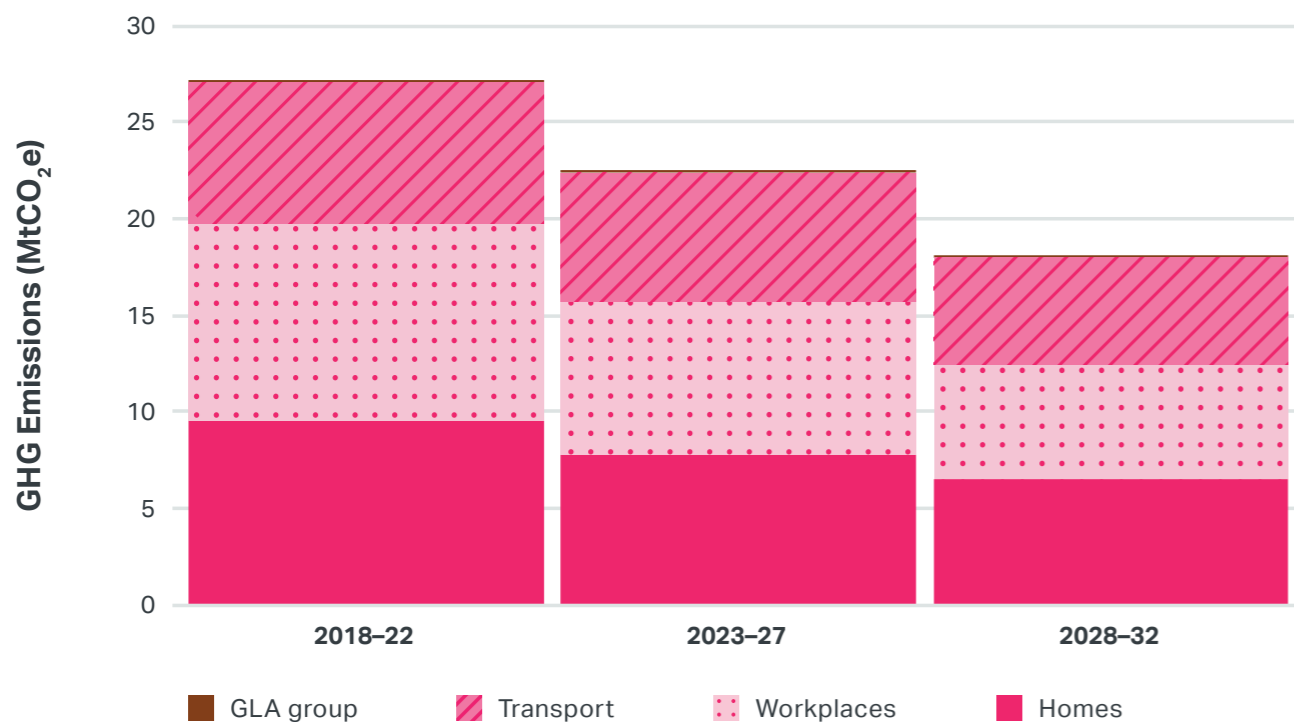


Figure 2: London Environment Strategy, p127

## Key messages



### 1. We urgently need to increase the number of buildings retrofitted with energy efficiency measures.

- All our pathways to zero carbon in 2050 rely on a high level of energy efficiency building retrofits by 2030. Only 35 per cent of homes currently achieve adequate energy efficiency performance (EPC C or above) and many will still be in use by 2050. At least 70 per cent of London's buildings need to reach EPC C by 2030.
- However, national government support for energy efficiency was cut drastically in 2012 and building retrofits have fallen since then. Londoners have also struggled to access the national programmes that do exist.

Figure 3: Level of wall insulation achieved with past programmes compared with level required in London's zero carbon pathway

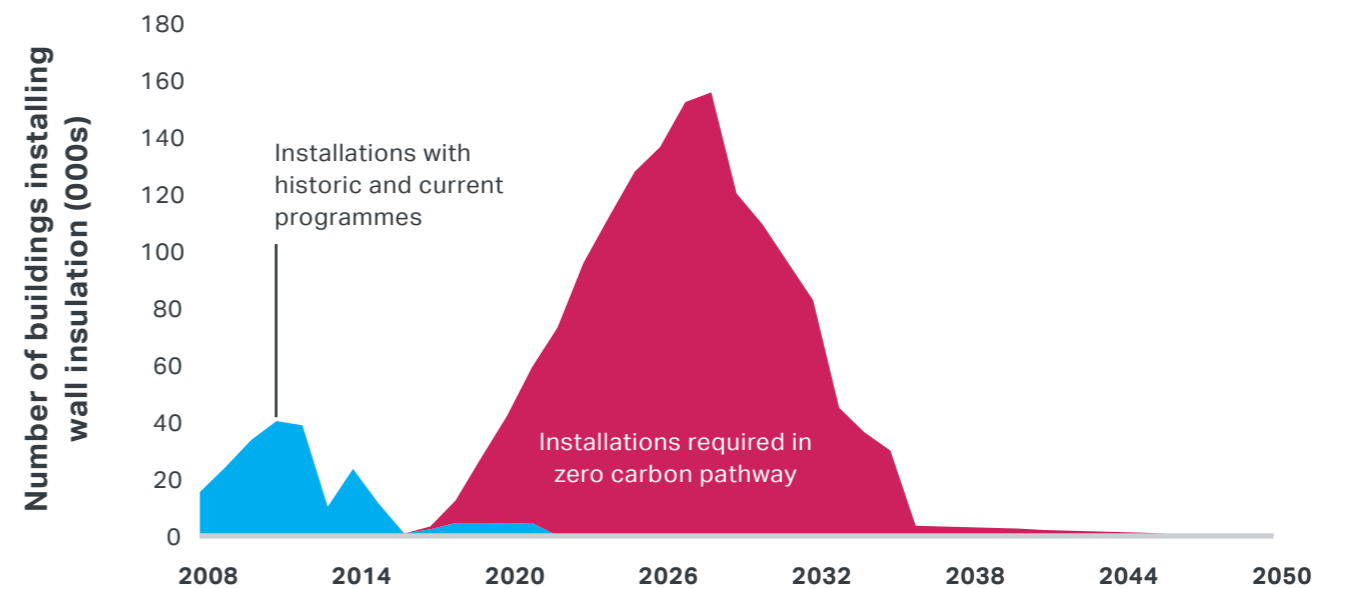


Figure 3: Arup report, p31

- Energy efficiency enables a switch to low carbon heating. Heat pumps and district heat networks are most effective in buildings with reasonable energy efficiency (EPC C or above). This is due to the lower temperature of these systems; they provide heat more slowly so will not warm up a leaky building.

- However, achieving this would require building retrofit rates per year to reach more than four times their historical peak. In 2012, around 40,000 houses in London were reached with energy efficiency programmes. By the mid 2020s we would need to reach nearly 160,000.

- Early action will reduce cumulative carbon emissions; the carbon intensity of the electricity grid is likely to fall further as more renewables power the national grid. That means any cuts in electricity use in buildings for heating and lighting we make now, will save more carbon than reductions in future.

- A five year delay could lead to an additional 33 MtCO<sub>2</sub>e, or a seven per cent increase in total emissions over the modelled period.

- Retrofitting a building now reduces energy bills sooner which is especially important for the fuel poor. The building also starts to save carbon straight away. Waiting longer would mean that more buildings would need to be retrofitted to achieve the same cumulative carbon reduction.

- If we delay these energy efficiency actions until 2022, it will cost around £2.5bn more to achieve the same cumulative carbon reductions.

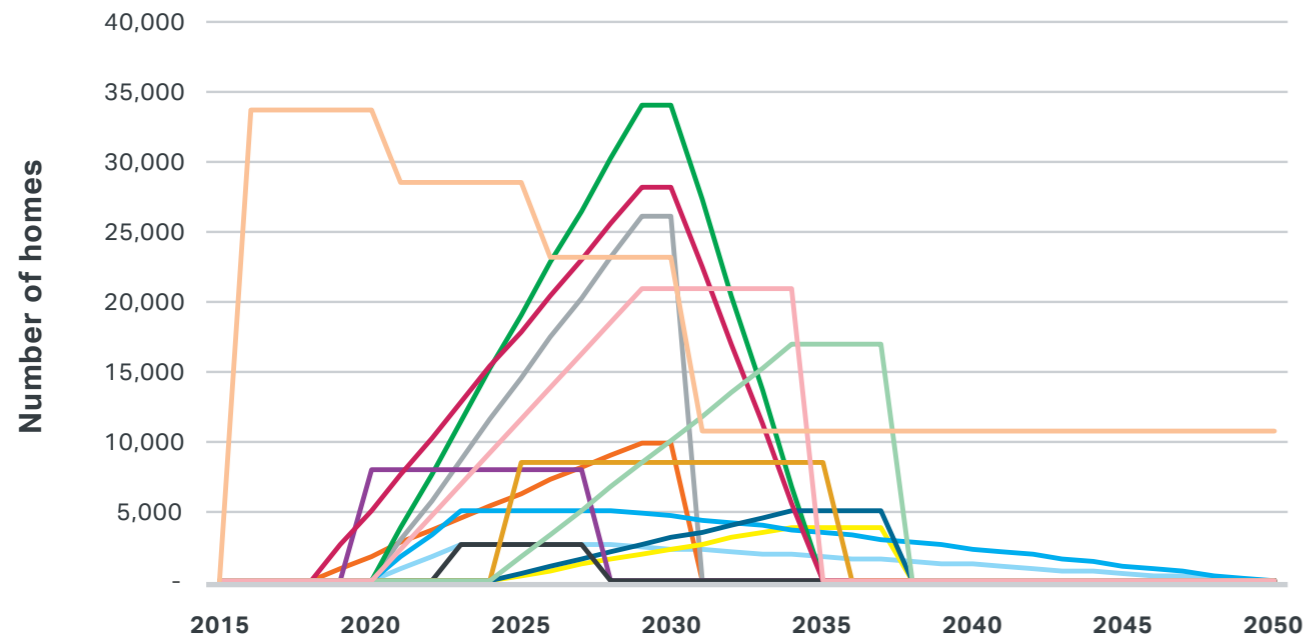




**2. Strong national government policy and programmes are needed to get London's buildings to the required levels of energy efficiency.**

- Regulation with effective enforcement to bring buildings up to an EPC C rating will be the best way to achieve the building energy efficiency levels needed. This includes setting Minimum Energy Efficiency Standards to EPC C across all building types.

**Figure 4: Range of policies modelled to bring London's homes up to required energy efficiency levels**



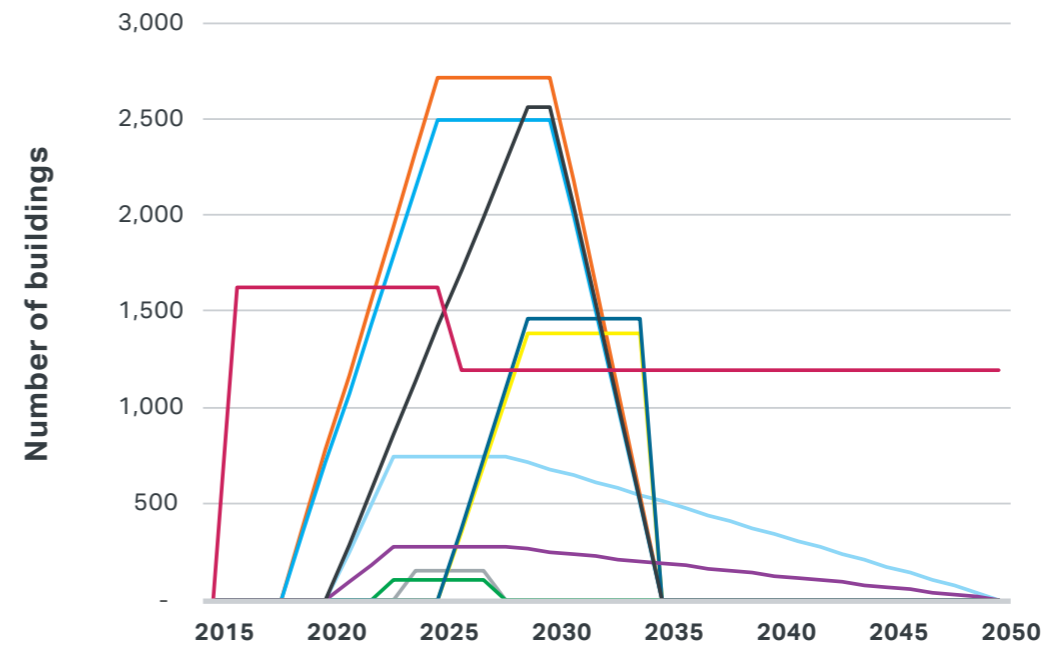
- Fuel Poor - Extended domestic retrofit
- Fuel Poor - Landlord MEES - EPC C
- Fuel Poor - All buildings MEES - EPCC
- Fuel Poor - Extended whole house retrofit
- Social housing - Extended domestic retrofit
- Social housing - All buildings MEES - EPCC
- Social housing - Extended whole house retrofit
- Able to pay - Building Regulations and planning policy
- Able to pay - Council tax variation by EPC
- Able to pay - Landlord MEES - EPCC
- Able to pay - Stamp duty energy efficiency scaling
- Able to pay - Extended whole house retrofit
- Able to pay - All buildings MEES - EPCC
- ALL - Stronger planning requirement for smart controls

Figure 4: Arup report, central scenario, p21-22

- We estimate capital cost of installing the required number of energy efficiency measures to total £10bn by 2050. National government must put in place new policies to start attracting investment into these measures.

- Improving social housing will require much greater investment at a national level. Further work is needed to understand how these measures can be funded at the buildings level.

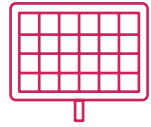
**Figure 5: Range of policies modelled to bring London's non-domestic sector up to required energy efficiency levels**



- SME - Energy efficiency programme
- SME - Landlord MEES - EPC C
- SME - Energy performance tax grading - business rates
- SME - All buildings MEES - EPC C
- Large Enterprise - Landlord MEES - EPC C
- Large Enterprise - Energy performance tax grading - business rates
- Large Enterprise - All buildings MEES - EPC C
- Public - Extended non-domestic retrofit
- Public - All buildings MEES - EPC C
- ALL - Stronger planning requirement for smart controls

Figure 5: Arup report, central scenario, p23-24





**3. London's path towards zero carbon relies on continued grid decarbonisation and more ambitious national government action.**

- Significant carbon reductions have and will be achieved by electricity sector decarbonisation. However, greater action is needed to reach our carbon targets.

- With only the levels of grid electricity decarbonisation committed to in current national government policy, London's emissions will only be 35 per cent lower than 1990 levels by 2050.

- If government further decarbonised energy systems and buildings UK wide, we could reduce carbon by an extra 30 per cent. This is in line with current government policies and proposals to achieve UK carbon budgets.

- The remainder of emissions requires further action. This could either be from national government, or from them devolving powers and resources to the Mayor or boroughs to deliver in London.
- It will be difficult to eliminate some residual emissions from old building stock, aviation and parts of industry. The zero carbon pathway assumes there will be 10 per cent residual emissions. These will need to be offset through negative emissions technologies such as carbon capture and storage or tree planting.
- The only way London can reach zero carbon faster than currently modelled is for the government to increase its action sooner. Alternatively, London needs to be given more funding and powers to enable it to take the action.

**Figure 6: London's GHG emissions trajectory to zero carbon**

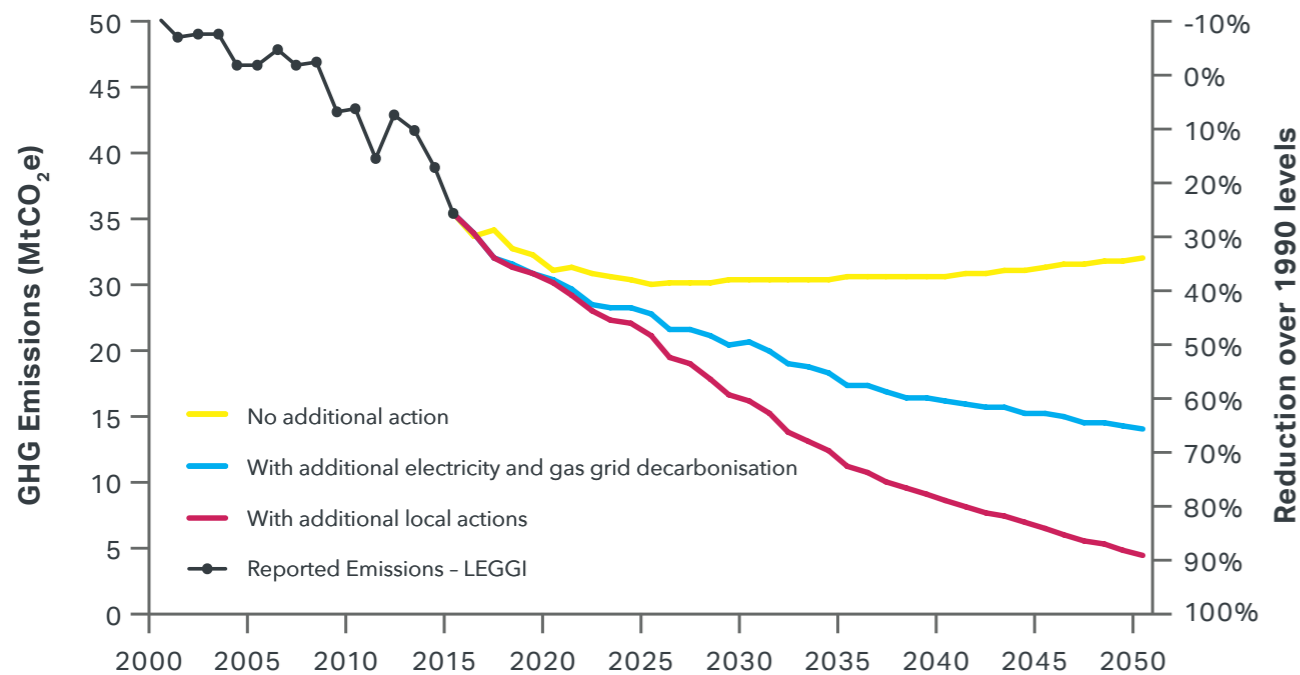


Figure 6: London Environment Strategy, p208

**“I’m doing everything in my power to reduce London’s carbon footprint, and going further and faster than national government to make London a zero-carbon city by 2050.”**

**Sadiq Khan**  
Mayor of London



Image © TfL



**4. Any increases in London's energy demand should be offset by energy efficiency deployment and increasing use of smart technology to smooth peaks in demand.**

scenarios, improvements in energy efficiency and demand side flexibility will be enough to manage the additional peak load.

- We modelled peak electricity demand under each scenario down to substation level to assess the impacts of increasing numbers of heat pumps and electric vehicles.
- Meeting the additional load from heat pumps and electric vehicle charging doesn't have to mean building large scale electricity generation capacity. In most scenarios, improvements in energy efficiency and demand side flexibility will be enough to manage the additional peak load.
- Our modelling showed that strong energy efficiency policy could enable peak electricity demand to decline to 2035.
- Beyond 2035 only the high electrification scenario results in a big increase in London's peak demand.
- Peak demand can also be reduced by demand side response initiatives, such as time of use tariffs.

**Figure 7: Modelled London-wide peak electricity demand**

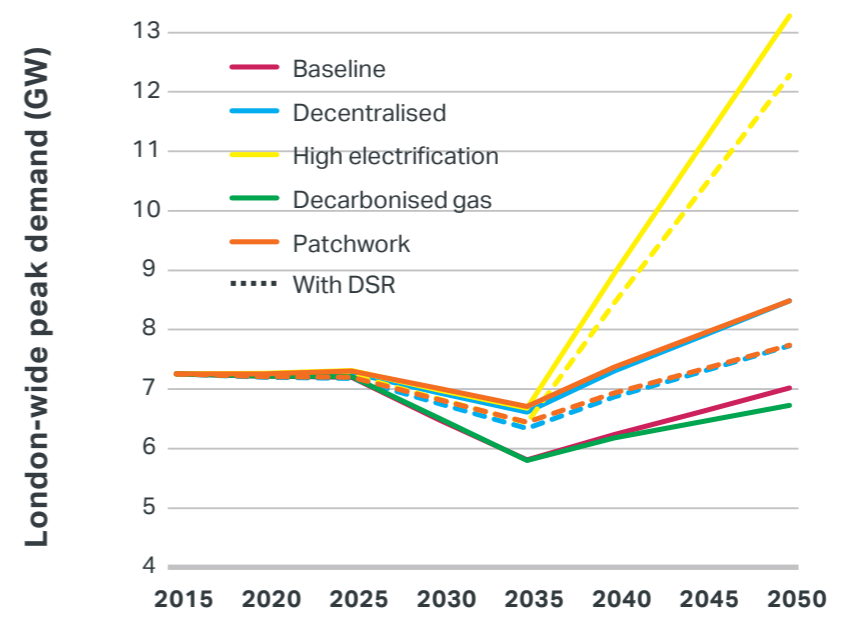


Figure 7: Element report, p55



**5. Costs associated with grid upgrades should be manageable.**

- Cumulative electricity grid upgrade costs in all scenarios are less than £4bn to 2050.
- To put that into perspective, the cumulative cost of London's electricity bills to 2050 will be over £200bn.
- This analysis also does not consider the cost to London if nothing is done to reduce emissions and London has to pay to adapt to climate change impacts. These costs could be many times higher.

**Figure 8: Modelled number of London primary substations requiring reinforcement**

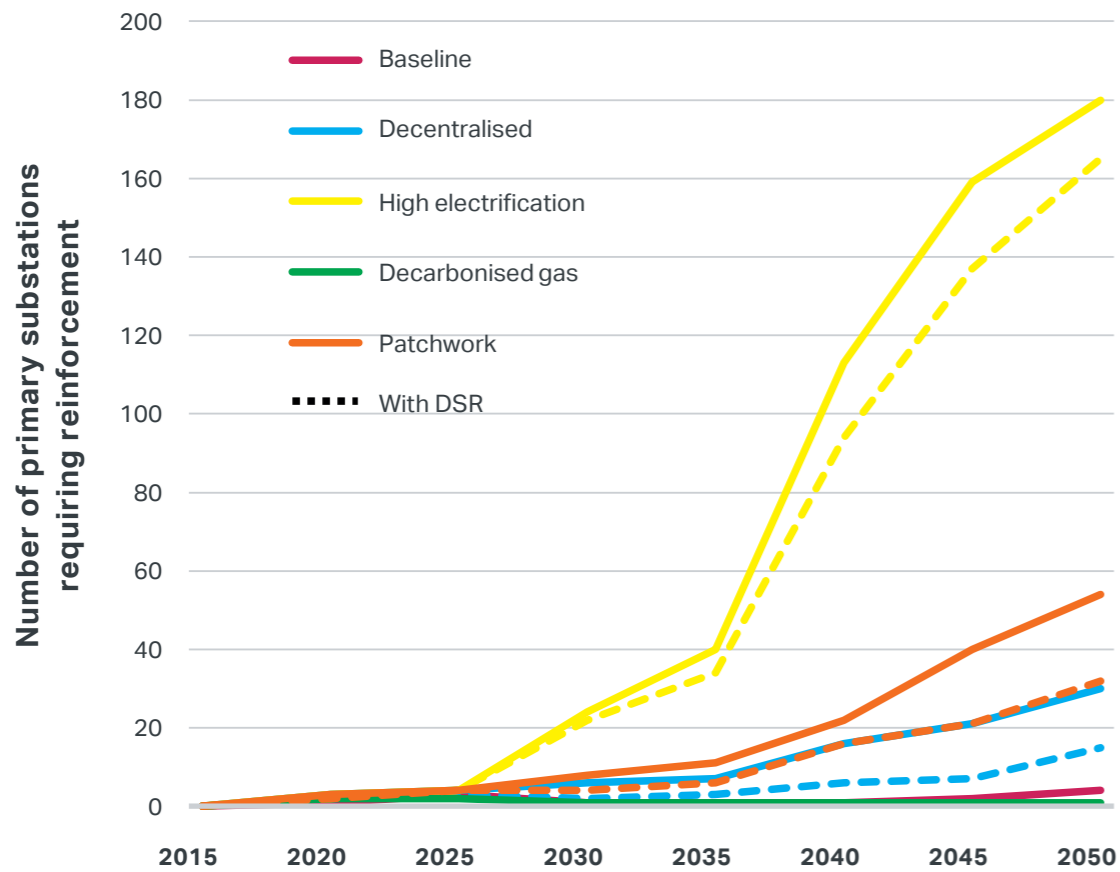


Figure 8: Element report, p55

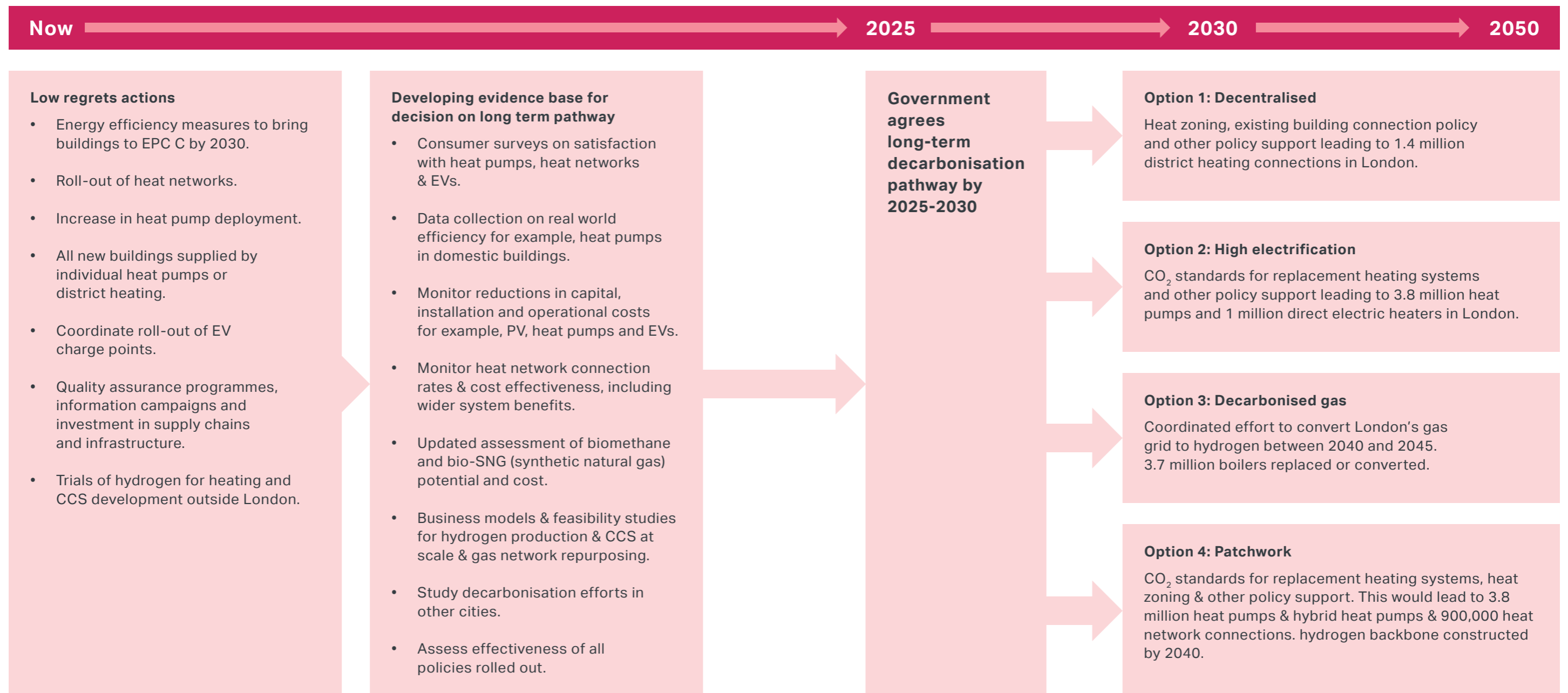




**6. Government must decide which low carbon heat pathway the UK will take by the mid-2020s at the latest.**

In the meantime, there are important short-term actions London and the national government should focus on. These include rapidly scaling up energy

efficiency improvements, rolling out heat networks and heat pumps, and taking a coordinated approach to electric vehicle charging.





**7. Each different energy system pathway has its own pros and cons. However, costs may be similar and business as usual is not the cheapest option.**

Some of the zero carbon pathways have lower fuel and energy bill costs than the business as usual pathway. This offsets the further investment in buildings and low carbon infrastructure needed.

For a summary of cumulative discounted scenario costs to 2050, see Table 1 on page 26.

**Figure 9: Annual total costs to 2050 by scenario**

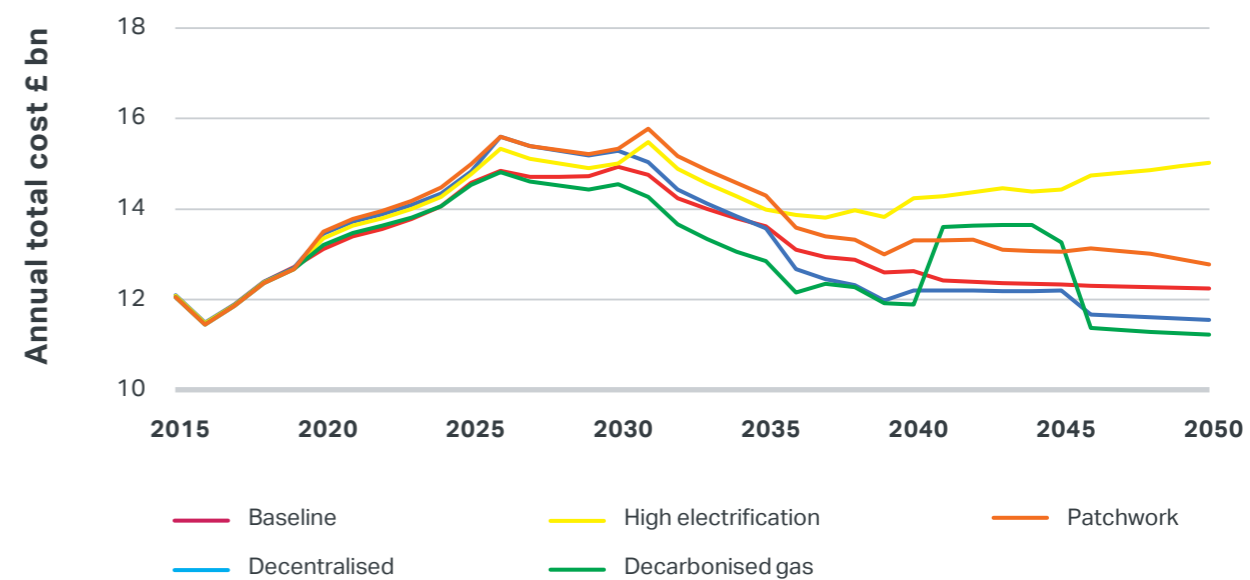


Figure 9: Element report, p63

**Table 1: Summary of cumulative discounted scenario costs, with associated emissions results**

Scenario summary		BASELINE	Decentralised	High electrification	Decarbonised gas	Patchwork
Annual emissions in 2050 MtCO <sub>2</sub>		18.5	6.9	3.4	3.5	4.4
Cumulative emissions to 2050 MtCO <sub>2</sub>		820	626	597	617	600
Total Cost £ bn		£278	£279	£292	£274	£288
Total Cost w/o fuel £ bn		£40	£55	£61	£48	£61
<b>Building level</b>	<b>Total</b>	<b>£39</b>	<b>£49</b>	<b>£57</b>	<b>£42</b>	<b>£56</b>
<b>£ bn</b>	Energy Efficiency	£10	£10	£10	£10	£10
	Heat networks	£1	£5	£1	£3	£3
	Heat Pumps & HHP	£2	£12	£24	£2	£24
	Solar thermal	£1	£1	£1	£1	£1
	Hydrogen Boilers	£0	£0	£0	£5	£0
	Gas Boilers	£23	£18	£16	£19	£16
	Electric heating	£0.8	£0.6	£1.4	£0.7	£0.5
	PV	£0.3	£1.9	£1.9	£0.7	£0.7
	Smart installation	£0.00	£0.02	£0.03	£0.00	£0.03
	Add. thermal storage	£0.0	£0.1	£0.2	£0.0	£0.1
<b>Infrastructure</b>	<b>Total</b>	<b>£1.8</b>	<b>£6.5</b>	<b>£4.4</b>	<b>£5.8</b>	<b>£5.1</b>
<b>£ bn</b>	Elec. grid upgrades	£0.0	£0.0	£0.9	£0.0	£0.1
	Elec. Network storage	£0.0	£0.0	£0.5	£0.0	£0.0
	Heat networks	£0.7	£4.1	£0.7	£2.7	£2.7
	Hydrogen grid	£0.0	£0.0	£0.0	£1.2	£0.1
	EV charging	£1.0	£2.2	£2.2	£1.4	£2.0
	Hydrogen refuelling	£0.1	£0.1	£0.1	£0.4	£0.2
<b>Fuel £ bn</b>		<b>£238</b>	<b>£224</b>	<b>£231</b>	<b>£227</b>	<b>£226</b>





**8. Decarbonising transport and increasing use of active and public transport remains a key objective for London.**

- By 2041, around 80 per cent of all trips in London should be made by sustainable modes of transport including cycling, walking and public transport.
- By 2050, all of London’s motorised road transport will need to be battery electric or fuel cell electric vehicles. The split between electric vehicles (EVs) and fuel cell electric vehicles (FCEVs) run on hydrogen depends on the wider energy scenario. FCEVs will only be an option at scale in the decarbonised gas scenario.

- Coordination at a city level is needed so public charge points are compatible with the widest possible range of vehicles and impacts on the electricity grid can be managed.
- Fully decarbonising aviation is going to be difficult. That means we will need a combination of approaches, such as switching to rail, or relying on negative emissions technologies.

**Figure 10: Energy use in transport in the Patchwork Scenario**

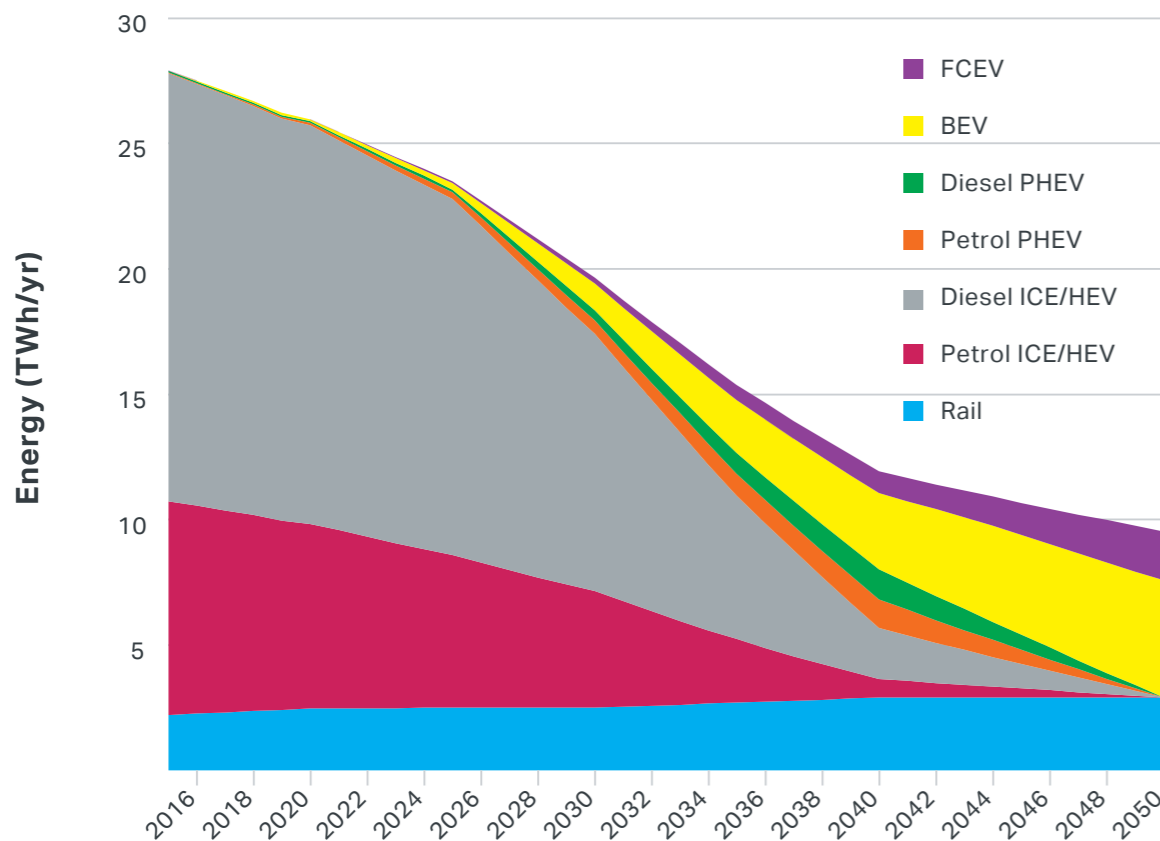


Figure 11: Element report, p49

**Figure 11: Energy use in transport in the decarbonised gas scenario**

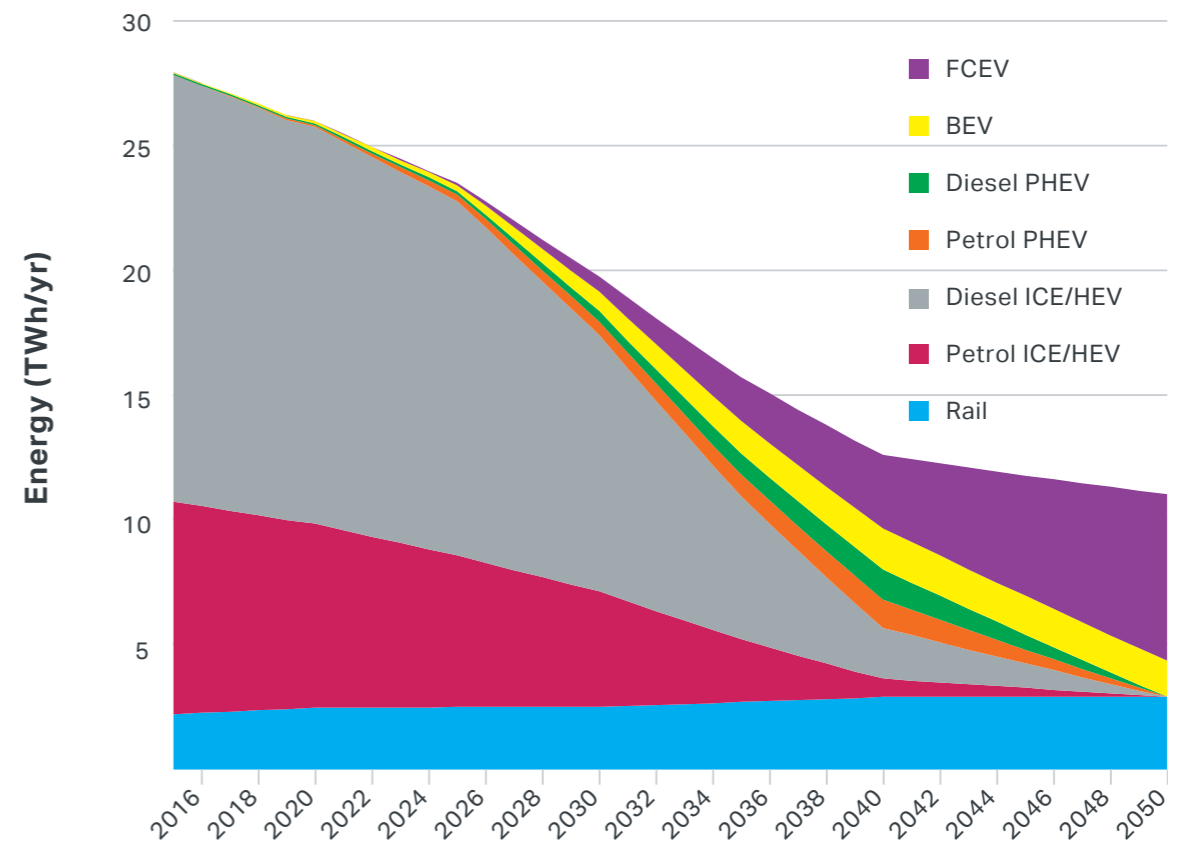


Figure 12: Element report, p48



## What role will the Mayor and others play in realising London's ambition?

The Mayor has already set out his **London Environment Strategy** and put a number of policies and programmes in place to help London become a zero carbon city. Here we outline some of the key actions needed to make this happen.

However, it's not just the Mayor that needs to act. We can all play a part.

### What will the Mayor and the GLA group do?

- Work with boroughs and other stakeholders to deliver a zero carbon transport system by 2050. This includes the new T-Charge and Ultra Low Emission Zone, development of a public network of rapid EV chargers, no longer licensing new diesel taxis and making sure all new taxis are zero emissions capable, and rolling out electric buses.
- Ensure new buildings are zero carbon through setting strong policy through the London Plan.

- Support boroughs, Londoners and businesses to do their part through technical and support frameworks for energy efficiency and heat networks, and grant programmes.
- Lead by example to make all GLA buildings more energy efficient and transition vehicle fleets to zero emissions. We will also increase renewables on our estates, and use collective energy procurement to encourage new renewable projects inside and outside London.

- Work with pension funds and other investors to divest from fossil fuels and boost investment in energy efficiency, low carbon transport and low carbon heat solutions.
- Work with the private sector to drive action, for example, through the EV taskforce and London Business Climate Leaders group.
- Continue to call on national government to introduce policies and incentives to enable a 1.5C compatible pathway.



**What can London boroughs do?**

- Ensure new buildings comply with London Plan zero carbon policies.
- Collect and use carbon offset funds from new developments to drive carbon reductions across the boroughs.
- Work with the Mayor and GLA group on rolling-out a public network of rapid EV chargers and the delivery of zero emission zones.
- Accelerate building stock improvements, including building fabric using support from the Mayor's Energy for Londoners programmes RE:FIT and RE:NEW.
- Roll out solar PV and storage installations on their building stock and land.
- Use heat mapping and energy masterplans to identify heat network opportunities. Use support from the government's Heat Network Delivery Unit and GLA Decentralised Energy Enabling Project to speed up the build out of heat networks.

- Work with pension funds and other investors to divest from fossil fuels and increase investment in energy efficiency, low carbon transport and low carbon heat solutions.
- Use low cost funding available from the Mayor for energy efficiency and renewable projects from the £500m Mayor's Energy Efficiency Fund (MEEF).

**What does the national government need to do?**

- Provide the regulatory framework and financial support for energy efficiency:
  - Allocate funds to tackle harder, more expensive measures, for example, solid wall insulation
  - Bring in Minimum Energy Efficiency standard regulations for all buildings and remove loopholes from existing regulations
  - Provide greater support and incentives for home owners and SMEs to improve their buildings, for example, a successor to the failed Green Deal
  - Ensure London gets its fair share of funding under the Energy Company Obligation (ECO) by reforming the scheme to better target hard to treat homes or setting regional targets.
- Help London generate more clean energy:
  - Provide support for small scale solar
  - Ensure tax regime supports uptake of storage, solar and other renewables
  - Provide direct support for community energy

- Establish a clear and realistic plan for the long-term decarbonisation of heat
- Offer long term support for renewable heat projects and heat networks beyond 2020/21
- Ensure adequate customer protection and quality control for heat networks and heat pump installations
- Support the transition to sustainable transport:
  - Ensure adequate financial support is provided to buyers of electric vehicles to maintain demand for new vehicles so costs continue to fall
  - Provide a targeted scrappage scheme which also assists with wider health, transport and environmental objectives. It should also offer rewards for changing behaviour rather than just focus on payments to help buy a new car
  - Commit funding for charging infrastructure beyond 2020 to both support the private sector in expanding charging infrastructure and increase residential on-street charging

**What role could businesses play?**

There are a number of ways businesses can help make London a zero carbon city by 2050.

Here are some of the most important:

- Measure and report on greenhouse gas emissions and set long term targets.
- Adhere to Minimum Energy Efficiency Standards (MEES) building regulations.
- Ensure new buildings are as energy efficient as possible and include measures to reduce cooling needs.
- Look to connect new buildings to low carbon heat networks to use local sources of waste heat or install heat pumps.
- Replace old boilers with more efficient ones and consider renewable options like heat pumps. Support is available for SMEs through Cleaner Heat Cashback or for all businesses through the Renewable Heat Incentive.
- Optimise fleet movements and switch owned vehicles to electric vehicles.

- Use procurement to encourage decarbonisation, for example, switch to additional green electricity and gas tariffs.
- Work with staff to drive behavioural changes that help reduce business emissions, for example, travel less.

**What can all Londoners do?**

There are many actions that Londoners can take.

Here are some of the most important:

- Get an Energy Performance Certificate (EPC) assessment to see how best to improve your home.
- As landlords you should adhere to Minimum Energy Efficiency Standards, bring poorly performing buildings up to a higher rating and develop a plan to improve all your stock.
- Explore whether your home is suitable for solar and/or electricity storage installations. Look at installing a low carbon heat technology so you can benefit from the Renewable Heat Incentive.
- Only buy energy efficient appliances.
- Walk, cycle or use public transport instead of driving where possible. Use car clubs, ideally those with electric or hybrid vehicles.
- Switch energy supplier to a green tariff for electricity and gas.

**#zerocarbonlondon**